

Executive Office of the President
Floodplain Management Review Committee
730 Jackson Place, N.W.
Washington, D.C. 20503

Memorandum for: Recipients of the Working Draft

From: BG G. E. Galloway 
Executive Director

Subject: Concurrent Review of the Working Draft
Report of the Floodplain Management Review Committee

Date: 2 May 1994

1. Attached for your review is a copy of the working draft of the Report of the Floodplain Management Review Committee. The purpose of providing you this working draft prior to its detailed editing and proofing, is to offer you the opportunity to identify for the committee elements of the report that may be factually incorrect or that may not properly represent your agency's views. It will also provide you a chance to suggest to the committee sections of the report in need of clarification or expansion, or subjects not covered by the report that you believe should be. We recognize the gaps and shortfalls in the draft. We are awaiting final information from the SAST on several subjects. Many changes will be made in the report prior to its release on 11 May for general comment. The committee's tight time schedule does not permit sequential editing, preliminary review and final review. The first two must be accomplished concurrently.

2. Because of the extreme sensitivity of some of the proposed actions, it is imperative that they not be made public until the report can be made available to selected members of Congress and the Administration. Therefore, I would ask that you treat this draft as a 'Close Hold' document and limit its distribution within your agency. I would appreciate it if you not reproduce it.

3. Part VI, Cost Information will be provided late in the week.

4. I would appreciate receiving your comments by noon on Friday 6 May. If members of your staff would like to discuss the draft with the committee, they should contact either me, Shannon Cuniff, Harry Shoudy, Mike Robinson or Tom Wehri at 408-5295.

Incl: Issues Not Covered in the Report

ISSUES NOT COVERED IN THE REPORT

Over the past six months the Committee has been engaged in an effort to obtain and analyze data regarding management of the Mississippi River Basin and the Great Flood of 1993.

Because of the time constraint, some of the issues raised by floodplain managers and government officials have not received the level of attention they merited. The final report will touch on these issues and make recommendations for follow-on reviews. These issues include:

Flood proofing

Flood warning

Gaging --a measurement issue--

Weather\ flood forecasting

Impacts of existing (pre NFIP & EO 11988) floodway encroachments

Mapping of residual risk below dams

Stormwater management activities

Details of Revenue Sharing Act (FWS) (FS)

Basement flooding\groundwater issues

Ensuring that insured are financially better off than those who get Disaster Assistance

WORKING DRAFT
NOT FOR RELEASE OR ATTRIBUTION

FINDING THE PATH TO THE FUTURE

A VISION
FOR
FLOODPLAIN MANAGEMENT
IN THE 21ST CENTURY

Report of
the Interagency
Floodplain Management Review Committee

WORKING DRAFT
NOT FOR RELEASE OR ATTRIBUTION

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INTRODUCTION

The time has come to face the fact that this Nation can no longer afford the high costs of natural disasters. We can no longer afford the economic costs to the American taxpayer, nor can we afford the social costs to our communities and individuals.

James L. Witt

Director, Federal Emergency Management Agency
Testimony before Congress, October 27, 1994

Throughout the Spring, Summer and Fall of 1993, the people of the United States were faced each night with pictures of the devastation wrought on the Midwest by what became "The Great Flood of 1993." For nearly six decades, the Nation had labored to reduce the impacts of floods, yet 55,000 homes had been damaged, and the lives of hundreds of thousands of Americans had been disrupted. Acre after acre of some of the richest land lay fallow. Why did this happen? What caused the flood? Had human intervention over the years exacerbated the situation? What should we be doing as a nation to prevent a repetition of the 1993 event? The Administration Task Force on Floodplain Management, part of the Administration's Flood Recovery Task Force, headed by Secretary of Agriculture Mike Espy, established the Floodplain Management Review Committee to seek out answers to these questions and to recommend a path to the future.

As spelled out in its charter (Appendix A), the committee's mission is to: (a) delineate the major causes and consequences of the 1993 flooding, (b) evaluate the performance of existing floodplain management and related watershed management programs, and (c) make recommendations to the Task Force about what changes in current policies, programs, and activities of the federal government would most effectively achieve risk reduction, economic

efficiency, and environmental enhancement in the floodplain and related watersheds.

The review Committee consisted of a group of experienced federal engineers and physical and social scientists who brought to the review both technical and institutional knowledge in the fields of flood control and river basin ecosystem management. Federal agencies represented on the Committee included:

- Department of Agriculture
- Army Corps of Engineers
- Department of the Interior
- Environmental Protection Agency
- Federal Emergency Management Agency
- Department of Commerce
- Tennessee Valley Authority
- Department of Justice

Departments and agencies not represented on the Committee provided assistance when requested. The Council on Environmental Quality provided guidance at key milestones, as well as an "on-call" team member, and the Council of Economic Advisors organized an economic analysis review team to assist the Committee.

Fifteen members of the Committee were located in Washington, D.C. The remaining 16 were formed as the Scientific Assessment and Strategy Team (SAST), which operated from the Earth Resources Observation System (EROS) center at Sioux Falls, South Dakota. The SAST was first chartered by the White House in November 1993 "provide scientific advice and assistance to officials responsible for making decisions with respect to flood recovery in the upper Mississippi River Basin," but was incorporated into the Review Committee in January to serve as its research arm for scientific analysis. A full listing of Committee members and their parent agency is given in Appendix B.

Upon commencing work in January, the Committee focused its attention on federal agency briefings and consultation with other levels of government to gain a better understanding of the complex intergovernmental system of floodplain management responsibilities and decision making. This initial focus was followed by discussion in the nine Midwest states with the governors and their representatives, state flood recovery and mitigation task forces, staffs of the relevant congressional committee members from the flood states, and interest groups at the national, regional and local level. In March, the Committee focus shifted to outreach visits to the Midwest communities and environs affected by the flood. During this phase of review the Committee visited over 60 communities, where city, county and local drainage district officials assembled to share information and insights. All of those contacted were asked to share with the Committee their candid opinion about the best use of flood hazard areas, their visions of the future, and how that vision was changed by the 1993 flood. They were asked about hazard mitigation, floodplain management and emergency response plans of the flood affected communities, with particular regard to whether such plans were useful during or after the flood. All were asked to give their opinion as to the strengths and weaknesses of federal programs and policies as presently structured, and what federal and state roles should be in long-term management of floodplains.

Throughout the review process, the Committee received a steady stream of letters from organizations, special interest groups, state and local officials, and from individuals offering information, insights and advice, all of which was greatly appreciated by the Committee.

Following visits with agencies, interest groups, state and local officials, and the public, the Committee formulated an array of floodplain management options. These were then displayed for comment to the Administration Task Force on Floodplain Management, Congressional interests, federal agencies, and state officials and interest groups. Meetings to review the options were held in Washington, D.C.; Kansas City Missouri; Springfield,

Illinois; and Minneapolis, Minnesota. The Committee then developed its recommendations.

A MESSEGE FROM ELIZABETH

Dear General Galloway:

My name is Elizabeth Darabcsek. I am eleven years old and in the 5th grade at Christ Prince of Peace School.

I read your article in the news paper and was interested. I thought I could help.

I did a science fair project on floods. I tested levees, back to nature and something I made up, it was a small levee by the river and a larger one a little farther back. The little one held most of the water but not all. The water that was not held back from the small levee would then stay in the space between the big and little levee. The land between the two levees could be used as farm land or other things that could not be badly damaged by a big flood. The damaged levee could be used as the levee in the front (the smaller levee). Therefore, we would only have to build one new levee. This information may not help you, but I wanted you to know that I am trying to help protect our cities too.

Sincerely,
Elizabeth Darabcsek

P.S. Just to tell you, I won first place for my project out of the whole 5th grade.

GOOD NEWS

While the flood of 1993 did cause major damages throughout the basin, many elements of structural and nonstructural flood damage reduction systems put in place by federal, state and local governments did work and prevented billions in damages.

During the floods, the nation was visibly impressed with the outreach from all over the country to those who were suffering. Thousands filled and stacked sandbags, to hold weakening levees; others worked day after day to help clean the homes and businesses of people they had never met. Dry communities adopted those in need. Contributions to assist flood victims poured in from around the world. Federal, state and local disaster teams worked around the clock month after month to mitigate damages and suffering. Those who were recipients of this assistance will never forget this demonstration of true "caring." While this report will not address these successes, they should not be forgotten.

A lot of great things have been done that prevented damages and mitigated the damages that did occur... we can't lose sight of this

Terry Brandstad
Governor of Iowa

THE REPORT

This report provides the Committee's findings and recommendations for action. Part I provides a road map to the future -- a consensus view of floodplain management for the 21st century. Part II (Chapters 1-3) discusses the flood event and its impacts as well as the effects of human intervention, over time, on the nature of this flood. It also provides insights into the potential for recurrence of the event. Part III addresses problems that must

be overcome to reach the vision and proposes actions to achieve the desired end state. Part IV provides brief conclusions and discusses the economic impacts of the report. Part V of the report converts the general actions proposed in Chapters 4 to 10 into specific tasks for the executive branch of the federal government. Every proposed action is assigned a sponsor. Part VI provides details on the costs associated with the proposed actions.

A VISION FOR THE FLOODPLAIN

The Congress... declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

Section 101, National Environmental Policy Act of 1969

... it is the sense of Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with the States, their political subdivisions, and localities thereof; that investigations and improvements of rivers and other waterways, including watersheds thereof, 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.

Section 1, Flood Control Act of June 22, 1936

WHERE WE ARE

As it moves into the 21st Century, the nation is at a crossroads in its use of the floodplains. It may continue to aggressively develop them or it may seek to arrive at balance between development of the potential and safeguarding of the natural components of the floodplain. Floodplains are meant to be shared. There is room for human occupancy and for natural systems; however, over the last century in the Mississippi and Missouri Basins we have stretched this sharing to its limits and we have put both humans and nature at risk.

Some development made and still makes good sense but other activity did not and does not today. Many great cities and communities border our rivers and thousands of acres of rich alluvial soils produce valuable food and fibre to feed and clothe our nation and the world. In the process of development we also have taken low lying lands from nature and seen them become saturated ill-used bottoms. Unknowingly perhaps, we built homes in areas subject to frequent inundation and with little hope of protection. We have destroyed habitat for terrestrial and aquatic ecosystems. We have crowded levees against the banks of these rivers without understanding the full impacts, up and downstream, of these actions. For some period, upland of the floodplains, we did little to control the clearing of lands and the subsequent increases in runoff thus generating the need for flood control. Now, with watershed focused programs, we have begun to move in the other direction.

In the Beginning

From the arrival of the first explorers until late in this century, the immigrant population of America saw our rivers and floodplains as challenges to be tamed. Rivers were, and still are unruly, running dry in some years and spilling over their banks in others. The depth of rivers needed to be controlled to provide draft for vessels. The floodplains created by these rivers, for the most part were seen as swamps and that could be put to a 'beneficial' use if only the swamps could be drained and then protected from river overflow. Federal programs were established to carry out these objectives and were, for the most part, successful in meeting their original goals. Recognition, in the early sixties, that there were many natural uses for the floodplain - habitat, scenic beauty, water filter, storm buffer, ground water recharge and floodwater storage - caused the nation to reconsider its policy of supporting wholesale conversion of natural areas to other uses. The failure of flood losses to dramatically decline in the face of an over half century flood control program culminating in the disastrous midwest flood of 1993, raised questions concerning the long term efficiency of such programs. Since the mid-fifties, a movement to reduce flood damages through non-

structural means, limiting unwise development of the floodplain and evacuation of those at most risk, gradually began to be seen as at least a partner with the construction of dams, levees and floodwalls.

Many see that Federal actions to have permitted the nation to develop. Navigation work provided and continue to offer highways of commerce. Cities like St. Louis, Kansas City, Rock Island and Hannibal were able to grow and prosper because of the flood control works. Levees, built by both the Federal government and local landowners, have helped agriculture to flourish in the fertile bottomland environment, but, when overtopped have created major economic losses. Reservoirs have reduced the threat to many downstream communities; however, the reduction in flood flows also created incentives for many to crowd the riverbanks and be subject to the impacts of the next major flood. Others, heartened by the strength of post-flood support from the government and private agencies, continued to occupy land at frequent risk to flooding. Concern for the environment and sustainable development, and appropriate allocation of government resources and opportunities lost to these expenditures, speaks to the need to examine the nation's direction.

DEFINING THE VISION

The National Commission on the Environment proposes the concept of sustainable development through which broad based economic progress is accomplished in a manner that protects and restores the quality of the natural environment, improves the quality of life for individuals, and broadens the prospects for future generations (NCE, 1962). Effective floodplain management embodies these very concepts.

What then should be the national vision for use of the floodplain? To assist in the development of the vision, the Committee reviewed literature that has spelled out some of the early and more recent goals of the nation's floodplain activity. It also consulted with interest groups at the national and regional and local level and discussed possible goals with

citizens who had been affected by the flood of '93. The Governors of the nine midwest flood affected states were asked to provide their vision of future floodplain activity. The Committee looked to the National Assessment and its accompanying Action Agenda for definition. Based on this review, the Committee proposes the following as goals for the nations future use of its floodplains and the management of that use.

A VISION FOR THE FLOODPLAIN

Reduce the vulnerability of the nation to the dangers and damages that result from floods.

Appropriately protect urban areas, industry and agriculture, when such protection is justified and reasonable; move people out of the floodplain when protection is not appropriate. Strive to eliminate threats to life and property, to the mental health and well being of floodplain occupants. Ensure the viability of critical infrastructure and the regional economy.

Preserve and enhance the natural values of the floodplain.

Treat the floodplain as part of a unified system that includes the floodplain within the larger context of a watershed. Seek to identify and enhance the cultural, historic and aesthetic values of floodplains. Restore and enhance bottomland and related upland habitat and flood storage. Using programs already authorized, over time acquire environmental interest in these lands. Ensure the consideration of social and environmental factors in all actions relating to the floodplain.

Streamline the floodplain management process.

Through improvements in the National Flood Insurance Program, Federal-State-Tribal relationships in floodplain management, and in the conduct of mitigation and disaster planning and execution. Ensure the collaboration of Federal and State and Tribal activities in a shared planning and decision making process. Implement consistent, equitable, flexible, cost-shared and efficient programs. Reduce the cost to the nation of flood damages.

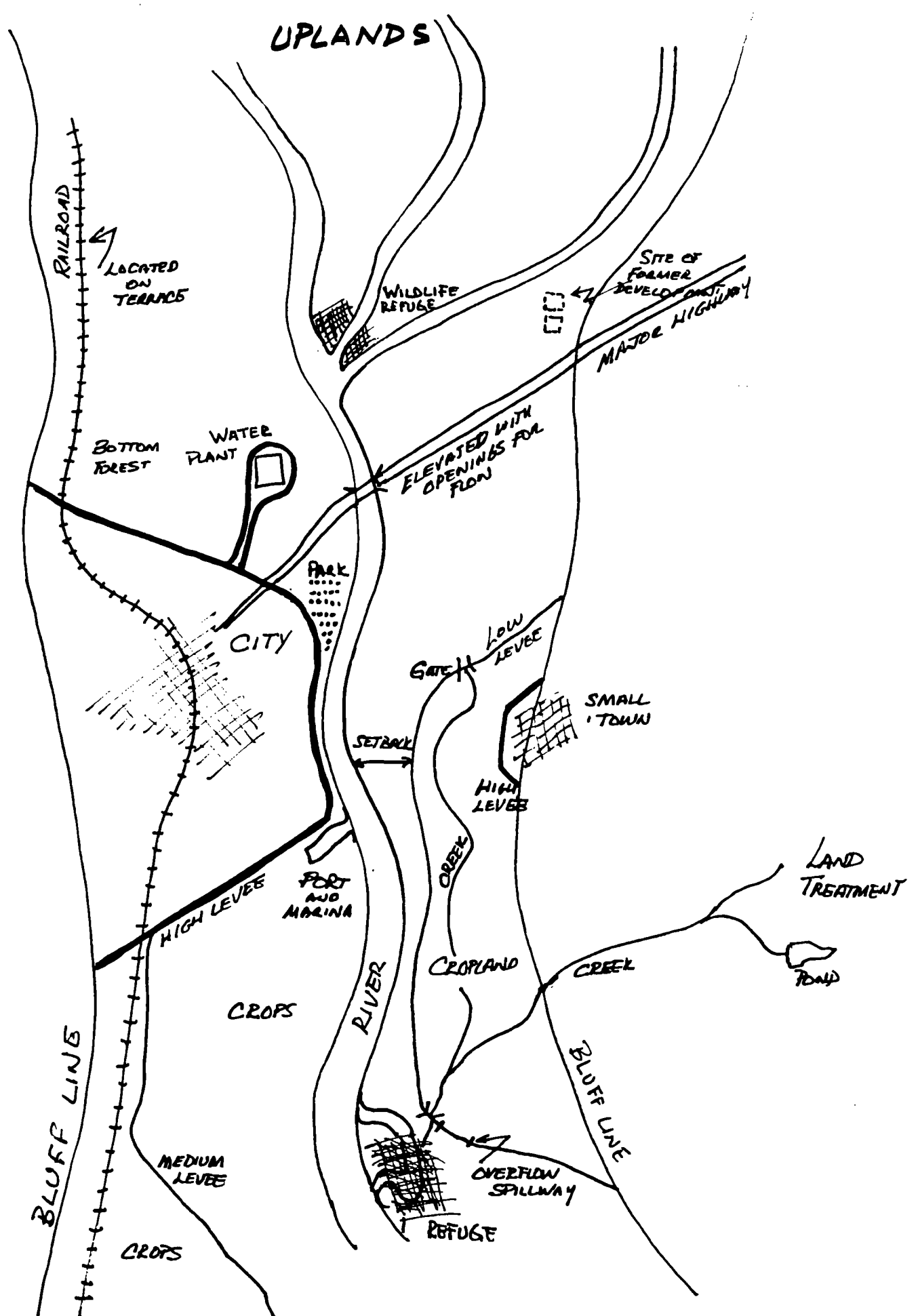
Capitalize on technology to provide information required to manage the floodplain

Provide timely and accurate information to assist in identification of hazards, determination of impacts of proposed actions and development of a temporal and spatial basis for determining long term action strategies. Leverage the strength of geographic information systems.

IMPLEMENTING THE VISION

Were this vision to be implemented, how would the floodplain of the future appear and how would it be managed? Clearly human activity in the floodplain would continue to exist (Figure 1-1) but would be carried out in clear recognition that any such activity is subject to the residual risk of flooding. Determination as to what activity would prosper would be dependent on historical settlement, and a balancing of the economic, social and environmental impacts of its continuation together with a recognition of its place in the hydraulic regime of the basin - what physical impacts its existence has on other segments of the basin.

Urban centers whose existence depended on the river for commerce or whose locational advantage was tied historically to the floodplain would be protected from the



ravages of devastating floods by levees, floodwalls or upstream reservoirs or flood water storage in carefully managed upland and floodplain natural areas. Sections of these communities, formerly the site of frequently flooded business or homes, have become parks and recreation areas as the former occupants were relocated to safer areas on higher ground

In areas outside these highly protected communities, depending on the land elevations, development has taken place either in unprotected areas or behind lower structures that provide protection against only the more frequent floods. Responsible state and local officials have controlled this new construction by requiring it to be at elevations well out of harms way. Those who were at risk in lower lying areas were relocated, over many years, to other areas. Higher land in these alluvial areas continue to produce their rich harvest of food and fibre. Industry, not located in urban areas, on its own has protected its facilities against major floods.

Critical infrastructure, such as water and power plants, major highways and bridges has either been elevated to be out of the flood's reach or protected against its ravages. This infrastructure as well as the isolated homes, businesses and agricultural activities located behind the lower levees are insured against the flooding that will someday occur through full participation in commercial or federally supported insurance programs.

At the upstream end of many of these levees, federally built water control structures, permit river waters to keep sloughs wet throughout the year and during selected periods for some fields to be covered with water for waterfowl and hunting. All of these levees have been modified to provide for controlled overtopping in the event of major high waters, eliminating the catastrophic failures that occurred in the past.

Many areas, previously protected by levees have become wildlife refuges or natural habitat areas, under federal or state easements but still under the control of their long time owners. Decisions to convert these areas were made by the owners based on their own as well as government analysis that either the land was too wet for farming or that its location made levee protection impossible to maintain.

Upland of the floodplain, federal state and tribal programs to improve the treatment of

lands, control new runoff and to restore wetlands, have reduced substantially the flows in these rivers for the frequent floods and have taken the peaks off some of the larger events.

Both commercial and recreational vessels continue to ply the river's waters, operating in a navigation system that provides strong support to the enhancement of the riverine ecosystems through water level adjustments and controlled activities. Modifications in river control structures long ago began to provide for increased habitat.

Activity in the floodplain has been guided by broad-based plans of state, tribal and federal governments working together as partners in a streamlined floodplain management effort. Operation of the waterway and the levee systems with their attendant environmental components has been focused in a single agency working in active collaboration with other interested agencies. Levees along the main stem rivers and the principal tributaries are maintained on a cost-shared basis by the federal- state governments and local levee boards. Decisions concerning activities in a and near the water are vetted in basin -wide computer models indicating the effects of one action on other regions of the basin. Forecasts of river conditions reflect the availability of basin-wide data and rapid processing of this data. Use of high technology remote sensing platforms and data-filled geographic information system provide highly accurate information on which to base key decisions for planning or in time of crisis.

Chapter 1

THE FLOOD OF 1993

Floods are a function of many factors: 1) the location and quantity of rainfall and snowbelt; 2) characteristics of the regions topography; 3) land cover conditions; and 4) capacity of the floodplain to convey or store water. The flood of 1993 was no different.

THE BASIN

Topography: The Upper Mississippi/Missouri River basin is physiographically, ecologically and climatologically diverse. Physiographically it ranges from the high rugged mountains of the Rocky Mountains, to the deeply dissected uplands of the Ozark Plateau and Wisconsin's "driftless area", to the broad plains of the Red River Valley and the central lowlands. Climatologically it ranges from the harsh, semi-arid basins and plains of eastern Colorado and Wyoming to the humid-temperate margins of the Great Lakes. Geographic analysis shows that this region can be divided into as many as 70 terrain units, each defined by unique combination of physical, geologic, soils, ecological, climate and land use characteristics. Each of these terrain units is subject to different combination and intensities of hydrologic and geomorphic processes. Individual areas respond differently to extreme storm events or specific soil conservation and land treatments.

Setting

The Mississippi River rises at the outlet of Lake Itasca in the lake and forest country

of north-central Minnesota and empties into the Gulf of Mexico in the marshy delta just below Head-of-Passes, Louisiana. Over its journey of 2,320 miles the Mississippi River falls 1,463 feet and drains 1,245,000 square miles (sq. mi.), or 41 % of the land area of the forty-eight contiguous United States. That portion of the Mississippi River's drainage lying above its confluence with the Ohio River is referred to as the *upper Mississippi River basin* and is the focus area of this report for it is in this basin where the deluge of rain and consequent record flooding occurred in the mid-west during the spring, summer and fall of 1993.

SIDEBAR:

Upper, Lower, Middle?

Lending some confusion to naming parts of the Mississippi River and its drainage basin is the fact that the basin, which also include the tributaries basins is generally divided into two parts -- the upper and the lower, while the river is divided into three reaches -- the upper, middle and lower. Division between the *upper basin* and *lower basin* is at Cairo (above Ohio R. mouth). For the river itself, the reach upstream from St. Louis is called the *upper Mississippi R.* ("upper Miss."), the reach between St. Louis and Cairo is the *middle Mississippi R.* ("middle Miss."), and the reach downstream from Cairo is called the *lower Mississippi R.* ("lower Miss.").

Draining all or parts of thirteen states, the upper Mississippi River basin is approximately 714,000 sq. mi. in area. It comprises 57 percent of the total basin and 23 percent of the area in the contiguous U.S. From its source at Lake Itasca, Minnesota, to its confluence with the Ohio River at Cairo, Illinois, the Mississippi River courses a distance of 1,366 miles. Its principal tributary is the Missouri River, which drains 529,300 sq. mi. above its mouth at St Louis, Missouri, including 9,700 sq. mi. in Canada. Other major tributaries include the Minnesota, Wisconsin, Iowa, Des Moines, and Illinois Rivers, all of which drain watersheds greater than 10,000 sq. mi. in area.

FIGURE 1 BASIN MAP

The Missouri River drains all or parts of ten states and is the major contributor of water and sediment in the upper Mississippi River basin. Hydrologically, the basin is divided into upper and lower portions with demarcation between the two at Sioux City, Iowa. The upper and lower basins contain 314,600 sq. mi. and 214,700 sq. mi., respectively. Runoff from the upper basin is controlled in great measure by regulation of the six large dam and reservoir projects on the main stem Missouri River operated by the U.S. Army Corps of Engineers (USACE). The drainage area (279,400 sq. mi.) above Gavins Point Dam, the downstream-most of the six dams, encompasses about 90 percent of the upper basin and over 50 percent of the total basin area. The amount of water that runs off the upper basin annually averages ____million acre-feet

History Of Development

The Upper Mississippi River Valley was first settled by European immigrants in 1673, and experienced rapid population growth through the 18th and 19th centuries. By 1824 early steamboat travel created a demand for navigation improvements. Urban and rural populations continued to grow, creating an increased demand for forest lumber resources and agricultural products. Most early urban settlements were located on or near rivers to be close to water supplies and transportation arteries. By the late 1800's many wetlands were cleared for agriculture and the higher floodplain areas were cropped. Some areas were protected with agricultural levees.¹ Early development of the basin was closely tied to the river system, therefore many navigation and local flood control efforts were installed without federal assistance. By 1870, the basin's fisheries resources were declining as a result of a wide range of environmental perturbations (i.e. sedimentation, pollution, water level fluctuations)² During the 1930 - 1950 time frame, extensive modification continued on the main rivers, while upland areas continued to be drained for agricultural purposes. Major

urban areas such as St. Louis, Kansas City, and Minneapolis/St. Paul developed as business and industry centers.

SIDEBAR: VOLUMES OF WATER

When quantifying large volumes of water, a measuring unit as small as a gallon results in numbers in the billions or trillions and makes perception difficult. Water engineers and scientists have adopted a larger unit and, therefore, employ smaller, somewhat more readily envisioned numbers. That unit is the *acre-foot* and represents the volume of water standing one foot deep over an area of one acre. Thus the mean annual volume of water that runs off the upper Missouri R. basin can be expressed as 25,000,000 acre-feet rather than 8,145,720,000,000 gallons.

Antecedent conditions

The conditions that gave rise to the flood of 1993 include, in addition to the record rainfalls, the wet soil conditions began to occur in the central Great Plains beginning in the summer of 1992 and increased dramatically with increasing precipitation and cooling air temperatures by late 1992. July, September and especially November 1992 were much wetter than normal over the upper Mississippi River basin; during winter, precipitation was near normal. By late March, extremely moist conditions covered much of the region as a result of the wet fall and spring snowbelt runoff. ⁴ Iowa, which is centrally located in the area of heaviest flooding, experienced the second wettest November - April period in 121 years of record. This period was followed by above-normal precipitation over the upper basin during April and May (Figure __). The period April through June was the wettest observed in the upper Mississippi basin in the last 99 years. Consequently, even before the onset of the heavy summer rains, most of the upper basin soils were saturated and many streams and rivers were flowing at well above seasonal normal levels.

SIDEBAR: INGREDIENTS FOR A MAJOR FLOOD.....

These weather facts for Iowa tell why the flood occurred:

Wettest Period -- Precipitation during the period January through September 1993 was the greatest amount, 44.5 inches, in 121 years of record; previous record was 44.2 inches in 1881.

Wettest 12 Months -- Precipitation during the period September 1992 through August 1993 was the greatest amount in history, 54 inches; previous record was 49 inches in 1881.

Unusual Persistence of Rainfall -- No previous record of such a sustained period of precipitation.

Highest Soil Moisture -- Soil moisture in August 1993 were the highest in history.

Cloudiest Period -- Cloud cover from November 1992 through August 1993 was the greatest for that time period on record.

Lowest Evaporation -- Evaporation was the lowest in history.

Source: Iowa State Climatologist

Rainfall

During much of the summer of 1993, a persistent atmospheric pattern of excessive rainfall occurred across much of the upper basin. The major river flooding resulted primarily from numerous series of heavy rainfall events from June through late July. The recurrence of heavy rainfall was the direct result of a stable upper-level atmospheric circulation pattern with a deep trough to the west of the upper Mississippi Valley and a strong ridge along the East Coast (Figure). In late July and early August, a change in the upper air circulation pattern brought drier conditions to the Midwest as the trough shifted eastward. Locally heavy thunderstorms generated some additional flooding problems in parts of the soaked upper basin during mid-August; however, these rains were associated with a typical summertime pattern and not a return to the anomalous and persistent June and July atmospheric conditions.

FIGURE 1-2 Monthly Precipitation

FIGURE 1-3 Weather pattern

During the June-August 1993 period, rainfall totals surpassed 12 inches across the eastern Dakotas, southern Minnesota, eastern Nebraska and most of Wisconsin, Kansas, Iowa, Missouri, Illinois and Indiana. Over 24 inches of rain fell on central and northeastern Kansas, northern and central Missouri, most of Iowa, southern Minnesota, and southeastern Nebraska. Up to 38.4 inches fell in east-central Iowa. Generally, precipitation amounts were 200-350 percent of normal from the northern plains southeastward into the central Corn Belt .

Rainfall amounts over the upper basin during the May-August 1993 period are unmatched in the historical records of the central United States. In July, broad areas in the lower Missouri River basin experienced rainfall amounting to four times normal. The series of storms producing these record rainfalls were remarkable not only in their magnitude but also for their broad regional extent: record wetness existed over 26,000 square miles of the upper Mississippi River basin. Seasonal rainfall records were shattered in all nine states impacted by the deluge of 1993. Summer rainfall amounts equalled those computed for storm frequencies as rare as those having 75 year - 300 year recurrence intervals.

River Flow

The deluge in the upper Mississippi and Missouri River basin produced record setting peak flow rates and water levels in many tributaries and the main stem rivers, including a large reach of the upper Mississippi, over the full reach of the middle Mississippi and over much of the length of the lower Missouri river. Flooding began in the more northern portion of the upper Mississippi River basin in June and then moved southward with the shifting of the storm-producing weather pattern and the travel of the flood flows downstream as summer progressed.

Major flooding began after a particularly heavy rainfall period from June 17 - 20 in southwest Minnesota and northwest Iowa. As a result, record flooding occurred on the Minnesota River. The next major pulse of precipitation occurred June 23 - 25. Runoff from

these rains combined with flood flows from the Minnesota River to initiate the first flood crest that moved down the upper Mississippi River.

Following a short, dry period, a prolonged siege of heavy precipitation occurred from June 30 to July 11. This included extreme amounts of rainfall on July 9 in Iowa, which produced record high flooding on the Raccoon and Des Moines rivers. Just as the crests from these two rivers reached Des Moines, a relatively small, convective pocket dumped several inches of rain on the crests rapidly boosting the river levels and flooding the City's water treatment plant. The intense rainfall during this period also led to record flooding on portions of the lower Missouri River and combined with the crest already rolling down the Mississippi to ensure the development of record river stages from the Quad Cities area on the upper Mississippi R. on downstream to Thebes, Il. on the middle Mississippi R.

Another major volume of precipitation occurred July 21 - 25. The heaviest rains were focused farther south than the earlier events, with especially heavy rain falling over eastern Nebraska and Kansas, leading to second major crests on both the Missouri and Mississippi Rivers. Hydrographs of river stages for the Missouri River at Kansas City and the upper Mississippi River at the Quad Cities is shown on Figure _____. The Kansas City graph shows two flood peaks, one caused by the June 30 - July 11 rainfall and the other by those falling from the 21st to the 25th, while the Quad Cities graph shows only the single peak from the earlier period. This comparison clearly demonstrates the generally southern focus of this second event. Both peaks are evident on the hydrograph for the Mississippi R. at St Louis. Figure _____. While flooding from this latter rainfall period did not extend as far upstream on the Mississippi River, new record river levels were observed at many locations downstream and on much of that portion of the Missouri River that flows through Missouri.

FIGURE 1-4 Hydrography for Missouri River at Kansas City

FIGURE 1-5 Hydrography for Mississippi at Quad Cities

FIGURE 6 Hydrography for Middle Miss at St. Louis

FIGURE 7 **Summary of Flood Crest Miss & Mo.**

WHAT WAS THE 1993 EVENT?

The flood of 1993 in the Midwest was a hydrometeorological event without precedent in modern times. In terms of precipitation amounts, record river levels, flood duration, areal extent of flooding, and economic losses, it surpassed all previous floods in the United States. During the period from June through September, record and near record precipitation fell on soil already saturated by previous seasonal rainfall and spring snowbelt, resulting in the flooding along major rivers and their tributaries in the upper Mississippi River basin. River levels exceeded flood stage at approximately 500 National Weather Service (NWS) river forecast points and record flooding occurred at 95 forecast points throughout the flood-affected region.⁵ At 45 U.S. Geological Survey streamflow gaging stations, the peak discharge rate (flowrate) exceeded that of the one-percent annual chance (100-year) flood value.⁶ Not only great in magnitude and areal extent, the 1993 flood was prolonged in time as evidenced by the fact that many locations remained above flood stage for weeks, with some remaining for as long as five straight months.

Because of the extremely wet antecedent soil and river conditions, the flood flows resulting from these storms are more rare than the storms themselves and exceeded the 100 year - 500 year recurrence intervals at many locations.

FIGURE 8. MAP of area showing frequency of event and area impacted

IMPACTS OF THE FLOOD

To be added

DEMOGRAPHICS OF THE REGION

To be added

DAMAGES AND OTHER LOSSES CAUSED BY THE FLOOD

Estimates of total damages in the Midwest from weather events during 1993 range from \$12 and \$16 billion. Over one half of these damages were related to agriculture including crops, livestock, fields, agricultural levees and farm buildings and equipment. The remaining damages were primarily to residences, businesses, public facilities, or transportation. However, much of the agricultural damage occurred in upland areas due to wet fields compounded by a short growing season and were not due to inundation by floodwaters. Similarly, a portion of the damages to residences and business was the result of basement flooding due to high groundwater and sewer back-up in areas not in the floodplain.

The National Weather Service (NWS) has estimated damages for the Midwest Flood at \$15.7 billion based on information provided by NWS field offices. This estimate is contained in the report "Water Year '93 Flood Damage Report" that was developed for inclusion in the USACE's annual report to Congress on flood damages prevented by flood control projects. This information provides totals by state, but does not include breakdowns of damage by type. The NWS report includes several pages of discussions on the problems and limitations of current methods of estimating flood damages. Most of the states have developed updated estimates of flood damages that have been published in state reports or otherwise provided the Committee. These state estimates indicate that total damages were between \$12 billion and \$13 billion. The New York Times developed and published on

August 10, 1993 an estimate of nearly \$12 billion in damages based on information they obtained from state and federal officials. This was early in the flood, although most areas that did flood had flooded. The officials that were consulted could not accurately assess all damages until floodwaters had receded. In addition, the full extent of the agricultural damages would not be known until after the end of the growing season. The available estimates are summarized in Table ____.

Table __ Damage Estimates for 1993 Midwest Flooding
(in millions of dollars)

STATE	NWS Totals	State Totals	State Agriculture	NY Times Total	NY Times Agriculture
Illinois	2,640	1-2,000	565	1,535	605
Iowa	5,740	> 3,400	-	2,200	1,200
Kansas	551	> 500	441	574	434
Minnesota	964	1,700	1,500	1,023	800
Missouri	3,430	3,000	-	3,000	1,800
Nebraska	295	-	-	347	292
North Dakota	414	600	500	1,500	705
South Dakota	763	596	572	595	595
Wisconsin	904	930	800	909	800
Total	15,701	12-13,000	-	11,683	7,231

NWS Totals are from "Water Year '93 Flood Damage Report", NOAA, 1994.

State Totals are from Hazard Mitigation Team Reports, other state reports, and personal communications from state officials.

NY Times totals are from the August 10, 1993, New Times.

The Committee also developed an estimate of flood damages using federal payments and making assumptions as to what percentage of damages these payments represent. This information indicates that total damages were around \$12 billion with as much as \$4-5 billion of that total being agricultural damages in upland areas.

There are marked inconsistencies among the estimates of damages for the Midwest Flood. No federal agency is responsible for developing accurate assessments of flood damages or funded to do so. Preliminary damage assessments are conducted by States and the Federal Emergency Management Agency (FEMA) for the purposes of determining whether or not a Presidential disaster declaration is warranted and to determine what resources will be necessary for response and recovery. Once sufficient damage has been identified to justify a declaration and get a general idea of how resources should be allocated, there is no reason for agencies to expend resources updating the preliminary assessments. Resources are instead focused on tracking and projecting expenditures. The NWS is not funded to estimate total damages, but does so in support of its other missions. The USACE in the past estimated flood damages, but is no longer funded to do so. The committee is concerned that decisions involving hundreds of millions of dollars often are being made without systematic assessments of flood damages and without a clear understanding of the nature and extent of those damages.

Damages to Agriculture

There were two primary causes of agricultural damages from the 1993 weather event. The first was excessive moisture that prevented planting and reduced yields in both upland and floodplain areas. The second cause was actual flooding which destroyed crops and severely damaged many acres of fertile floodplain cropland. It is difficult to disentangle the many factors that influenced crop production during the 1993 growing season in the 9-state region--rain, lack of heat, early frost, and floods. However, more than 70 percent of the claims for crop disaster assistance were from counties in upland areas ¹ -- not in floodplains.

Agricultural damages directly attributed to the flood event totaled more than \$2.5

billion. It was estimated that \$1.4 billion worth of corn and soybean sales were lost. damage to field fertility and farm infrastructure was around \$100 million, and direct community impacts were at least \$1 billion. Each state suffered different types of losses. For example, Missouri has 15 million acres of cropland, 5.1 million acres (34 percent) are in the floodplains. Crop damage caused by flooding on 3.1 million acres of Missouri land caused \$247 million in lost sales.² In Illinois, only 3 percent of the state's corn and soybeans were lost to flooding (312,000 and 276,000 acres respectively). The value of the loss in sales of the commodities in the floodplain was \$153.4 million.³ Minnesota farmers had losses in crop sales of about \$500 million, but most of the damage was caused by wet conditions rather than riverine flooding.⁴

Damage from scour and deposition affected 20 percent of the flooded cropland (455,000 acres on the Missouri floodplain), drainage ditches were filled with sediments, and other agricultural infrastructure was destroyed. Almost 60,000 acres have sand deposition more than 24 inches thick. Reclamation costs to restore fertility to damaged cropland are approximately \$190/acre.⁵ It would cost \$10.8 million to remove sediment and debris from ditches.

Secondary impacts of agricultural losses to a local economy vary substantially depending on the dependence of that economy on the agricultural sector. Immediate losses are incurred by lost sales and unemployment. In the long run, the assessed value of land that sustained long-term damage may be reduced which will affect the property tax base of affected communities.

Another important secondary effect was the reduction in crop support payments that occurred when prices adjusted to the reduced production caused by wet weather in the Midwest and drought in the Southeast in 1993. This loss to farmers was a gain for taxpayers since subsidies represent transfer payments. For corn, these deficiency payments were reduced by more than \$2.6 billion.⁶ These price effects (and subsequent reduction in deficiency payments) will be temporary.

Damages to Residences and Businesses

There are varying estimates of the numbers of homes flooded and families impacted by the Midwest flood. Windshield surveys done by Red Cross Chapters immediately after the floods identified more than 55,000 flooded residences. FEMA subsequently verified these damages with individual Red Cross Chapters and developed an updated estimate of 70,545 residences. The August 10, 1993 New York Times article estimated that more than 84,000 residences were damaged. However, as of April 11, 1994, there were 167,224 registrations for individual assistance and 112,042 applications for the Disaster Housing Program. A total of 89,734 applications for the Disaster Housing Program were approved. The Disaster Housing Program data indicates that more than 100,000 residences were flooded.

These seemingly contradictory numbers illustrate a characteristic of this flood that is generally missed. While the media focused on flooding of communities along the main stem Mississippi and Missouri Rivers and major tributaries, at least as many families were impacted by flooded basements due to high groundwater, overloading of storm sewer systems, or sewer back-up. Many of the homes with flooded basements were not in the 100 year floodplain or behind levees that overtopped or failed. In Cook County, Illinois, for instance large numbers of homes on the south and west sides of Chicago had basement flooding due to stormwater and sewer back-up caused by heavy rainfall. The county was eventually added onto the Illinois declaration even though this type of damage generally does not warrant a disaster declaration. Over half of the 60,448 registrations for individual assistance in Illinois and 20 percent of the registrations for the entire nine state region were in Cook County.

Businesses sustained significant physical damages particularly in urban areas such as St. Louis County and the Kansas City areas of Missouri. Much of this damage occurred behind levees that failed or were overtopped. The 996 claims NFIP claims payments made to small business and the 4,347 SBA loans for damages to businesses indicate that in excess of 5,000 individual businesses were damaged. Although there are no available estimates of damages to businesses, a measure of this damage, SBA loans to business, exceeded \$337

million for physical damage and for economic injury and NFIP flood insurance payments for small business and other non-residential buildings exceeded \$94 million for a total of over \$431 million. In addition to physical damage to buildings and their contents, lost profits and wages from businesses that were closed due to flood damages had important local and regional impacts. For example, an American Cyanamid Plant near Hannibal, Missouri, was protected by its own levee and not damaged by floodwaters. However, the plant was shut down for nearly three months because its access road was inundated when an agricultural levee was overtopped or failed. While the company may have been able to shift production to its other facilities, there are fixed costs of operating the plant and lost wages that will not be recovered. These losses are difficult to quantify and often not reflected in estimates of flood damage.

Damages to Transportation Systems

Rivers and river valleys have historically been major transportation routes, particularly in the Midwest area impacted by the 1993 flood. In the Midwest river boats opened many areas for settlement and directly led to the establishment of communities along the rivers. Railroads and highways follow the river valleys in preference to the more rugged upland areas. Those transportation routes that do not follow the river valleys have to cross those valleys including major transcontinental routes such as mainline railroads and interstate highways. As a result, physical damages to transportation systems are a significant percentage of total damages for most floods. In addition to these physical damages, there are indirect costs when these transportation routes are inundated by floodwaters and traffic is either halted or detoured.

A major portion of the damages to public facilities due to the flood were damages to roads and bridges. These damages range from blown culverts and wash-outs on rural roads and city streets to loss of bridges and damages to interstate highways that are inundated by floodwaters. The repair of damages to roads and bridges is generally funded through FEMA's Public Assistance Program or by the Department of Transportation. Funds

expended by those agencies when added to the state/local cost share for public assistance indicates that physical damages to roads and bridges exceeded \$250 million. This should closely approximate total damages to roads and bridges. However, there were limited instances where communities made unreimbursed repairs to roads and bridges.

There are indirect losses due to roads and bridges that are flooded due to increased transportation costs. In extreme cases, detours of 100 miles were required to travel between adjoining communities that were connected by a bridge. Often the bridge itself was elevated high above the river to allow for navigation or to minimize hydraulic impacts on floods. However, the approaches to the bridge were often built at or near the natural elevation of the floodplain and inundated by floodwaters. Even though the bridge was not damaged and the damage to the approaches was minimal, the economic impacts on the communities served by the bridge could be extreme, particularly for a long duration flood such as the 1993 Midwest flood. For example Keokuk, Iowa was cut off from market areas in Illinois and Missouri for several weeks when the approaches to bridges over the Mississippi and Des Moines Rivers were inundated. This resulted in serious economic impacts on local businesses. When the approaches to the bridge over the Mississippi River at Quincy, Illinois were flooded for 73 days resulting in an estimated \$30 million in lost business to Quincy merchants. In addition, many people who lived in Missouri could not commute to work in Illinois and were temporarily unemployed. Ferries were eventually established to address part of this problem. The Committee was not able to obtain data on the full magnitude of these losses. However, some are reflected in the over 36,000 claims that were approved for a total of \$92 million in Disaster Unemployment Assistance.

Historically, railroads were built in floodplains and river valleys to minimize construction costs and fuel costs. Main lines currently parallel both the Missouri and Mississippi Rivers. Although generally tracks are elevated on embankments above the elevation of most floods or located behind levees, they will be flooded by major flooding events. Over 800 miles of track were flooded and several main lines were inundated for varying periods of time. However, there is redundancy in the railroad system and trains

could be routed around flooded areas. The Association of American Railroads estimates that damages to railroad totalled \$182 million including \$131 million in physical damages to tracks, bridges, signals and communication lines, switches, locomotives and rolling stock, and buildings and \$51 million in additional costs resulting from the detouring of trains around sections of flooded track. The costs of repair are generally borne by the railroads themselves with the exception of \$18 million distributed to smaller branch line railroads through the Supplemental Appropriation for Local Rail Freight Assistance.

Airports are also often located in floodplains due the flat terrain, inexpensive land, and close proximity to urban areas. The Federal Aviation Administration (FAA) has identified 33 airports that were flooded with varying degrees of damage. The estimated costs to repair these airports exceeds \$5.4 million. The airports range in size from the Spirit of St. Louis Airport in St. Louis County, Missouri to airports that are little more than grass landing strips with a few hangers for private aviation. Most of the airports that were flooded were in Missouri (16) and Iowa (12). The Spirit of St. Louis Airport is a major reliever for Lambert-St. Louis Airport. It sustained \$1.7 million in damages when the Monarch Levee failed. Other major airports which were flooded include those at Creve Couer and Jefferson City, and the Kansas City Downtown Airport. Several of the smaller airports remain closed and may not reopen.

Navigation (to be developed).

Damages to Water and Wastewater Treatment Plants and Other Public Facilities

The Midwest Flood also caused extensive damages to water and wastewater treatment plants and other public facilities. Damages to utilities which includes water and wastewater treatment facilities and storm sewer systems exceeded \$85 million. Water treatment plants are often located in floodplains to be near well fields or the surface water that supplies the system. In addition, water supply lines must cross floodplains or serve floodplain residents.

EPA has identified 289 municipal water systems which were impacted to some degree by the flood. The most prominent example of a water treatment facility that was damaged by the flood is the Des Moines Water Works which serves the City of Des Moines and adjoining communities. The plant was flooded and remained out of operation for a period of ?? days.

In addition to physical damage of \$12 million, there were significant impacts on the service area. Businesses in the city were closed because of lack of fire protection and bottled water and portable toilets had to be provided for residents. The economic impact of the shut down may far exceed the cost of repair of the physical damage.

Wastewater treatment plants tend to be located in floodplains because since they are generally the lowest point in the community and can take advantage of gravity flow. Furthermore, the effluent from these plants must be discharged into a major river or stream. The impact of flooding ranges from temporary plant shut-down and the discharge of raw sewage into the river during the flood to physical damage that results in extended plant shut downs and continued discharges of raw sewage or partially treated effluent until such time as the plant can be repaired. (Add numbers on wastewater treatment plants affected.)

There were also extensive damages to public buildings (more than \$27 million), water control facilities (more than \$20 million), and other facilities such as parks and other recreation facilities (more than \$22 million). These estimates are based on FEMA projections of infrastructure spending that include the 10 percent local cost share.

RESPONSE AND RECOVERY COSTS

The Midwest flood was the most costly flood on record and one of the most costly disasters of any kind exceeded only by the Northridge Earthquake and Hurricane Andrew. By the end of the flood there were nine state disaster declarations that included more than 525 counties. Current estimated federal response and recovery costs include \$4.4 billion in direct federal expenditures, \$1.3 billion in payments from federal insurance programs, and

more than \$623 million in federal loans to individuals, businesses and communities.

A review of the types and amounts of federal response and recovery costs by state illustrate again the differences in types of damages among the nine states. In the upper basin states of Minnesota, Nebraska, North Dakota, and South Dakota, and Wisconsin and in northern Iowa, the losses were primarily to agriculture, much of it in upland areas. Along the main stems of the Mississippi and Missouri and their major tributaries in Missouri, Illinois and central Iowa there were significant losses to agriculture as result of bottomland flooding, but there were also significant urban damages as well.

Federal Expenditures

Federal expenditures include those disaster response and recovery costs borne by the federal government. These costs include disaster assistance payments to individuals and farmers, costs to repair levees and other infrastructure, costs to provide health and social services, costs associated with hazard mitigation, housing and community development, and other assorted costs. A summary of federal expenditures for the Midwest flood is included in Table __, but does not include insurance payments from the Federal Crop Insurance Corporation and the National Flood Insurance Program (NFIP) or loans from the various federal loan programs.

23

[illegible]

Public Health Service	75.0									
Impact Aid	70.0	-	-	-	-	-	-	-	-	-
Student Financial Assistance	30.0	-	-	-	-	-	-	-	-	-
Education Subtotal	100.00	-	-	-	-	-	-	-	-	-
Training and Employment	54.6									
National Community Service	4.0									
Labor Subtotal	58.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coast Guard Operation	10.0	-	-	-	-	-	-	-	-	-
Federal Highway Administration	115.7	15.9	16.7	19.4	4.6	47.8	3.0	3.6	2.1	2.6
Local Rail Freight Assistance	21.0	.6	3.2	3.1	1.9	6.7	-	-	1.4	
DOT Subtotal	146.70	16.51	19.90	22.50	6.50	54.50	3.00	3.60	3.50	2.60
Abatement, Control, and Compliance	24.3	3.4	3.4	1.9	.8	6.9	1.5	.9	.7	.9
Program and Research Operations	1.0	.2	-	.1	-	-	-	-	-	-
Underground Storage Tanks	8.0	1.4	1.2	.7	1.4	.7	.5	.3	3	1.5
Oil Spill Response	.7	.3		.4						
EPA Subtotal	34.00	5.30	4.60	3.10	2.20	7.60	2.00	1.20	3.70	2.40
FWS Construction	30.0	2.3	6.0	.5	1.6	10.7	-	.4	-	6.0
Historic Preservation	5.0	-	-	-	-	-	-	-	-	-
NPS Construction	.9	-	-	-	-	-	-	-	-	-
USGS Surveys	1.4	-	-	-	-	-	-	-	-	-
BIA Indian Programs	3.9	-	-	-	-	-	-	-	-	-
DOI Subtotal	41.20	2.30	6.00	0.50	1.60	10.70	0.00	0.40	0.00	6.00
Total	4,397.80	458.45	762.29	277.00	556.89	838.40	166.95	167.97	215.49	181.47
		IL	IA	KS	MN	MO	NE	ND	SD	WI

Notes: USDA data is assistance paid as of 3/30/94 except for the SCS 1994 Supplemental
FEMA data is projected costs (Federal share only) as of 4/1/94.
HUD data is allocations of funds appropriated in the 1993 and 1994 Supplementals.
EDA data is grants awarded and applications invited as of 4/15/94.
DOT data for highways is funds allocated.

Payments by Federal Insurance Programs

The federal government operates two insurance programs that provided claims payments to those impacted by the Midwest flood, the Federal Crop Insurance Program and the National Flood Insurance Program (NFIP). Table ??? summarizes claims payments from these programs by state. Payments from these loan programs illustrate graphically the differences in the type of damages among the states.

TABLE __ MIDWEST FLOODS OF 1993
SUMMARY OF FEDERAL INSURANCE CLAIMS PAYMENTS BY STATE
(in millions of dollars)

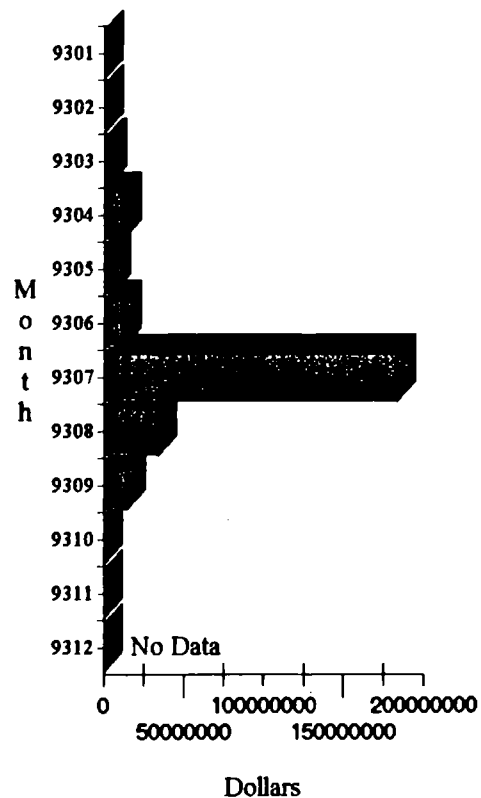
PROGRAM	TOTAL	IL	IA	KS	MN	MO	NE	ND	SD	WI
Federal Crop Insurance Program Claims Payments	1,017.0	25.4	281.2	40.4	353.9	27.7	49.0	139.3	54.1	46.0
National Flood Insurance Program Claims Payments	297.3	61.4	23.4	10.7	1.7	192.3	4.8	.3	.8	2.0
Total Claims Payments	1,314.3	86.8	304.6	51.1	355.6	220.0	53.8	139.6	54.9	48.0

TABLE _ NATIONAL FLOOD INSURANCE PROGRAM (NFIP)
MIDWEST FLOOD OF 1993
LOSSES FROM 4/1/93 TO 9/30/93

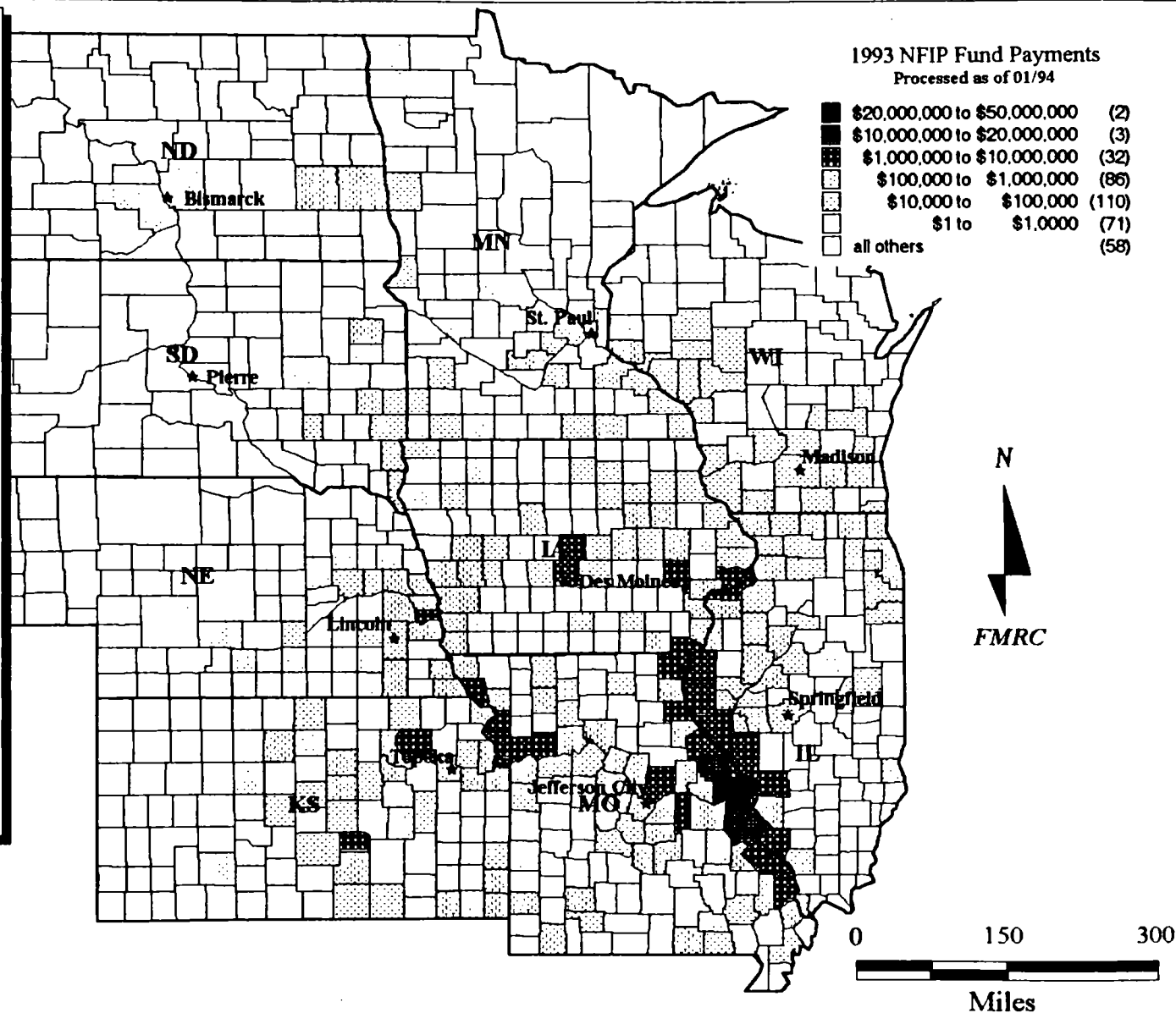
State	Policies 1/31/94	Loss Count	Total Payments	Average Payment	Percent Losses	Percent Payments
Illinois	36,844	3,624	\$61,389,123	16,939.60	0.22	0.21
Iowa	8,689	1,690	\$23,378,415	13,833.38	0.10	0.08
Kansas	11,065	1,071	\$10,702,780	9,993.26	0.07	0.04
Minnesota	3,472	372	\$1,712,960	4,604.73	0.02	0.01
Missouri	20,981	8,271	\$192,296,740	23,249.52	0.51	0.65
Nebraska	6,652	503	\$4,833,133	9,608.61	0.03	0.02
North Dakota	3,008	198	\$285,572	1,442.28	0.01	0.00
South Dakota	1,313	115	\$745,309	6,480.95	0.01	0.00
Wisconsin	7,096	323	\$1,999,654	6,190.88	0.02	0.01
Total	99,120.00	16,167.00	\$297,343,686.00	\$18,392.01	0.99	1.02

National Flood Insurance Program Policy Fund Payments for 1993

Payment Amounts by Month



Data Source: NFIP-CIS



Claims payments by federal insurance programs are different than federal expenditures. Under both programs, individuals pay an annual insurance premium to the government and the government provides insurance coverage. Under the NFIP, insurance premiums for buildings that pre-date the identification of the flood hazard in a particular community are subsidized, but for buildings built after that date, premiums are based on full actuarial rates. All costs of administering the program, including the costs of floodplain mapping and salaries of federal employees are charged to policyholders. For a further discussion of the Federal Crop Insurance Program see the section below.

Loans from Federal Agencies

Federal agencies have approved \$623 million in loans to individuals, businesses and communities impacted by the Midwest Floods. These loans must be repaid and are a federal expenditure only to the degree that interest rates are subsidized or borrowers default on the loans and for administrative costs. These loan programs are summarized by state in Table__.

MIDWEST FLOODS OF 1993
SUMMARY OF FEDERAL INSURANCE CLAIMS PAYMENTS BY STATE
(in millions of dollars)

PROGRAM	TOTAL	IL	IA	KS	MN	MO	NE	ND	SD	WI
Federal Crop Insurance Program Claims Payments	1,017.0	25.4	281.2	40.4	353.9	27.7	49.0	139.3	54.1	46.0
National Flood Insurance Program Claims Payments	297.3	61.4	23.4	10.7	1.7	192.3	4.8	.3	.8	2.0
Total Claims Payments	1,314.3	86.8	304.6	51.1	355.6	220.0	53.8	139.6	54.9	48.0

MIDWEST FLOODS OF 1993
SUMMARY OF AMOUNT OF FEDERAL LOANS BY STATE
(in millions of dollars)

PROGRAM	TOTAL	IL	IA	KS	MN	MO	NE	ND	SD	WI
Small Business Administration Disaster Loans	599.3	133.4	106.1	29.6	26.4	232.4	13.8	21.4	23.9	12.3
Rural Development Administration Loans	9.3	-	6.7	1.2	-	.7	.1	-	.6	-
Farmers Home Administration Emergency Disaster Loans	14.7	2.1	7.3	.1	2.4	.9	.1	.2	.9	.8
Total Amount Approved	623.30	135.50	120.10	30.90	28.80	234.00	14.00	21.60	25.40	13.10

The primary source of these loans is the Small Business Administration (SBA) Disaster Loan Program which provided \$599 million of loans to homeowners and renters, businesses of all sizes, and non-profit organizations. For SBA disaster loans the interest subsidies, defaults, and administrative costs combined amount to approximately 30 percent of the loan amount.

Federal Income Tax Deductions

Uninsured and otherwise unreimbursed losses resulting from casualties such as a floods are deductible for Federal Income Tax purposes to the extent that they exceed 10 percent of Federal Adjusted Gross Income plus \$100. This deduction results in decreased tax revenue to the federal government. The Internal Revenue Service provides tax counselling to disaster victims to assist them in applying for refunds by emending their previous years tax return when a major disaster is declared. The loss of tax revenue has not been quantified for the Midwest Flood. Due to the amount of insurance and disaster assistance payments, the income levels of many of the flood victims, and the requirement that the loss exceed 10 percent of adjusted gross income, the loss may not be substantial. However, the casualty loss deduction does act as an additional mechanism for transferring the costs of flood damage from the private sector to the federal government.

Costs to State and Local Government

The Midwest flood was also costly for state and local government. Since FEMA assistance was provided at a 90/10 cost share, the state/local share was approximately \$42 million for Public Assistance and nearly the same amount for assistance to individuals. States and communities also had unreimbursed expenses associated with the response and recovery.

Of greater concern to some communities is the short and long-term reductions in real estate tax revenues as properties are reassessed to reflect flood damages to buildings and

agricultural lands or losses in market value due to the increased awareness of the flood hazard. In those where homes are not be rebuilt and fields not restored and these losses will be permanent. Impact aid from the Department of Education, currently budgeted at \$70 million, will replace a part of the lost tax revenues that would have gone to schools.

At the state level there may be losses in tax revenue due to lost profits and wages. However, these losses may be compensated for in part by the increased economic activity due to the recovery effort and the provision of federal assistance.

MIDWEST FLOODS OF 1993
SUMMARY OF FEDERAL EXPENDITURES BY STATE
(in millions of dollars)

Program	TOTAL	IL	IA	KS	MN	MO	NE	ND	SD	WI
Crop Loss Payments	1,463.3	49.2	351.1	65.5	442.5	121.2	76.0	99.5	151.1	107.2
Emerg. Conservation Prog.	2.7	.1	1.53	-	.1	.7	.1	-	.2	-
Emergency Watershed Prog.	57.2	9.5	13.8	4.0	1.1	11.9	1.0	.9	3.5	1.0
Food Stamps and Commodities	10.9	2.1	2.4	-	-	6.4	-	-	-	-
FmHA Loans and Grants	15.8	2.4	7.4	.2	2.5	1.4	.1	.2	.9	.8
SCS Supplemental 1994	340.00	-	-	-	-	-	-	-	-	-
USDA Subtotal	1,889.90	63.30	376.23	69.70	446.20	141.60	77.20	100.60	155.70	109.00
Infrastructure (Proj.)	424.4	92.8	99.6	31.2	27.5	94.9	41.8	8.2	9.9	18.5
Human Services (Proj.)	449.1	59.7	54.9	56.5	24.4	125.9	3.5	22.7	20.4	18.0
Hazard Mitigation (Proj.)	134.9	26.3	27.0	15.2	9.7	30.0	10.0	4.2	4.5	8.0
Administration (Proj.)	89.6	18.7	8.3	8.8	1.3	40.7	3.5	2.0	2.1	1.9
EMA Subtotal	1,098.00	197.50	189.80	111.70	62.90	291.50	58.80	37.10	36.90	46.40
CDBG Allocations	200.0	35.89	43.08	18.78	13.51	57.20	7.77	11.92	5.97	5.88
HOME Allocations	50.0	10.84	11.39	3.40	2.69	15.3	1.25	2.57	1.29	1.27
CDBG 1994 Supplemental	250.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUD Subtotal	500.00	46.73	54.47	22.18	16.20	72.50	9.02	14.49	7.26	7.15
EDA Assistance Programs (includes \$18M for Levees)	200.0									
NOAA Expenses	1.0	-	-	-	-	-	-	-	-	-
Legal Services Corporation	.3	-	-	-	-	-	-	-	-	-
Commerce Subtotal	201.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flood Control Emergency	218.0	70.0	7.0	11.0	.3	128.0	1.0	-	25.0	32.0
Emergency Operations and Contingencies	31.4	-	-	-	-	-	-	-	-	-
Operation and Maintenance	3.7	.3	2.7	-	-	.7	-	-	-	-
COE Subtotal	249.40	70.30	9.70	11.00	0.30	128.70	1.00	0.00	25.00	32.00
Public Health Service	75.0									

Impact Aid	70.0	-	-	-	-	-	-	-	-	-
Student Financial Assistance	30.0	-	-	-	-	-	-	-	-	-
Education Subtotal	100.00	-	-	-	-	-	-	-	-	-
Training and Employment	54.6									
National Community Service	4.0									
Labor Subtotal	58.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coast Guard Operation	10.0	-	-	-	-	-	-	-	-	-
Federal Highway Administration	115.7	15.90	16.73	19.39	4.55	47.80	3.01	3.57	2.13	2.59
Local Rail Freight Assistance	21.0	.61	3.16	3.15	1.87	6.66			1.42	
DOT Subtotal	146.70	16.51	19.89	22.54	6.42	54.46	3.01	3.57	3.55	2.59
Abatement, Control, and Compliance	24.3	3.4	3.4	1.9	.8	6.9	1.5	.9	.7	.9
Program and Research Operations	1.0	.2		.1						
Underground Storage Tanks	8.0	1.4	1.2	.7	1.4	.7	.5	.3	3	1.5
Oil Spill Response	.7	.3		.4						
USDA Subtotal	34.00	5.30	4.60	3.10	2.20	7.60	2.00	1.20	3.70	2.40
WS Construction	30.0	2.3	6.0	.5	1.6	10.7	-	.4	-	6.0
Historic Preservation	5.0	-	-	-	-	-	-	-	-	-
NPS Construction	.9	-	-	-	-	-	-	-	-	-
USGS Surveys	1.4	-	-	-	-	-	-	-	-	-
BIA Indian Programs	3.9	-	-	-	-	-	-	-	-	-
DOI Subtotal	41.20	2.30	6.00	0.50	1.60	10.70	0.00	0.40	0.00	6.00
Total	3,230.50	110.08	125.75	66.92	38.81	196.96	25.28	26.43	20.30	27.41
		IL	IA	KS	MN	MO	NE	ND	SD	WI

NOTES:

USDA data is assistance paid as of 3/30/94. Except that SCS 1994 Supplemental

FEMA data is projected costs (Federal share only) as of 4/1/94.

HUD data is allocations of funds appropriated in the 1993 and 1994 Supplementals.

DOT data for highways is funds allocated.

DOT for railroads is the amount allocated per State from the 1993 Supplemental.

Breakdowns by State are not included where funds are not tied to individual States or actual spending per State is not yet known and cannot be projected.

Table A-2: U.S. Department of Agriculture ASCS Disaster Payments - 1993

	\$ to PROGRAM CROPS¹	\$ to NON- PROGRAM CROPS	\$ TOTAL
ILLINOIS	42,662,617	7,445,761	50,108,378
IOWA	342,849,940	12,910,334	355,760,274
KANSAS	60,739,569	4,823,055	65,562,624
MINNESOTA	414,574,259	30,983,156	445,557,415
MISSOURI	113,812,607	8,290,327	122,102,934
NEBRASKA	64,123,698	13,233,694	77,357,392
N. DAKOTA	67,127,874	34,760,511	101,888,385
S. DAKOTA	142,318,846	11,299,410	153,618,256
WISCONSIN	82,468,812	18,377,402	100,846,214
9-STATE TOTAL	1,330,678,222	142,123,650	1,472,801,872

¹ Program crops that received 1993 disaster payments within the 9-state region include those within the Commodity Programs (Barley, Corn, Upland Cotton, Oats, Rice, Sorghum, Sugar Beets, Wheat) plus those in special programs (Soybeans and Tobacco).

Federal Crop Insurance Program

Farmers have the opportunity to protect themselves from actual crop losses or prevented planting caused by uncontrollable natural events through the purchase of crop insurance from the Federal Crop Insurance Corporation (FCIC). The FCIC is a wholly-owned government corporation within the U.S. Department of Agriculture and it provides coverage for 51 crops in the event of loss due to drought, excess moisture, flood, frost, hail, wind, insects, and other natural perils. Historically, drought has been the major cause of crop loss (55 percent) while floods represent only 2 percent of the claims. Excess moisture, however, represents 16 percent of the losses.

Farmers must purchase the insurance early in the crop year. For example, a policy to cover a corn crop planted in 1994 in the Midwest would have to be purchased by April 15. Farmers can choose the level of insurance coverage that they wish to purchase, but they are not able to insure their crop for the full value. The maximum coverage that can be obtained is only 75 percent of expected crop yield. The amount paid for a claim is based on loss below the coverage amount. For example, a farmer with a 65 percent level of crop insurance who lost half of his crop would be compensated for 15 percent of the crop value ($65\% - 50\% = 15\%$). A farmer with a 35 percent level (the minimum) would get no compensation. The price paid per unit of eligible crop loss can be selected as the market price or as a percentage of an established price. The insurance premium depends on both the chosen yield coverage and price election. To encourage participation, the Federal Government subsidizes crop insurance premiums up to 30 percent and pays the administrative, actuarial, underwriting, and selling expenses.

Table A-3 shows the participation rate for crop insurance purchases in the 9-state area for 1993 as well as the indemnities paid to policy holders. Participation is lowest in the corn/soybean region and highest where wheat is the principal crop. The largest claims were in the prairie pothole region (as were the bulk of the crop disaster payments) rather than in the floodplains. The probability of participation in the crop insurance program is lower for floodplain farmers than for those in the upland because flood damage is, in general, more

localized than drought which is the primary hazard in the Midwest.

Table A-3: Federal Crop Insurance - 1993

STATE	PARTICIPATION (percent)	PAYMENTS (\$ million)
Illinois	44.4	25.4
Iowa	60.2	281.2
Kansas	76.4	40.4
Minnesota	52.4	353.9
Missouri	24.0	27.7
Nebraska	56.1	49.0
N. Dakota	93.4	139.3
S. Dakota	47.0	54.1
Wisconsin	11.3	46.0
TOTAL		1,017.0

Loans from Federal Agencies

Federal agencies have approved \$623 million in loans to individuals, businesses and communities impacted by the Midwest Floods. These loans must be repaid and are a Federal expenditure only to the degree that interest rates are subsidized or borrowers default on the loans and for administrative costs. These loan programs are summarized by state in Table

TABLE _ MIDWEST FLOODS OF 1993
SUMMARY OF AMOUNT OF FEDERAL LOANS BY STATE
(in millions of dollars)

PROGRAM	TOTAL	IL	IA	KS	MN	MO	NE	ND	SD	WI
Small Business Administration Disaster Loans	599.3	133.4	106.1	29.6	26.4	232.4	13.8	21.4	23.9	12.3
Rural Development Administration Loans	9.3	-	6.7	1.2	-	.7	.1	-	.6	-
Farmers Home Administration Emergency Disaster Loans	14.7	2.1	7.3	.1	2.4	.9	.1	.2	.9	.8
Total Amount Approved	623.30	135.50	120.10	30.90	28.80	234.00	14.00	21.60	25.40	13.10

The primary source of these loans is the Small Business Administration (SBA) Disaster Loan Program which provided \$599s loans to homeowners and renters, businesses of all sizes, and non-profit organizations.

Federal Income Tax Deductions

Uninsured and otherwise unreimbursed losses resulting from casualties such as a floods are deductible for Federal Income Tax purposes to the extent that they exceed 10 percent of Federal Adjusted Gross Income plus \$100. This deduction results in decreased tax revenue to the federal government . The Internal Revenue Service provides tax counselling to disaster victims to assist than in applying for refunds by emending their previous years tax return when a major disaster is declared. The loss of tax revenue has not been quantified for the Midwest Flood . Due to the amount of insurance and disaster assistance payments, the income levels of many of the flood victims, and the requirement that the loss exceed 10 percent of adjusted gross income, the loss may not be substantial. However, the casualty loss deduction does act as an additional mechanism for transferring the costs of flood damage from the private sector to the federal government.

COSTS TO STATE AND LOCAL GOVERNMENT

The Midwest Flood was also costly for State and local government. Since FEMA assistance was provided at a 90/10 cost share, the state/local share was approximately \$42 million for Public Assistance and ??? for assistance to individuals. States and communities also had unreimbursed expenses associated with the response and recovery.

Of greater concern to some communities is the short and long term reductions in real estate tax revenues as properties are reassessed to reflect flood damages to buildings and agricultural lands or losses in market value due to the increased awareness of the flood

hazard. In those where homes are not be rebuilt and fields not restored and these losses will be permanent.. Impact aid from the Department of Education will replace a part of the lost tax revenues that would have gone to schools.

At the state level there may be losses in tax revenue due to lost profits and pages although these may be compensated for in part by the increased economic activity due to the recovery effort and the provision of federal assistance.

NON-QUANTIFIABLE COSTS

EPA determined that 59 Superfund sites experienced flooding; however, impacts to the sites were minimal and those sites requiring corrective measures have had them completed⁷. In addition, 73⁸ solid waste treatment, storage, and disposal sites⁹ were also flooded. In addition, large propane tanks were dislodged and floated down river creating the potential for massive explosions. Besides the large propane tanks, the states collected over 18,000 orphaned drums¹⁰ -- each with a potential hazardous or toxic substance -- and a large amount of household hazardous wastes whose disposal was necessitated by the flooding. Daily loads of agricultural chemicals (herbicides and nitrates) transported by the Mississippi River were large relative to previous years; record flooding did not dilute the concentrations of herbicides.¹¹ Concentrations of two herbicides (atrazine and cyanazine) in some samples from the Mississippi River exceeded health-based limits for drinking water; however, the annual concentration was not expected to exceed those limits for 1993.¹² The cumulative impact of any releases of hazardous materials, including pesticides, herbicides and other toxic materials is not established.

The effects of flooding on ground water hydrology and groundwater quality are poorly known. Due to concerns regarding the safety of private wells, a well-water contamination survey of the nine states was established by the Administration in coordination with the states.¹³ The results of that study are not yet available. EPA performed flood water

quality sampling around major metropolitan areas on the Missouri. In some cases, drinking water standards were exceeded, although the vast majority of those exceedances posed no health risk.¹⁴ Results from treated drinking water, showed three locations where Maximum Contaminate Levels were exceeded; however, results from a single sample do not necessarily indicate a problem.¹⁵ USGS and National Oceanic and Atmospheric Administration have not found significant changes in water chemistry since the 1993 floods.¹⁶

Impacts of the flooding on the distribution of contaminated river sediments is also unknown. Studies are underway to determine sediment chemistry and characterize sediment deposition patterns in rivers and streams.¹⁷

Effects of the flood on public and mental health are largely anecdotal. While some communities noted increases in spousal and child abuse and numbers of calls for police response, during the course of Review Committee visits, no studies correlating the flooding with mental health changes were conducted.¹⁸ Mental health effects of community and individual buyout/relocation are poorly understood. Experience with other flooding events, indicates that outbreaks of Equine and St. Louis Encephalitis can be expected two years after a flooding event (due to the availability of standing water for disease vectors).¹⁹

BENEFICIAL EFFECTS

Flood-pulse

The ecological importance of maintaining connections between the river and its floodplain and the flood-pulse advantage has been described by numerous authors⁸⁹. The 1993 floods connected many midwestern rivers with their floodplains, and for the first time in decades this flood coincided with the natural spawning period of riverine fishes. The tremendous benefits of this inundation to fisheries and aquatic resources was evidenced anectdotally in reports of fishermen utilizing newly created scour holes, and empirically in

fisheries samples collected as part of the fall fish sampling for the Upper Mississippi River System Long Term Resource Monitoring Program (LTRMP). Catches of young of the year fish in fall 1993 LTRMP samples (after the flood) were greater than numbers of such fish collected in all samples for the entire 1992 sampling year (before the flood).¹⁰

ENDNOTES

1. SAST map reflecting 1879 land cover.
- 2.
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3. Bhowmik, Nani G., editor, *The 1993 Flood on the Mississippi River in Illinois*, (Illinois State Water Survey Misc. Publication No. 151, 1993).
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8. Ibid
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9. Junk, W.J., P.B. Bayley, and R.E. Sparks. 1989. The flood pulse concept in river-floodplain systems, pp. 110-127. In: D.P. Dodge (ed.) *Proceedings of the International Large River Symposium*. Can. Spec. Publ. Fish. Aquat. Sci. 106.
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Chapter 2

IMPACTS OF HUMAN INTERVENTION

THREE CENTURIES OF CHANGE

As settlement spread west, the landscape of prairies, forests, meandering streams, and free-flowing rivers was changed to provide arable farmland, raw materials for homes and industry, and transportation. Federal policies assisted in this development, and saw to it that these investments were protected to the extent possible. This human use changed the landscape of the Midwest to the detriment of ecological systems. The 1993 event raised the question as to what extent have these landscape changes contributed to changes in flood frequency and duration.

HISTORY

Upland and bottomland wetland losses

Wetlands are transitional zones between open water and dryland. They occur in poorly drained soils or in areas where water is found at or near the ground's surface. Between 1780 and 1980 an estimated 53 percent of this county's original 221 million acres of wetland were drained.¹ The Swamp Land Acts of 1849, 1850, and 1860 paved the way for transferring nearly 65 million acres of wetlands in 15 States from federal to state administration for the purpose of expediting their drainage.²

The policy of the United States, since the early 1800's, has been to cede "overflow and swampy" land to the states and to convert this land to productive use.³ Substantial harvesting of bottomland timber resources began with the coming of pioneers, and by the 1930's, over 84 million acres nationwide were included in regional enterprises known as drainage districts. Early federal policies resulted in conversion of most lands from natural to agricultural uses prior to the 1930. By the 1950's, forested wetlands had been reduced to about 66.7 million acres, and by the mid-1970's to 60.3 million acres.⁴

Between the mid 1950's and 1970's an average of 458,000 wetland acres were lost each year in the conterminous United States. Of this amount agricultural development was responsible for 87 percent of the loss, as wetlands were drained, filled, or otherwise converted to cropland.

MAP OF MIDWEST WETLAND LOSSES

Agricultural Production in the 9 Flood Affected States

Agriculture is the leading industry in many counties in the 9 state region. Cropland in the 9 states is 208 million acres. The area comprises 32 percent of the nation's acreage in farms and 35 percent of its total agricultural sales.⁵ Almost 60 percent of the total corn, wheat, and soybean acreage in the country is found in the region. Combined production from Illinois and Iowa alone represents 33 percent of corn and 30 percent of soybean acreage in the U.S. Each state is different with respect to dominant crops and yields. In the region impacted by the 1993 flood, the floodplain is approximately 10.5 percent of the total. Sixty six percent of floodplain is in agricultural production.⁶ Table _ shows the basic farm characteristics and the total value of production.

Table _ -- Agricultural Characteristics of Flood Affected States

STATES	FARMLAND (million acres)	AVERAGE FARM SIZE (acres)	CASH RECEIPTS: CROPS		CASH RECEIPTS: LIVESTOCK	
			\$million /yr	U.S. Rank	\$million /yr	U.S. Rank
Illinois	28.5	321	3,913	3	2,262	10
Iowa	31.6	301	3,510	4	5,270	2
Kansas	46.6	680	1,807	11	3,914	6
Minnesota	26.6	312	2,165	6	3,645	7
Missouri	29.2	275	1,517	14	2,173	11
Nebraska	45.3	749	1,975	8	4,848	3
N. Dakota	40.3	1143	1,548	13	760	32
S. Dakota	44.2	1214	813	27	1,910	15
Wisconsin	16.6	221	795	28	4,222	5

Source: 1987 Census of Agriculture, U.S. Department of Commerce.

U.S. farm policy

Since 1933, the US federal farm policy has used as system of price support through loans, purchases, payments, or a combination of these methods to assure the country with a consistent, inexpensive food supply while assuring cheap food cost for the people of the United States. The Food, Agriculture, Conservation, and Trade Act of 1990 (The 1990 Farm Bill) continued the market orientation of its predecessor, the Food Security Act of 1985. The stated goals of the 1990 Farm Bill were to ease financial stress for farmers, reduce government costs, reduce crop surpluses, maintain export competitiveness, and enhance environmental quality. The most widely known features of farm policy are the Production Adjustment/Price Support Programs administered by the Agricultural Stabilization and Conservation Service of the USDA. Appendix __ provides an example of how deficiency payments operate.

SIDE BAR: Production differences of floodplain vs. other areas

Production of agricultural products in floodplains are primarily commodity crops of corn and soybeans. Yields of corn in floodplain are very uniform and in the State of Missouri average yields in the floodplain are 15 percent higher than the state average. Production yields of uplands soils are quite variable and are dependent on their location. The highest yields of corn on uplands is 16 percent higher than the floodplain; however, these croplands are presently in full production. If production is removed from the floodplain it must go to the other upland regions where yields are from 14 to 26 percent lower.

Flood control development

The 1936 flood control act codified the federal interest in development and installation of flood prevention control measures that had begun in the Mississippi valley in 1879. In the

early years the primary method used to prevent damages in the floodplain were levees. After 1936 the USACE responsibilities focused on major rivers and development of project watershed plans which are approved by Congress . These plans include the most cost effective method of preventing flood damages and include the features of reservoirs, levees, channelization, and diversions. To date the USACE has installed 71 reservoirs which can store acre-feet of flood water. Soil Conservation Service (SCS) flood control related activities began nationally in 1944 with passage of PL-534 which authorized installation of upland treatment and flood control works in selected watershed areas. In 1954 Public Law 83-566, Watershed Protection and Flood Prevention Act (expanded the SCS flood control program to the entire nation. During the past 40 years, in the 9 midwestern states, the SCS has planned and evaluated 316 watershed projects with a drainage area of 40,000 square miles (25.5 million acres). Locally sponsored PL-566 projects have installed 2964 reservoirs, controlling runoff over 5 million upland acres and 818 miles of channel work of which 75 percent is in the states of North Dakota, Minnesota and Illinois. These reservoirs have a surface area of 51,731, acres providing 1,057,481 acre feet of flood storage and 320,673 acre-feet of sediment storage.

The PL-566 program requires that at least 50% of the area above any reservoir must have adequate land treatment installed before construction. Because most states usually require 75% of the land to be treated before installation of the reservoir it is estimated that the Small Watershed Program has resulted in treatment of in excess of 3 million upland acres.

Navigation Development

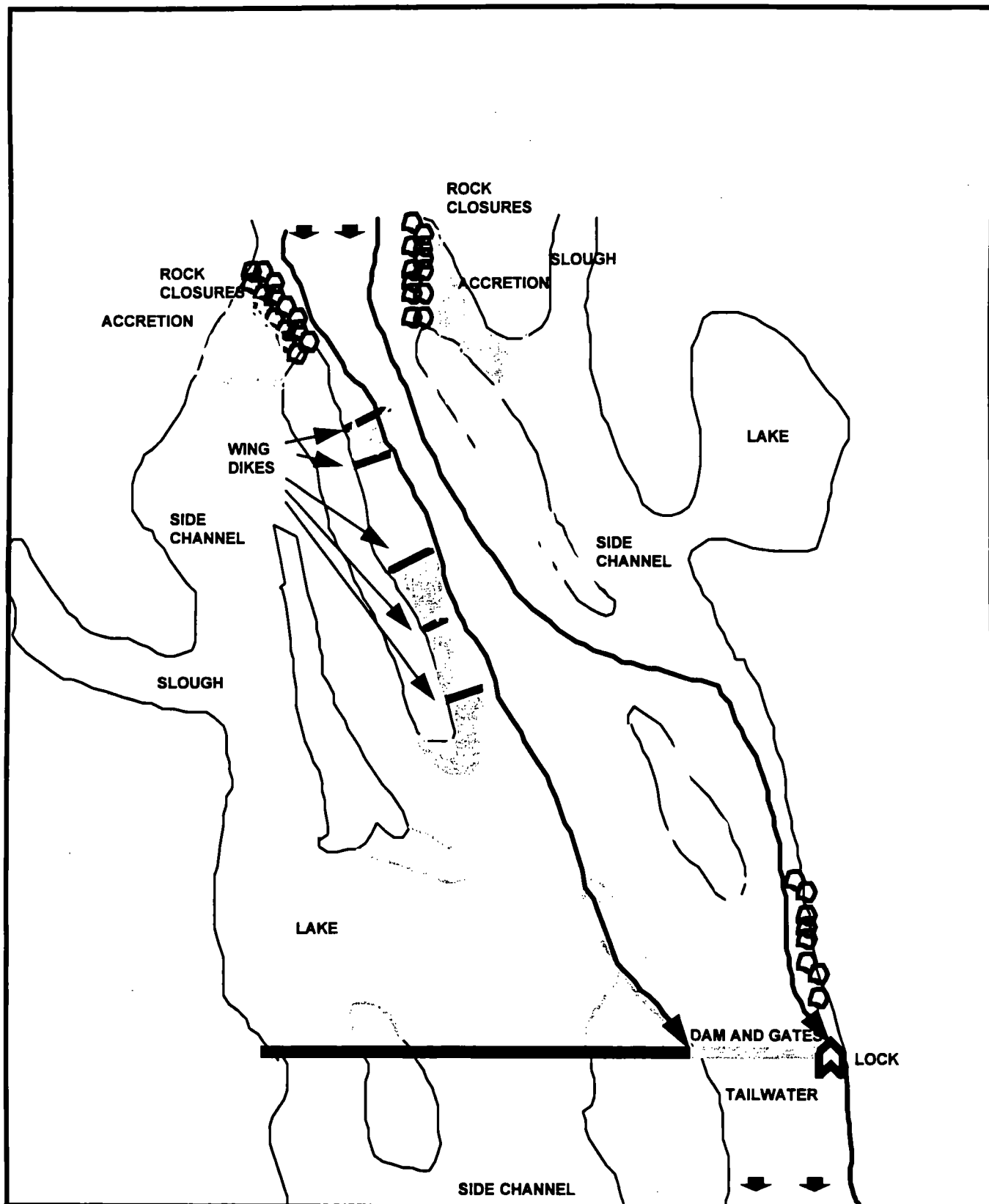
Upper Mississippi River: The Upper Mississippi River navigation system provides for a wide variety of uses: commercial transportation, recreation, environmental resources, water supplies for domestic and industrial use, and energy production. The Water Resource

Development Act of 1986 declared the Upper Mississippi River System as both a nationally significant ecosystem and commercial navigation system.

Navigation has been an important aspect of the Mississippi river since settlement and the federal government has been actively supporting navigation since 1824. The nine foot navigation channel projects, authorized by Congress in the 1930's for the Mississippi and Illinois Rivers, extend navigation upstream to Minneapolis/St. Paul and connect the St. Lawrence-Great Lakes and Mississippi-Ohio-Missouri Navigation Systems (Figure). Construction of the 27 locks and dams were completed by 1940, and are nearing their 50-year life span. Lock and dam 26 near Alton, Illinois was replaced in the early 1980's. Below lock 27 at Granite City, Illinois, the Mississippi River navigation channel is maintained through channelization and placement of flow regulating structures, such as wing dikes, and by dredging.

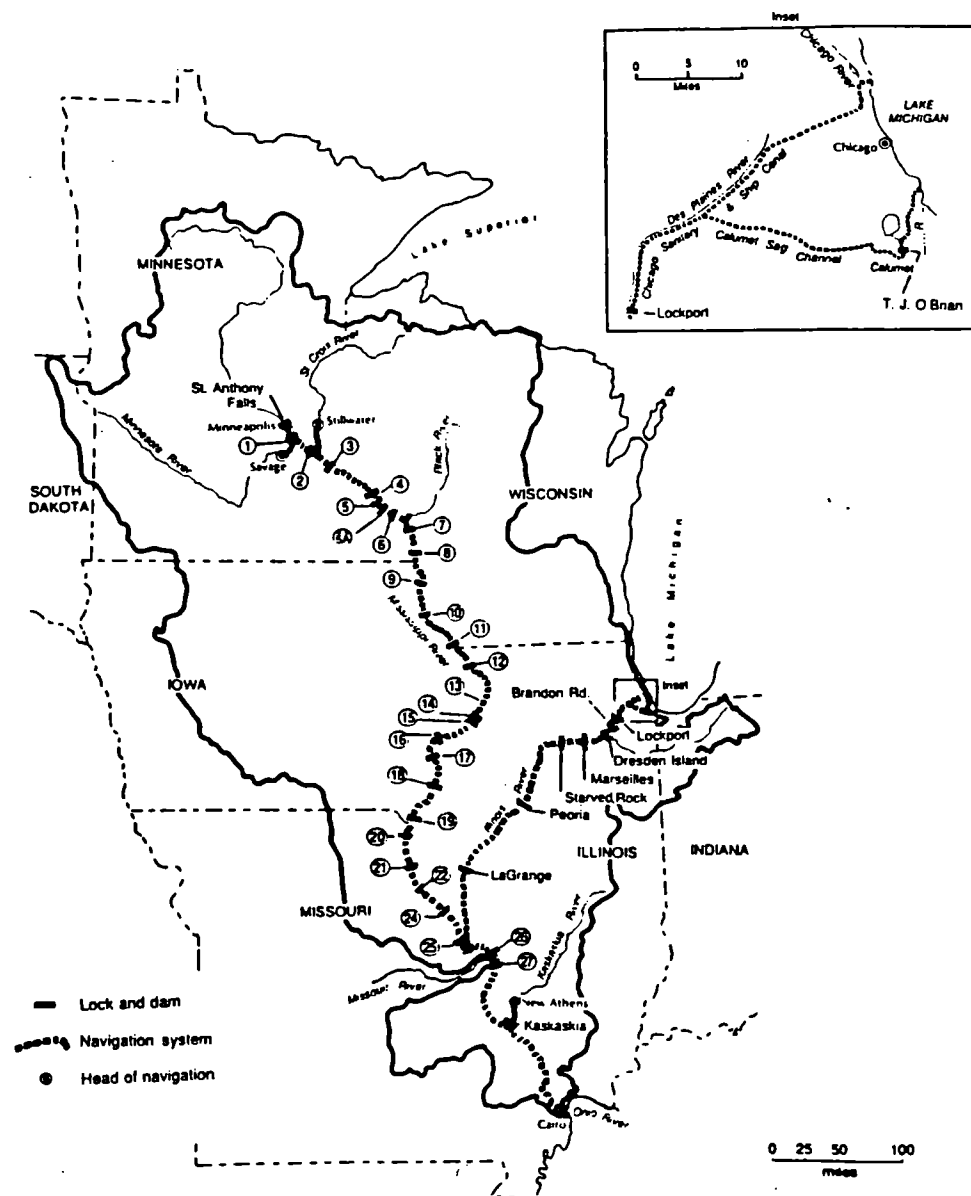
FIGURE Sketch of navigation pool with types of protection features

TYPICAL LOCK AND DAM IN THE UPPER MISSISSIPPI RIVER SYSTEM



Timetable of Navigation Development Activities

Activity	Year
Mississippi River:	
Congress authorizes removal of snags and local obstructions	1824
Congress authorizes 4½-foot channel from mouth of Missouri to St. Paul	1878
Congress authorizes 6-foot channel	1907
Construction of Lock and Dam 19	1914
Construction of Lock and Dam 1	1917
Congress authorizes 9-foot deep, 300-foot wide channel from St. Louis to Cairo	1927
Congress authorizes extension of 9-foot channel to St. Paul through construction of locks and dams	1930
Construction of 29 lock and dams	1930-1950
Construction of Lock and Dam 27	1953
Construction of 1200-foot chamber at Lock and Dam 19	1957
Illinois River:	
Congress authorizes construction of the Illinois and Michigan Canal	1822
Construction of Chicago Sanitary and Ship Canal and 5 low navigation locks and dams	1900
Construction of present day system of 7 locks and dams	1933-1939
Kaskaskia River:	
Congress authorizes navigation project	1962



Upper Mississippi River Navigation System

Over 200 sites on the Upper Mississippi River navigation system require periodic dredging, averaging 9.5 million cubic yards of material annually. In addition, about 2,400 submergent and 700 emergent wing dikes have been constructed to reduce main channel sedimentation, and 420 miles of bankline stabilization are maintained.⁷

Missouri River: A comprehensive navigation plan was authorized for the Missouri River System in 1945. This project, created using wing dikes and revetments, channelized and deepened the river's channel to a minimum of nine feet upstream to Sioux City, Iowa. Installation of the six mainstem reservoirs (in the Dakotas and Montana) for flood prevention, provide a constant water supply for navigation releases affecting over 900 miles of the river above Gavins Point. The lower 735 miles of the Missouri River consists largely of a navigation channel with associated wing dikes, channel stabilization and other erosion and sedimentation control devices. Navigation on the Missouri River is limited to the ice-free season, normally extending from April 1 to December 1. Annually target flows for navigation are established based upon available water supply that, when combined with the winter releases needed to ensure water supply requirements, and winter hydropower demands, obligates all of the available water supply during a normal year.

Flood Control Levees

Levees are earthen fills which are installed in flood plains to prevent water from damaging building, and property. Typical levee configurations have sloping sides with a flat top sufficiently wide to perform maintenance. With the settlement and economic development of the upper Mississippi and Missouri landowners were the first to construct levee to protect from inundation of flood flow. The constructed levees normally were not engineered but were pushed up into mounds. The evolution of federal interest in flood control programs resulted in USACE building some new levees or upgrading or reconstructing other levees through Congressionally approved projects. This has resulted in

a combination of federal and private levees within the basin.

FIGURE Cross section typical levee in floodplain setting

There exist no complete inventory of levees in the basin. It is estimated there are _____ miles of federally constructed levees along the upper Mississippi River, _____ miles along the middle Mississippi River, and _____ miles on the Missouri River. Nearly _____ additional miles of privately constructed levees exist along the main stem rivers and their tributaries, especially the Missouri River.⁸

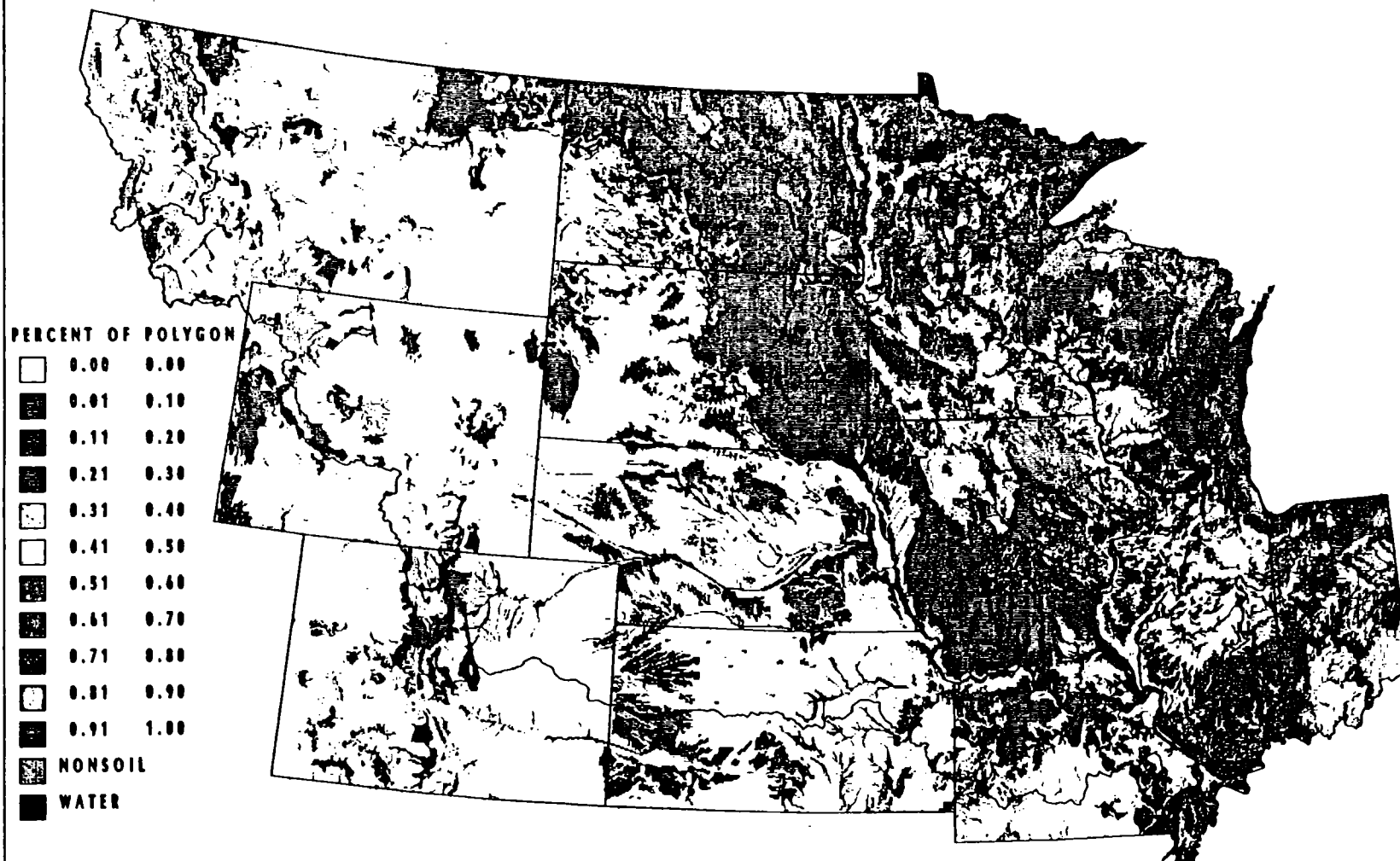
IMPACT AND EFFECT

Development within the Mississippi and Missouri basins for agriculture, flood control and navigation have changed the landscape of the basins. These changes have reflected on the characteristics of flood events and the vitality of the basin's natural resources.

Role of wetlands on flood storage

Many of the agricultural lands in the Midwest were created as the result of draining wetlands and hydric soils. One function of wetlands is their potential to store flood waters. During the committee's review, some indicated that they felt the flood would have been greatly reduced had wetlands been restored. An evaluation of the ability of the basins to store water shows that potential water storage capability in the Mississippi and Missouri basins includes 8.9% as surface ponding and 91.1% of as storage in the soil profile.⁹ Hydric soils provide good wetland indicators and a total of 10.35% of Mississippi and Missouri basin soils are classified as hydric¹⁰ (Figure).

UPPER MISSISSIPPI AND MISSOURI RIVER DRAINAGE SYSTEMS: HYDRIC SOILS



SCALE 1:12,000,000

03/18/94

STATSGO DATA, SCS

SAST

EROS DATA CENTER

Topography has a direct impact on water movement and soil formation. The upper Mississippi and Missouri basins are characterized by two distinct kinds of landscape: open systems which drain externally and closed systems where drainage is trapped within a common depository. The potential surface water storage is realized only if depressions are dry at the beginning of a flood event. Due to the extended period of rain preceding the 1993 flood, the entire area was completely saturated; therefore, storage available for additional runoff could only be found in the deep depressional areas located in the prairie pothole region of the Dakotas, Minnesota and Iowa.

Hydrologic model studies were completed with in three basins and a fourth basin was studied selectively. The three watershed used for detailed studies were selected to represent three distinct areas of the upper Mississippi River Basin. The basins were selected such that they were located within three different terrain units known as Major Land Resource Areas(MLRA's). ¹¹

Model evaluations looked at six alternatives; 1) maximizing depressional wetland storage; 2) effects of land treatment with CRP; 3) maximizing infiltration through application of land treatment measures; 4) small, single purpose flood control structures; 5) combining all runoff reduction options(1,2,and 3)and; 6) all runoff reduction options and structural control. The results of depressional storage alternative at the downstream location of the watersheds are reflected in Table ().

Table() - Percent Reduction in Flood Peak

Study	Recurrence Interval - Years			
	1	5	25	100
Redwood River	27	21	17	16
Whitebreast Creek	0.5	0.8	2	+0.2
Boone River	7	5	4	3
West Fork Cedar Creek	Wetland Storage Areas Not Possible in This Watershed			

Analysis of the watersheds indicate flood reductions are dependent upon the terrain, . In the Redwood River Watershed peak discharges were reduced quite substantially in normal moisture conditions by controlling 19% of the drainage area associated with the deep pothole area. This situation does not occur in the other watersheds modeled. In the Redwood basin, downstream peak flow impacts for the mainstem rivers and tributaries are reduced by approximately 1 percent for each 2 percent increase in drainage area available for storage.¹² This type of storage is only available in selected areas in the Dakotas, Minnesota and a in small portion of Iowa.

A State of Illinois report concluded that for certain areas of the state, peak flow decreases as a percentage of wetland areas increase in a watershed. For the small to intermediate sized watershed studied, peak flow decreased by an average of 3.7 percent for one percent increase in wetland area in the watershed. However, the application of this report is limited to watersheds that are less than 150 square miles in area. The analysis indicates that wetlands have some impact on peak flows in the smaller watersheds during smaller storms, but the impact on larger watershed during 50 or 100 year events has not been documented.

Present evaluations are inconclusive as to the exact magnitude that wetland restoration would have on peak flows; however, indications are that restoration of upland wetlands would reduce the 1 percent flood occurrence between 1-2 percent; however, for smaller and more frequent events, larger decreases of flow would occur. Based on the limited evaluations available, the committee would infer that, for a flood of the magnitude of the 1993 event, upland storage would have had only minimal effect. For lesser rainfall events, wetland storage can be important.

Role of Upland Treatment on Runoff

The watershed and its rivers are naturally integrated into a system where upstream land treatment activities affect downstream flow regimes of rivers and their floodplains. In addressing floods and floodplain management, it is important to understand where and how runoff occurs, and whether rainfall can be held where it falls. These conditions affect the quantity and quality of water and sediment which is transported during a flood event.

Factors which affect runoff are precipitation rate, soil type, land slope, available storage and land cover. In small areas, the method used to define the runoff factor is the runoff curve number (CN) which is tied to hydrologic soil groups and land cover.¹³

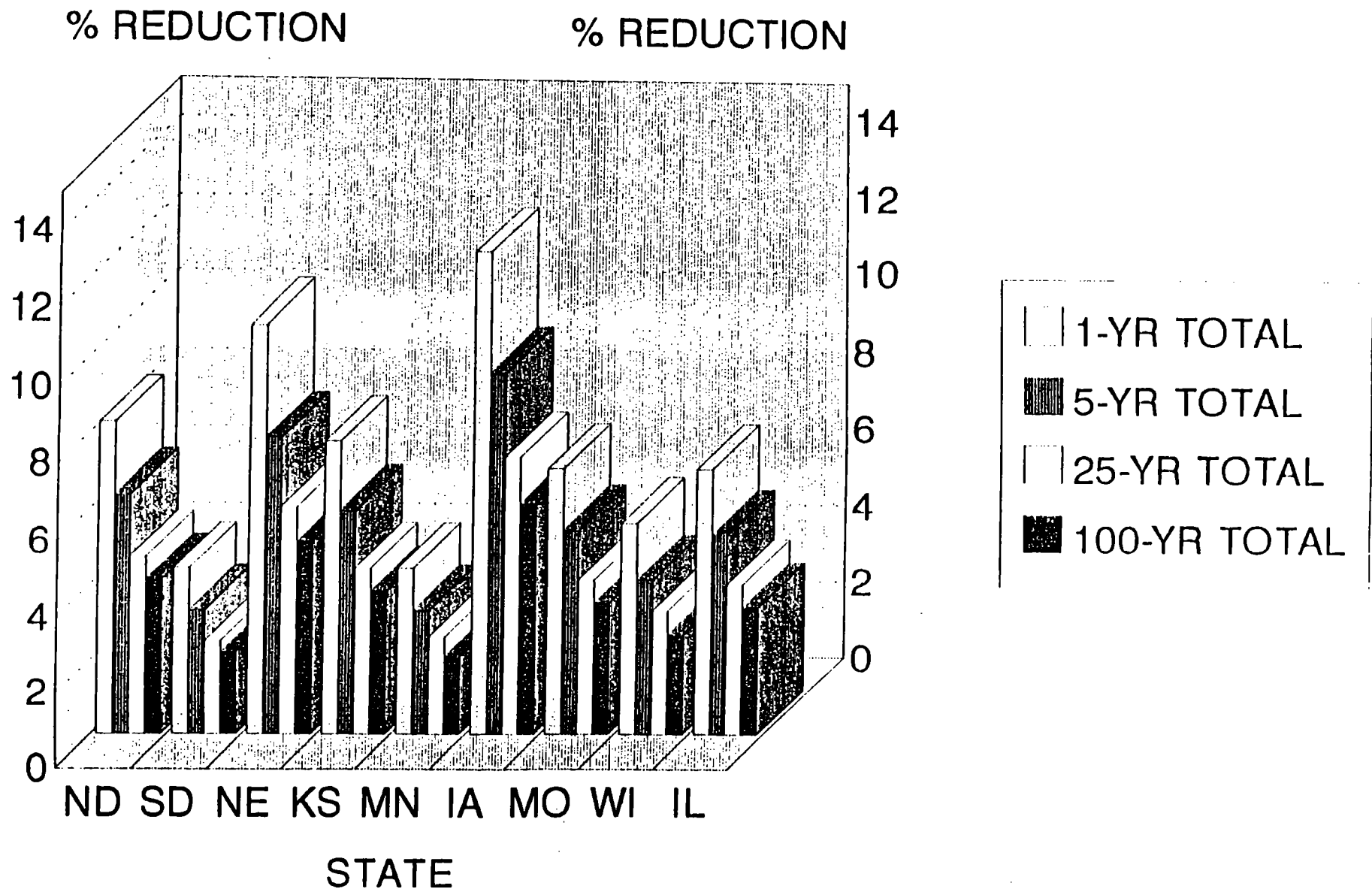
Proper management of agricultural lands requires that protected cover or conservation practices be installed. It is currently estimated that percent of the cropland in the Midwest have adequate land treatment. Conservation measures normally associated with row crop agriculture are conservation tillage, terraces, crop rotations, field borders, sediment and debris basins, strip cropping, and permanent vegetation. These practices increase infiltration rates and help hold both water and soil in place.

The 1985 Food and Security Act mandated treatment of all highly erodible land (HEL) with agreed to conservation measures to reduce erosion. The 1985 Farm Bill also established the Conservation Reserve Program (CRP) to encourage landowners to retire

highly erodible and other environmentally fragile land from crop production for ten years and reduce surplus agricultural commodity supplies. The CRP program within the upper Mississippi and lower Missouri basins converted 19,956,917 acres from cropland to grass or tree cover under 209,798 contracts at a ten year cost of \$. Converting this cropland to grass and trees has reduced the average erosion rates from 18.62 tons per acre per year to 1.38 tons per acre per year.

An evaluation of the upland HEL cropland using a normal antecedent moisture condition, revealed a reduction of runoff volume of approximately 6 to 12 percent at the 1 year event, 3 to 8 percent at the 25 year event, and 2-4 percent at the 100 year event.¹⁴ In the case of the 1993 Midwest flood, it would appear that soils were so saturated and the quantity of rainfall so great that runoff reduction became minimal. Figure ()

REDUCTIONS IN RUNOFF FROM CRP AND FSA



As CRP contracts expire, beginning in 1996, a large portion of the enrolled acres are expected to revert to cereal, row-crop, and forage production. Current estimates show that 63% of contracts expect to revert to cropland, 23% to grazing and pasture land, and the rest are expected to remain in permanent grass and trees.¹⁵ The conversion of these lands to cropland is anticipated to increase runoff from storm events even with proper conservation practices installed on the converted acres.

Role of Flood Prevention Reservoirs

The flood of 1993 clearly demonstrated that dams and reservoirs engineered and built to store and regulate the discharge of flood waters are extremely effective flood damage reduction facilities. For the 1993 flood event all federally funded flood control reservoirs operated as planned. At some facilities, such as Tuttle Creek Reservoir in Kansas, emergency spillway flows occurred when the reservoir reached capacity. All inflow quantities were transported downstream. During peak flooding (April 1 to August 1, 1993), USACE reservoirs stored 21.9 million acre-feet of flood water.¹⁶ In the Missouri basin about 18.7 million acre-feet was stored, half of which was stored in the 6 mainstem Missouri River reservoirs. The other half was stored in tributary reservoirs in the Kansas and Osage River. About 3.5 million acre-feet of water was stored in the Mississippi River Basin. The small PL-566 upland flood control reservoirs stored an additional million acre-feet of runoff waters. Damages prevented to urban and agricultural areas associated with the 1993 flood to major river floodplain developments protected by USACE projects are estimated to be \$19.1 billion.¹⁷ In the upland watershed areas protected by the damages prevented by the 316 Small Watershed Projects are estimated to be \$400 million.¹⁸

SIDEBAR: RESERVOIR OPERATIONS

The Role of Levees

Federally constructed levees (in concert with upstream flood control reservoirs) protect many large urban areas from major potential damage. For example, without levees (or floodwalls), such cities as Rock Island, Moline, Kansas City and St. Louis would have been devastated. The Mississippi River reached a crest stage of 49.6 feet on the USGS gage at St. Louis, almost 20 feet above flood stage, yet the large portion of the city protected by the wall escaped inundation. Earth City, MO. which is partly constructed in the floodplain was completely protected by its privately constructed levee. In fact, because of the flood protection levees and the flood control reservoirs, relatively little damage occurred in urban areas of St. Louis, Kansas City and other such areas,.

There has been much speculation about the effect of levees had on flood levels during the Great Flood of 1993. Most of it has been based on inferences drawn from comparisons between recent event data obtained from the modern, systematically-measured river flow (discharge) and river level (stage) record and similar data for historical floods, obtained by more crude, less accurate measurement methods. Significant differences in data quality exist between modern and historic records. In addition, myriad other changes have occurred in the watershed and along the river which influence its flow regime.

To ascertain the actual effect of the existing levees on peak stages of the Mississippi and Missouri during the 1993 flood, a mathematical hydraulic model analysis of the 1993 flood was conducted. The UNET ¹⁹model was applied to (1) the reach of the Mississippi from Hannibal, MO to Cairo, IL, (2) the reach of the Missouri from Hermann to its mouth at St Louis; and (3) the Illinois River from Meredosia, IL to its mouth above St Louis. Analysis was made using observed flow data for the 1993, 1986 and 1973 floods.

Recognizing the relative short history of the model, the limited number of reaches modelled, and possible differences in upstream conditions, one can infer that the levees did not significantly raise water levels at St Louis during either the 1993, 1986 or the 1973 floods. If all the levees (except the federal levees protecting the urban areas such as St

Louis) were removed from the floodplain, the peak stage at St Louis during the 1993 flood would have been about 3 feet lower -- still more than 16 feet above flood stage and 2.5 feet higher than the previous known maximum level recorded during the 1844 event. If the land reverted to bottomland hardwood forest, a condition that probably did not exist in the 18th Century, the peak stage at St Louis would be slightly higher than was experienced. This is attributable to the fact that the forested land would be effective for storage but would be relatively ineffective for flood waters conveyance. Farther downstream along the middle Mississippi, if the levees had been removed, there would have been a sizeable drop in river level. At Chester, IL, for example, the 1993 flood would have been 11 feet lower had there been no levees at Chester; but the region would have been under water. This reduction in river level would be completely lost (stage would be the same as observed in 1993) if the land were to revert from agriculture to dense forest. Where levees are removed, control and management of land use will be necessary to capture flood storage and conveyance values.

Erosion and Sedimentation

A great amount of erosion and deposition occurred during the 1993 flood, principally on agricultural lands. Preliminary analysis of aerial photography, satellite imagery, and historic maps of the Missouri River floodplain reveal that more than 90% of the areas affected by significant erosion and deposition are associated with breached levees that are situated in active high-energy zones of the floodplain. In most cases where levees breached, scour holes, locally known as "blow holes" or "blue holes", developed. These holes are deep (typically 25 to 50 feet) and are caused by scouring of the alluvial soils underlying the levees when the head of water on the levee suddenly surges forth through the breach with velocities similar to that of a dam break flood wave. The scoured material is then deposited onto the lands immediately downstream from the holes (Figure ().)

Locally, constricted flood flow in breaches through railway embankments and in the vicinity of railroad and highway bridges also acted to focus flood-flow energy thereby adding to the scour - sand deposition problem.

Comparison of the effects of the 1993 floods on the upper Mississippi and Missouri rivers shows that river reaches in broadly similar physiographic regions may respond very differently to floods. The annual discharge of the upper Mississippi River is generally comparable to the annual discharge of the Missouri River, but the sediment yield of the Missouri averages more than 5 times that of the upper Mississippi. Thus, the average slope of the lower Missouri River floodplain is about twice the slope of the middle Mississippi River floodplain downstream from the confluence of the two rivers. Levee breaches along the lower Missouri commonly resulted in high-velocity flows across its relatively narrow and relatively steep floodplain. These high-energy flows contributed to extensive deep scour and thick sand deposition across prime agricultural bottomlands (Figure). In contrast, levee breaches along the middle Mississippi produced less intense erosion and sedimentation, thus impacts were largely limited to passive inundation of large bottomland tracts.

FIGURE Deposition and Scour map

Navigation

to be added

Habitat Loss

The loss of wetland, riverine, bottomland and upland cover reflected in the basins ability to store rainfall and the major construction connected with navigation and flood prevention, also had significant impacts on the fish and wildlife of the basin.

Upper Mississippi River: The upper Mississippi River was originally characterized as a free flowing, alluvial riverine environment with associated riparian habitats. Construction of wing dams and installation of the slackwater navigation dams have changed the Upper Mississippi River system and has created habitat types substantially different from those found in a free flowing alluvial river.

Habitat types within the upper Mississippi River slackwater navigation project are created by coincident physical, water quality, and botanical characteristics. River position, depth, water surface area, stage and discharge, vegetation, river bottom types, water quality, and the superimposed structural elements within the river define the various habitats. Three distinct zones occur in the lock and dam pools. The upper end of each pool is in essentially the normal river condition where the water levels were not raised. In this portion marsh development is limited and the old conditions of deep sloughs and wooded islands are found. In the middle portion of the pool, impoundments backed up water over the islands and old hay meadows, spreading out over large areas of shallow water. This section has the best marsh development. Immediately above each dam the area is deep open water.

While impoundment of the upper Mississippi River with slackwater navigation dams created a wide variety of backwater and side channel habitats, these dams also slowed river currents and many backwater habitats are being filled with sediments from sediments from upland hills from erosion of agricultural lands and channel maintenance dredging. Mississippi River backwaters are important fish production and nursery habitats, and most may be lost to sedimentation and eutrophication within 50 yrs.²⁰

Downstream from its confluence with the Missouri River, the Upper Mississippi takes

on a very different character, similar to that displayed by the Missouri River (See Missouri River habitat description). Forty-six species of Upper Mississippi River Basin stream fish are listed by basin states as rare, threatened, endangered, or a species of special concern.²¹ Virtually all of these troubled species have been impacted by development for flood control and navigation.

Aquatic and terrestrial habitats of the Illinois River Valley have suffered a series of events since 1900: (1) rise in water level from water diverted from Lake Michigan, (2) the draining of more than half of the 400,000 acre floodplain through the construction of levees and pumping stations, (3) third an upsurge in untreated urban and industrial pollution during the 1920's, (4) the creation of a 9 ft. channel and its attendant navigation dams in the 1930's, and (5) an acceleration in sedimentation rates following World War II, apparently resulting from an increase in the amount of open row crops grown within the basin.²² As an example, in 1908, a 200-mile reach of the Illinois River produced 10 percent of the total U.S. catch of freshwater fish (employing 2,000 commercial fishermen and yielding 24 million lbs of fish annually). Commercial fish yield totalled about 178 lbs/ac of permanent water, but by the 1950's yield had dropped to 38 lbs/ac and by the 1970's to 4 lbs/ac, totaling 0.32 percent of the total U.S. freshwater harvest.²³

Missouri River: The Missouri River has always been known for its swift, muddy flows and meandering nature. The floodplain of the lower Missouri River is underlain by alluvial sediments, typically 60 to 80 ft thick, that are composed primarily of highly permeable sand with intermixed gravels. Less permeable silt and clay typically dominate the uppermost 7 to 16 ft. The early floodplain was a ribbon of islands, chutes, oxbow lakes, backwaters, marshes, grasslands and forests. Sandbars and wooded islands dotted the channel. In the 20th Century, the Missouri River was channelized for navigation and six upstream dams were installed to provide flood control and to augment flow for the navigation channel. Human and natural changes to the river between September 1879 and conditions as they existed in 1954 have (1) shortened the river by 45.6 miles, (2) reduced river surface

area by 50,588 acres, (3) reduced the number of islands from 161 (24,419 acres) to 18 (419 acres), and (4) transferred nearly 67,000 acres of river habitat from public to private ownership and converted it to agricultural use.²⁴

Nearly one-third of the Missouri River has been impounded, one-third channelized, and the hydrologic cycle, including temporal flow volume and sediment transport, has been altered on the remainder. The changes in basin and floodplain physiography and channel morphology have reduced commercial fish harvest by more than 80 percent and are implicated in the demise of native species. The natural riparian vegetation of the Missouri River ecosystem has been nearly eliminated, presently consisting of a single row of trees. A decline in floodplain forest coverage in the lower Missouri River from 76 percent in 1826 to 13 percent in 1972 occurred while cultivated land increased from 18 percent to 83 percent. Thirty-four species of Missouri River Basin stream fish are listed by basin states as rare, threatened, endangered, or a species of special concern.²⁵ The pallid sturgeon (endangered), piping plover (endangered), least tern (endangered), and bald eagle (endangered) are all native Missouri River species and listed by the U.S. Fish & Wildlife Service.²⁶

Population densities of five species of chubs (sturgeon chub, sicklefin chub, flathead chub, silver chub, and speckled chub) and two species of minnows (plains minnow and silvery minnow) have been reduced by as much as 95 percent since 1971. Burbot have been nearly extirpated, sauger have been greatly reduced, and blue catfish are rare.

The precontrol Missouri River carried peak run-off during two periods, March-April and June. Prior to 1954, flushing flows, known as dominant discharge, occurred every 1.5 years. The river was in a state of equilibrium; net sediment entering a reach replaced an equal amount leaving. Sand, silt, and organic matter were raw materials for habitat development, and aquatic nutrition. Loss of sediment load led to channel degradation which has contributed to the loss of off-channel habitat and has furthered the severance of the floodplain-channel connection. Since the early 1950's the Missouri River has been deprived of a floodplain. Water temperature, photoperiod, and run-off cues altered by the dams have also disrupted spawning of sauger, sturgeon, blue suckers and other species.²⁷

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Chapter 3

FUTURE FLOOD POTENTIAL

WHAT IS A 100-YEAR FLOOD EVENT?

A 100-year flood is one that has a one percent chance of being equaled or exceeded in any given year. It has a 26 percent chance of occurring over the life of a 30-year mortgage, and a 63 percent chance of occurring over the next 100 years. The point is that floods are random events. Through frequency analysis, they can be characterized as a 100-year flood or 500-year flood, etc. However, no one -- especially those living at risk in floodplains, should ever be misled to believe that a 100-year flood is one that will occur only once every 100 years.

SIDEBAR: MARBLES (1/100, MAYBE 2 OR 3) At one of the public meetings attended by members of this committee, a young farmer from Missouri accurately provided his own explanation of the possibility of experiencing a 100-year flood. He described a bag full of 100 marbles, 99 clear marbles, one black marble. Every time you pull one of those marbles out and it's black, you've got a 100-year flood. After each flood, you put all 100 marbles back in the bag and shake it up. It's possible that you could pull the black one out two or even three times in a row. It's also possible that there could be two or three black marbles in the bag.

There are uncertainties associated with the 100-year discharge and elevation, and mapping the 100-year floodplain boundary is at best an imperfect science. Estimates of the 100-year flood discharge (or flowrate), can be based on a wide range of techniques. Current techniques provide estimates that could be off as much as 5-45 percent.¹ Factors such the as

size of the watershed, the availability and the length of stream gaging records, and the level of detail of mapping for use in determining model parameters, contribute to uncertainty in a 100-year flood discharge estimate. Even if a fairly accurate 100-year discharge is determined, it may change due to land use changes in the watershed, and natural and man-made changes to the channel and floodplain.

Once a discharge is determined, this discharge is entered into a hydraulic model to determine the elevation of the 100-year flood. Hydraulic models, if given accurate input information on topography, friction losses, and hydrology, will produce estimates of 100-year flood elevations within 0.5 foot.²

After the elevation of the 100-year flood has been determined, the extent of the floodplain can be mapped. Topographic maps vary in precision and level of detail.

The accuracy of the floodplain boundary line is most strongly influenced by the quality of the 100-year flood discharge estimate. The next most significant factor is the quality of the topographic mapping. Research suggests that the probable nationwide standard error for base flood elevation mapping is 23 percent of the base flood depth. This value, translated into an average depth, amounts to about 3 feet.³ Thus, the floodplain boundary line shown on a map is not absolute, and structures located within several feet (vertically) of the 100-year floodplain are still at risk. For flat areas, structures located within several hundred feet (horizontally) of the 100-year floodplain may be at risk.

SIDEBAR: WHAT IS A FLOODPLAIN? The term floodplain refers to all of the land adjacent to a river channel that can be inundated by large floods. During the 1993 flood, floodplains along the Upper Mississippi and Missouri Rivers were inundated when the river stage exceeded the design elevations of flood-control levees or when the levees failed; and more than 90 percent of the total floodplain area was inundated.

THE POTENTIAL FOR FLOODS IN THE FUTURE

Current flood records are limited by their length. In addition, not all state and local governments regulate stormwater runoff, and the volume of runoff can be expected to increase in the future, as lands are paved over for shopping centers, new streets are installed for residential development, and the like. As more years of flood records become available, today's estimates of flood discharge, volume, stage and duration will change. There is no question that flooding will occur in the future. The open questions are when? where? and how much?

SIDEBAR: CLIMATE CHANGE Climate change could increase flood risk. Although considerable uncertainty exists, climate change could bring about more-frequent and/or more intense floods. Given that development in and near floodplains is expected to last a considerable period of time and that the nation's ability to predict the magnitude and frequency of future events is still limited, it may be prudent to consider the potential effects of climate change when decisions are made (or revised) about the type and amount of development allowed in vulnerable areas. In the absence of sufficient data, flexible and cautious policies are preferred.

Office of Technology Assessment
"Preparing for an Uncertain Climate"

THE RESIDUAL RISK FOR THOSE IN THE FLOODPLAIN BEHIND LEVEES

Residual risk exists in all areas within the natural floodplain -- both areas protected by channel modifications, dams, or levees, and areas outside the 100-year floodplain. Levees

built to provide a 100-year level of protection modify the natural overflow boundary of the 100-year floodplain and lesser events so that individuals and businesses remaining in what was once the 100-year floodplain, currently have no residual requirement to carry flood insurance even though there is a 1 in 4 chance of the 100-year flood occurring in the next 30 years. Areas protected by levees are considered "safe," yet the potential for catastrophic loss still exists. If the levee is overtopped, floodwaters in the protected area could reach depths of 10 feet or more.

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Chapter 4

ORGANIZE FLOODPLAIN MANAGEMENT EFFORT FOR SUCCESS

The need exists to improve the collective floodplain management efforts of federal, state, tribal and local governments, individuals, and the private sector in the use of the regionally and nationally significant assets associated with watersheds and associated floodplains in a manner that will reduce risk, achieve economic efficiency and enhance natural values. The existing floodplain management infrastructure has both the capability and responsibility to influence development in floodplain and recovery from floods. At issue is the appropriate distribution of responsibility across governments. Definition of governmental responsibilities empowers action and creates accountability.

DEFINE FEDERAL/STATE-TRIBAL/LOCAL RELATIONSHIPS AND RESPONSIBILITIES

The strengths of the federal government -- nationwide experience; ability to examine issues from a national, inter-state and a systems perspective; and, multi-disciplinary technical expertise -- should guide strategic decisions regarding its obligations and duties. However, since the Water Resources Council ceased operations, non-judicial activities of the federal government have offered little leadership in the resolution of interstate water resources issues. Because floodplain management is essentially land-use control, a responsibility of state, tribal, and local entities, the federal responsibility rests primarily with providing

leadership, data and advice to assist states' pursuit of sound floodplain management, coordinating interstate flows while promoting and assuring interstate commerce, stable agricultural production, national economic development, and national environmental quality including enhancement of human environmental quality.

The structure for intergovernmental relationships needs improvement. Responsibility and accountability need to be established at each tier of government and linked to assure compatibility and acceptability of decisions within a larger system framework. In some states, planning and regulation of floodplain use is limited. In others there are strong programs and the success of these programs was reflected in the minimization of damages during the flood of 1993. Appendix --- summarizes state floodplain management programs. The National Flood Insurance Program (NFIP) provides an example where federal/state/local relationships with better commitment enhanced floodplain management goals. Yearly, FEMA provides \$4 million to states to allow them to provide technical assistance to communities and to monitor community compliance with the NFIP. Where states are actively involved in floodplain management, the NFIP program is most effective. However, the NFIP is only one aspect of floodplain management.

Action: Enact a national Floodplain Management Act to define governmental responsibilities, strengthen federal-state coordination and assure accountability.

The Administration should propose enactment of a Floodplain Management Act, paralleling the intent, design, and key features of the Coastal Zone Management Act (CZMA), as amended.¹ A Floodplain Management Act would set national goals for floodplain management, define governmental responsibilities and empower state and local entities to develop and implement floodplain management plans. It would assign primary responsibility for floodplain management responsibility to the states and provide federal assistance to them for development and implementation of floodplain management programs. This legislation would provide a structure for governmental accountability and lead to

creation of a functional and conceptual state position on floodplain management that meets minimum federal standards. The Act would have to authorize funds to provide states with resources necessary to build and institute an effective floodplain management program; funds appropriation would require Congressional action. The Act would require federal activities affecting floodplains to assure that those activities are consistent, to the maximum extent practicable, with federally-approved state programs; this would strengthen the state leadership function.

IMPROVEMENTS IN FEDERAL COORDINATION EFFICIENCY AND FEDERAL-STATE PLANNING

The 1965 federal Water Resource Planning Act (PL 89-80) established the US Water Resources Council (WRC), authorized creation of federal-state river basin commissions, including Upper Mississippi and Missouri River Basin Commissions, and financial assistance to states for water planning.² The individual river basin commissions produced comprehensive, coordinated plans for water and related land resources which were advisory to federal, state, and local authorities. The Upper Mississippi and Missouri River Basin Commissions were abolished, along with federal funding, in 1981; the WRC ceased its operations shortly thereafter.³ Lost with the WRC funding was its interagency coordination, technology transfer, and data and information functions. Along the Upper Mississippi and Missouri Rivers several interstate organizations have evolved to fill, in part, the gap left by the demise of the river basin commissions in 1981.⁴ Federal agencies participate, as non-voting members, in the Upper Mississippi River Basin Association (which includes representatives of the Governors of five mid-western states) and the Missouri River Basin Association (which represents 9) states. A mechanism to facilitate enhanced federal presence among these groups is needed.⁵

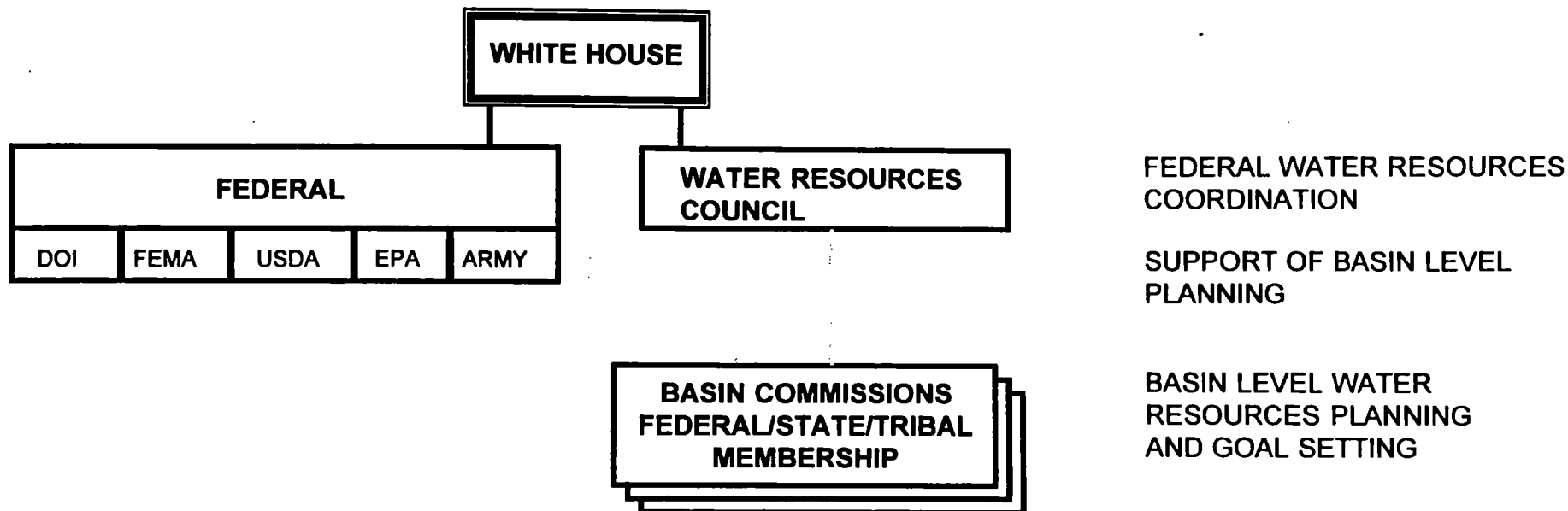
Action: *Revitalize the Water Resources Council*

Immediate revitalization of the WRC would launch and promote cooperation among the federal agencies and the states. The WRC would serve to align federal floodplain management goals with other broad National goals; provide a single point of focus to assist coordination and resolution of interstate water resource management issues; serve as an innovative planning and technology center (including intergovernmental data gathering and dissemination activities); and resolve federal agency disputes. The Secretary of the Interior, as current chairman of the WRC, should request that the Administrators of EPA and FEMA become full-time participants on the Council. Figure --- demonstrates the proposed system of relationships.

Action: *Re-establish River Basin Commissions*

The President should establish river basin commissions to provide a forum for coordinated federal and state planning across the basin and within sub-basins (as determined appropriate). The WRC should, in coordination with states, define areas, river basins, or group of related river basins for commissions. Each river basin commission would serve as the principle agency for the coordination of federal, state, interstate, local, and non-governmental plans for their designated areas and other activities pursuant to Title II of the Water Resources Planning Act of 1965.

PROPOSED INSTITUTIONAL FRAMEWORK



FEDERAL ACTIONS IN THE FLOODPLAIN - SETTING AN EXAMPLE

In 1978, with issuance of Executive Order (EO) 11988, Floodplain Management, President Carter successfully raised federal agency attention to issues of floodplain use.⁶ However, with time it is apparent that some federal agencies either are unaware of or misunderstand the requirements of the EO either by building, or supporting building, in floodplains. All federal activities in floodplains are not violative of the EO; however, the EO requires federal agencies to demonstrate that no practicable alternative site exists outside of the floodplain. If this can be demonstrated, then the federal agency must take steps to minimize direct and indirect impacts of the proposed action, restore and preserve the floodplain. Committee visits to the Midwest and discussions with the FEMA, USACE, and state floodplain managers revealed several examples which indicate that agencies seem to have failed to comply with the EO. Among the most notable examples encountered by the Task Force were a low income housing funded by Housing and Urban Development (HUD) and a federally-funded state prison within floodplains, and proposed construction of a federal weather station behind an uncertified levee. As indicated by the Association of State Floodplain Managers, such federal activities also occur nationwide. These type of activities lessen the moral authority of the federal government and its capacity to assume leadership in floodplain management.

The EO requires that federal agencies with responsibility for federal real property and facilities in the floodplain comply with National Environmental Policy Act (NEPA) requirements and the construction standards of the National Flood Insurance Program. Often, however, the task of evaluating cumulative, direct and indirect impacts and risks associated with individual projects within a floodplain require scientific and technical expertise beyond the capable of a single reviewer and, often, beyond the capacity of a single agency.

The EO does not explicitly recognize that certain federal actions or activities are critical to the health and welfare of floodplain inhabitants. The 1993 Midwest floods demonstrated the vulnerability of infrastructure upon which critical health, public safety, region-wide economic activity and environmental protection depend. The extended closure of transportation systems, pipelines, dispersal of hazardous materials and power outages demonstrates the widespread impact which destruction or disruption of critical infrastructure can have on a community or region. The current definition of critical actions contained in the EO's Guidelines, "those for which even a slight chance of flooding would be too great", suggests that critical actions not be undertaken in any area subject to flooding of greater than 500 year frequency. The guidelines fail to recognize the flood events differ in frequency, duration and type.⁷

The EO applies to federal agency activities including acquiring, managing and disposing lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and, conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.⁸ However, federal programs that are delegated or assumed by states, may fall outside the EO. Examples of the latter are state revolving funds authorized by EPA and RDA. Thus, these federal funds may directly or indirectly effect development in floodplains which is inconsistent with the intent of the EO.

To the extent that the federal government undertakes activities that induce development, it weakens the effectiveness of existing local or state floodplain management regulations and creates pressure on local governments to relax their regulations. Conversely, an active federal program to undertake activities outside the floodplain sets an example and encourages state and local program establishment and implementation. A number of states and communities have enacted floodplain management regulations, some of which are more stringent than those issued by FEMA.⁹ The EO does not explicitly recognize the existence of local or state floodplain regulations or the effect federal actions may have on them. Neither is there any requirement for agencies to consult with state floodplain managers concerning

floodplain activities. Federal leadership in floodplain management requires an adjustment in the manner in which that Federal activities in the floodplain are undertaken.

The federal government also leases some of its property in floodplains. In St. Charles, Missouri, 13 percent of the repetitive NFIP claims are from properties on land leased from the federal government.¹⁰ These leases appear to contradict the EO's mandate that the government "take action to reduce the risk of flood loss to minimize the impact of floods on human safety, health, and welfare"; however, Congressional action has extended the leases.

Action: Issue a new Executive Order to reaffirm the federal government's commitment to floodplain management and expand its scope.

By addressing the scope of activities, particularly critical infrastructure, reflecting uncertainties of scientific information, stating the economic policy implications of floodplain development, and requiring an interagency consultative process, the EO will reaffirm the federal commitment to floodplain management. Requiring federal activities to comply with state and local regulations, when more stringent than national standards, will affirm the state's role as floodplain manager. Revision will also require each agency to prepare new implementing guidelines for activities potentially occurring in or affecting floodplains and increase agency awareness of the issue, and allow agencies to address issues unique to their programs.

Action: Seek revision of the Water Resources Development Act of 1986

The Administration should seek revision of Section 1134, which forced continuation of leases of federal lands, to allow the federal government to provide floodplain management

leadership by taking action to reduce the risk of flood loss and minimize the impact of floods on human safety.

STATES LEAD THE WAY

The state is the entity most familiar with all the watershed and floodplain activities occurring within its borders. There is need for greater involvement on the part of states to set priorities, adjudicate intrastate issues regarding priorities and impacts of floodplain management projects, and to broker federal assistance. Active involvement by the states is necessary to package flood reduction projects within the context of multiple floodplain and watershed management goals and other state natural resource and economic goals. Currently, state involvement in locally sponsored flood reduction projects is highly variable ranging from requiring approval of the Governor at the end of project planning to multiple agency collaborative commitment throughout project planning. There are many areas where state level leadership and coordination is vital: flood fighting, repair activities, buy-outs, hazard mitigation, and permitting of levees and other structures which impact beyond the local area. State involvement, as a manager of levee programs, should be increased. Prior to the flood, states took no cognisance of the fact that many levees had been dropped from the USACE program. Greater involvement on the part of state governments in coordinating flood fight activities to ensure that they do not harm other parties, are focused to ensure greatest public benefit, and have no long-term adverse effect on floodplain management is required. During the Midwest flooding, many federal flood fight activities essentially were conducted directly with the local levee districts. Several midwestern communities noted that because they did not belong to a levee district that offered some level of protection, they were not involved in levee maintenance or flood fight decisions. State involvement could have provided an opportunity to raise community issues to the attention of federal officials. State involvement in coordinating levee repairs needs to be enhanced. In addition, in most

cases, because the states did not assume an active role, the USACE's and USDA's levee repair programs were put in a position of working directly with local entities. An example of more appropriate state involvement is the PL 566 watershed program wherein each Governor makes recommendations and set priorities for local watershed activities proposed for the program.

Increasing state involvement necessitates greater state technical capabilities in floodplain management. However, currently there exist few incentives for the state to build this expertise. The federal government provides technical assistance directly to individuals and/or local entities (including states) through the FEMA's community assistance program, USACEs' Floodplain Management Services and Planning Assistance Programs, and the Soil Conservation Service's PL-566 Program. Provision of technical assistance directly to individuals and local communities does not build and, in fact, detracts from the state's capabilities. The Tennessee Valley Authority, in a self review to increase customer service, determined that provision of assistance directly to individuals was not the most efficient use of federal resources and decided to focus its assistance onto states.¹¹

Action: *Increase the state role in all floodplain management activities including, but not limited to, flood fighting, recovery, hazard mitigation, buy-out, and floodplain regulation, zoning, enforcement, and planning.*

Increasing the state role in what are now primarily federal-local relationships is necessary. This could be accomplished for all federally-assisted/funded flood fight, repair and recovery activities, flood damage reduction activities and other floodplain activities by: 1) state sponsorship in lieu of local sponsorship or 2) prior state approval.

Action: *Restructure, refine the scope, and increase funding for federal technical services programs.*

By altering the focus of federal floodplain management technical and planning assistance programs from individual and local assistance to assistance to states for coordinated dispersal to local areas creates an incentive for states to build these types of expertise. Use of the federal government for information transfer and training to the states for subsequent transmittal to local governments is a far more efficient use of federal expertise and limited federal funds because the same information reaches and effects more people.

Action: Increase General Investigations funding for the Corps and TVA in the areas of Floodplain Management Services and Planning Assistance to the States programs.

In its most recent testimony to Congress, the Association of State Floodplain Managers indicated that funding for floodplain management services and planning assistance to states is not sufficient to provide dissemination of critical data necessary to support sound floodplain management decisions at the local level and other necessary planning assistance to the states. This viewpoint has been echoed by other state officials as well. There are far more requests for assistance than can be accommodated given the current funding constraints. The inability to provide assistance in some situations can lead to inappropriate floodplain development decisions. Additional funding would allow these agencies to provide and analyze pertinent data necessary to make sound floodplain management decisions at the state and local level.

LIMITED STATE/LOCAL STAKE IN FLOODPLAIN MANAGEMENT

Disaster specific changes in federal/non-federal cost-share percentages (from 75/25 to 90/10) for FEMA disaster assistance programs may have an adverse effect on floodplain

management. Due to the series of recent disasters affecting large geographic areas or dense population centers (i.e., Hurricane Andrew, Midwest flooding, and Northridge earthquake), non-federal cost-sharing was decreased to respond to state and local financial constraints. This change in the level of cost share has two potentially significant consequences. First, it sets up an expectation of equal treatment in subsequent disasters and increases political pressure to pursue lower non-federal share. This perpetuates the dominant federal recovery responsibility and increases the federal costs. Second, it may defeat the fundamental purpose behind cost-sharing which is to increase the amount of local involvement, responsibility, and accountability. By lessening the non-federal investment, the state/locals have less at stake and, therefore, may have less reason to seize opportunities for more sound floodplain management.

Sidebar: In July 1993 the Des Moines Water Works was inundated and put out of commission for three weeks. The damage totalled \$12.3 million, \$9.9 million of which was covered by private insurance previously obtained by the water works. This resulted in minimizing federal costs to \$2.0 million dollars. Although the insurance carrier subsequently cancelled their insurance, the water works was able to acquire new insurance after increasing the height of its existing flood protection and agreeing to other flood proofing measures and obtaining the maximum NFIP coverage available. The new premium of \$45,000/year purchased \$10 million of insurance.

Community consequences for choosing not to participate in the NFIP are limited because FEMA's disaster assistance pays for damages to all public (i.e., community) facilities and infrastructure, except for buildings, regardless of whether the community is participating in NFIP. Therefore, in non-participating communities the individual citizens suffer the consequences by not being eligible for flood insurance and individual/family assistance related to the repair of buildings, while the community itself suffers lesser consequences. Similarly, there exist few, if any, incentives for communities to seek private insurance for damages to community facilities; rather, most communities rely solely on FEMA to provide reparation. This is inconsistent with the philosophy that federal disaster assistance should be provided in situations where communities and states do not have the

capability to recover on their own due to the magnitude of damages.

Action: *Retain non-federal cost share at the 25% level.*

By retaining the cost-sharing for flood fight, mitigation and disaster recovery at 75/25 (federal/non-federal) as the basic cost share amount, non-federal investments will remain sufficiently significant to serve as an incentive for non-federal interests to pursue means to protect those investments through more effective floodplain management.

Action: *Limit public assistance grants to communities not participating in the NFIP.*

Additional incentives for communities to participate in the NFIP would be created by limiting the amount of public assistance given to non-NFIP communities to rescue and emergency operations.

Action: *Require communities to obtain private insurance for its public facilities as a prerequisite to receiving public assistance.*

The federal government should require a community desiring public assistance, to demonstrate that it had done all it could to secure private insurance for its facilities. This would help to increase community responsibility and accountability and would reduce the federal tax-payer burden associated with risky behavior in floodplain.

Funding infrastructure repair

Many communities do not budget sufficiently for maintenance and upgrading

infrastructure for flood protection and flood damage control. By not planning and funding for periodic maintenance of pumps or sewage systems, communities set themselves up for significant damage (e.g., resulting from poor interior drainage), then FEMA public assistance pays for replacing these facilities. When improperly maintained or constructed, public facilities and infrastructure are not only susceptible to flood damages, but also can cause increased damages in adjoining properties; this, in turn, increases federal disaster payments but does not disadvantage the community. Communities that have allowed deterioration of public infrastructure that fails, is damaged, or destroyed by a flood event, may benefit from FEMA public assistance grants. When a public facility or structure fails, is damaged or destroyed by flooding, FEMA attempts to determine the degree to which lack of local/state maintenance contributed to that failure, damage, or destruction and then reflects that by decreasing the grant amount. When such determination cannot be made, FEMA by necessity does not alter the grant amount. Whether FEMA pays for upgrades to damaged infrastructure necessitated by federal, state, or local requirements (i.e., substandard infrastructure) depends on the nature of the infrastructure (e.g., FEMA does not pay for bringing a wastewater treatment plant into compliance with water quality standards, unless the flooding event created an increased need for additional treatment).

Action: *Limit the use of grants and increase the use of loans for infrastructure repair, particularly upgrades.*

FEMA's provision of loans in lieu of grants would transfer more responsibility to local/state governments to budget for maintenance rather than using disaster assistance programs to pay for facility failures, damage, or destruction because there is a community cost associated with loans (as opposed to grants). Use of loans for upgrades also increases non-federal investment and should, therefore, increase maintenance responsibilities.

SIDEBAR: The Fiscal Realities of Disaster Funding

ENDNOTES

1. P.L. 92-583. Key features of the Coastal Zone Management Act are described in Appendix ____.
2. Water Resources Planning Act (79 Stat. 244, 42 USC 1962) PL 89-80, 22 July 1965.
3. Executive Order 12319 -- River Basin Commissions. September 9, 1981.
4. Executive Order 12319 -- River basin commissions.
5. National Fish and Wildlife Federation. Mississippi River Initiative Part II: After the Flood. March 1994.
6. For example, see Federal Interagency Floodplain Management Task Force, Floodplain Management in the United States: An Assessment Report, 1992.
- 7.43 F.R. 6030, Part II, Step 1., Section 1.c.
8. Ibid
- 9.
10. Personal Communication with Larry Zensinger, Director, Mitigation Directorate.
11. Personal Communication with Barbara A. Miller, Manager, Flood Risk Reduction, Tennessee Valley Authority, February 22, 1994

Chapter 5

DEAL WITH THE MISSISSIPPI/MISSOURI BASINS ON AN INTEGRATED HYDROLOGIC/ HYDRAULIC SYSTEM AND ECOSYSTEM BASIS

The Missouri River and Mississippi River above Cairo, Illinois, are affected by a complex of independently managed Federal programs for navigation, flood control, natural resources, and agricultural production. In order to assure coordinated and sustainable water resources development, consistent with national floodplain management goals, these programs should be integrated using existing and/or modified institutional arrangements between Federal agencies.

DEAL WITH THE MISSISSIPPI BASIN SYSTEM AS A WHOLE

Currently, no single entity has federal or federal-state oversight responsibility for this range of activities within either basin, or for ensuring commensurate fiscal attention and performance among programs. The Committee has found that for either basin, there is no single hydraulic or hydrologic model, no systemic flood reduction strategy, and no ecosystem management strategy in place. While it is clear to the Committee that linkage exists among system components, federal agencies are dealing with component problems independently.

With the demise of the river basin planning institution embodied in PL 89-80 (Water Resources Planning Act of 1965) , the coordinated basin scale approach declined in importance in American water resources planning in favor of more generic and place-specific solutions despite the National Environmental Policy Act's (NEPA) tenets for direct, indirect, and cumulative impact analysis and integration of regional federal actions^{1,2}. The result is exemplified by the number of separate activities currently underway, such as the Missouri River Master Manual Review and Update, the Upper Mississippi River-Illinois Waterway Navigation Study, the Floodplain Management Assessment, and the Missouri River Mitigation Project, and the Upper Mississippi River Environmental Management Program, and numerous USACE studies directed at improving or building individual levee projects in the basin.

System-wide, coordinated, and integrated management of the Mississippi River ecosystem is not currently a defined objective of any agency, nor is such an approach a part of agency operational plans at the regional or local levels³. Although several federal agencies have complementary goals⁴ and the National Environmental Policy⁵ establishes a common environmental goal for all federal agencies, no single agency serves as the necessary focal point for ecosystem protection needs in ongoing water management decisions.⁶ Separate government programs address land use, nonpoint source pollution, major point sources, wetlands, and a host of other environmental concerns. Failure to integrate such programs makes it difficult for land and water managers to achieve their goals⁷.

The Committee considers that two levels of activity are required: One, a strategic level that results in development of comprehensive plans for water and related land resource development - this is embodied in the authorities of the Basin Commissions established under Title II of the Water Resources Planning Act of 1965 PL 89-80; and two, an operational, or program implementation level such as that of the Mississippi River Commission, but with an expanded focus to include stewardship of the ecosystem which supports current and desired levels of development.

At the strategic level, utilization of a regional institutional framework for

comprehensive planning was exemplified by the Upper Mississippi River Basin Commission (UMRBC). The UMRBC prepared a Comprehensive Master Plan for the Management of the Upper Mississippi River System in response to Section 101 of the Inland Waterways Authorization Act of 1978 (PL 95-502). Although termination of the 6 Basin Commissions (EO 12319, 1981) established by PL 89-80 complicated implementation of the Master Plan, the Master Plan represented a successfully integrated federal, state, and local planning effort with substantial public input. PL 99-88 and PL 99-662 ultimately authorized implementation of portions of the Master Plan, with an Environmental Management Program with federal and state agency input to the USACE through the Upper Mississippi River Basin Association (UMRBA). The UMRBA evolved from the Basin Commission framework and continues through state commitment to the collaborative planning process. The UMRBA has no authority for plan implementation, and is basically a policy research and coordination forum for the UMR states. Because the UMRBA is a state initiative, the federal government has no voice in planning activities.

Action: Establish Missouri and Mississippi River Basin Commissions with a charge to update and maintain comprehensive strategic management plans that include ecosystem management, flood damage reduction, and navigation needs.

By reestablishing the Basin Commissions, it is anticipated that fully coordinated floodplain management decisions will be reached within the larger context of basin-level water resources planning and goal setting. The authorities and funding mechanisms provided by PL 89-80 will stimulate non-Federal attention to timely completion, update, and implementation of multiple-use plans. Reference Figure 5 - 1, Proposed Institutional Framework,

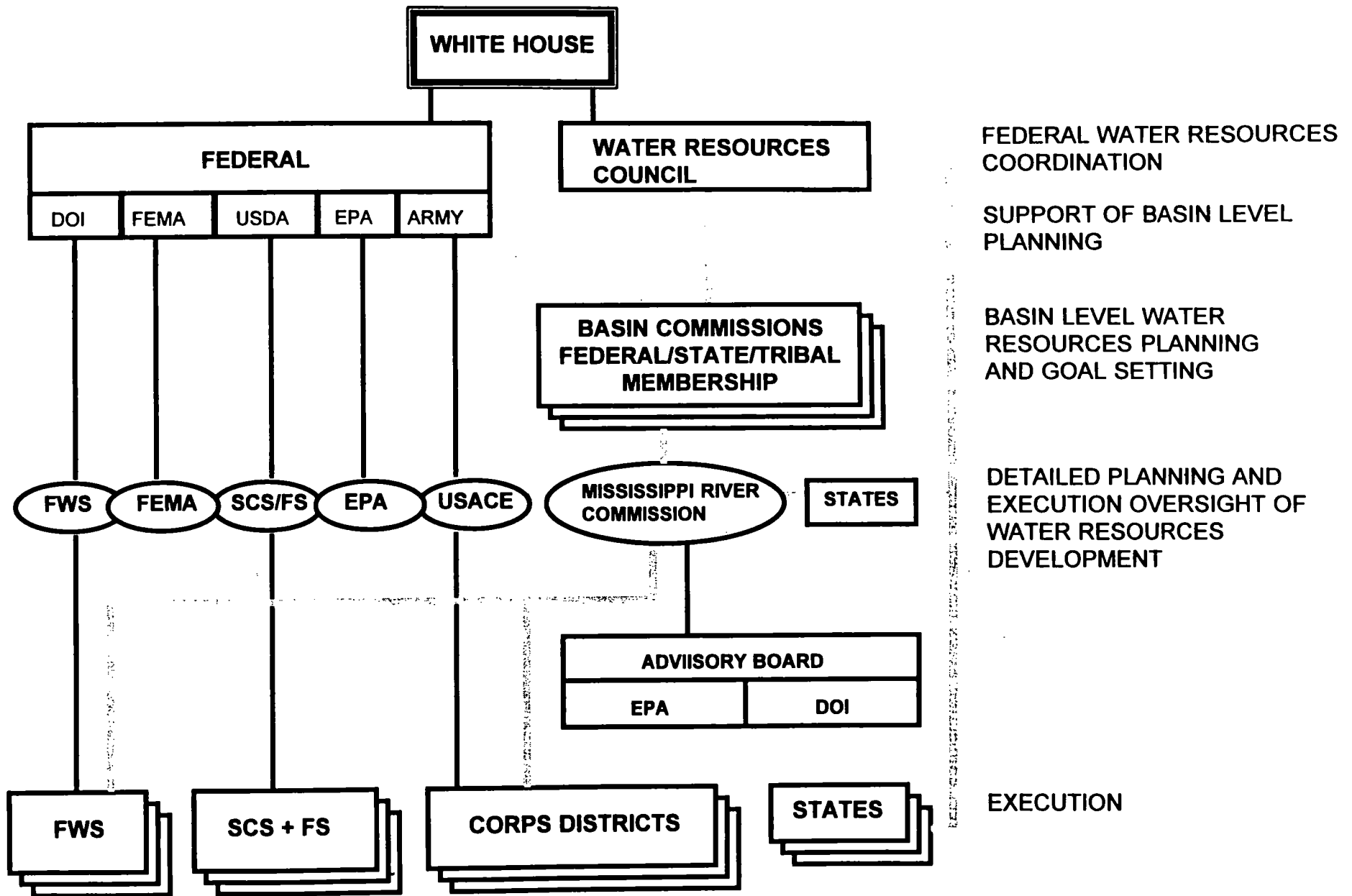
At the operational level, an institutional framework is currently in place via the USACE to effect operational modifications of flood control and navigation facilities

throughout the basin. The foundation of this framework is the extensive technical capability that the USACE brings to bear on water resource projects. Beyond this technical capability, Congress provided for detailed project planning and implementation oversight on the lower Mississippi by establishing the Mississippi River Commission. This Commission reports program performance directly to the Chief of Engineers and the White House. No similar framework or technical foundation is in place within one agency or between agencies responsible for natural resource protection or management within the basin. Importantly, no direct connection exists between natural resource management, and management of the river and floodplain for other uses.

Action: Expand the mission of the Mississippi River Commission to include the Missouri and Upper Mississippi Rivers. Further, to recognize ecosystem management as a coequal federal interest with flood control and navigation, the Commission membership should be expanded to include a Department of Interior member.

The expanded Commission will provide for detailed planning and execution oversight of water resources development projects and assure appropriate fiscal attention to programs necessary for achievement of national floodplain management goals. Annual Commission reports will be provided to the Chief of Engineers and the Secretary of Interior on the performance of navigation, flood control, and ecosystem management projects. Because of the direct relationship between hydrology, hydraulics, and floodplain ecosystem function, expanded membership of the Commission will ensure coordination between multiple use interests.

PROPOSED INSTITUTIONAL FRAMEWORK



ECOSYSTEM NEEDS

Although federal and state agencies have recently articulated general policies regarding pursuit of ecosystem management, there remains a lack of coordinated, multi-agency, ecosystem based planning upon which to base water resource and floodplain management decisions. Pursuit of watershed planning, described subsequently, requires a single hydrologic/hydraulic model and development of a natural resource baseline, against which agencies can develop and implement appropriate maintenance or restoration plans within their areas of jurisdiction or expertise.

Ecosystem planning strives to protect or restore the function, structure, and species composition of an ecosystem, recognizing that all components are interrelated. The USFWS National Ecosystem approach has 4 components; the first is the identification of natural resource needs. Information on the distribution, abundance, and ecological relationships of U.S. species and a comprehensive inventory and classification of ecosystems is a fundamental nationwide need.⁸ This information is largely incomplete for the Mississippi and Missouri River Basins⁹. In examining this issue, the Committee found that funding and support for this effort is lacking. It is clear that this information is critical for setting resource objectives, examining alternatives within multiple use planning, and implementing solutions.

Action: DOI should complete a ecological needs investigation of the Missouri and Mississippi Basins, and provide a report to the President within 18 months.

The resource needs investigation will be collaborative among Federal, State, and Tribal agencies, and will take full advantage of information from the NBS, under the Long Term Resource Monitoring Program, the USDA National Resource Inventory, and the OEP

1994 Floodplain Management Review Committee's SAST. The report will provide the necessary focal point from which government agencies can develop coordinated management strategies that reflect true resource needs, measure response to those strategies, and refine further research needs.

Action: *USACE should include a systemic flood reduction strategy within its Floodplain Management Assessment.*

Systemic flood reduction strategy will likewise be collaborative and should be conducted using the NEPA process to ensure full participation of stakeholders in floodplain management. The systemic approach will necessarily involve consideration of the two river basins as individual and aggregate watersheds with unique and common human uses and ecosystem functions.

MANAGE WATERSHEDS TO MEET FLOODPLAIN MANAGEMENT GOALS

What happens in watersheds significantly affects what happens in the floodplains below them. The Mississippi and Missouri River basins consist of watersheds of varying size. Each watershed is a physically discrete hydrologic units in which water is successively channelled from upland areas to lower areas and eventually into main stems. The height of the flood stage and frequency and duration of any flood event will normally be influenced to some extent by the degree to which rainfall is captured and released in the uplands. As discussed in Chapter--- of this report, the correlation between upland capture and release and downstream flood stage is complex and incompletely understood. But it is clear that well

managed watersheds will have reduced downstream flood stages with concomitant reductions in flood damages and additional water quality and ecosystem benefits.

A number of the Midwest communities flooded in 1993 reported to the Committee that they perceive an increase in flood stages and frequencies over the past two decades. Some attribute this to structural flood control (levees), and some attribute this to land use practices within the upland areas of the watershed which have increased the amount and velocity of runoff and decreased watershed storage capacity. Practices frequently pointed to as the culprits include increased agricultural land use and paving of residential and industrial areas, both of which reduce storage capacity and increase runoff. Downstream cumulative effects of individual activities are rarely considered due in large part to the fact that watersheds typically encompass a number of political jurisdictions with differing economic interests.

Watersheds have long been recognized as the optimal management unit for water resources planning. As early as the 1970's, the USACE was performing analyses of water quality and supply using watersheds as the basic planning unit.¹⁰ The USDA for decades has recognized benefits of watershed planning under its PL 566 program and through the Forest Service.¹¹ More recently, The National Park Service has instituted a watershed management program and the Environmental Protection Agency has begun a watershed initiative to address specific problems which traditional programs have been unable to adequately address.¹²

Federal watershed programs and policies suffer from lack of coordination and clear recognition and development of achievable multiple objectives. Many federal watershed programs focus exclusively on water quality and/or habitat improvements deriving from watershed management and disregard flood control benefits. Federal programs which focus on flood control are primarily operating in rural areas neglecting nonagricultural urban and suburban land uses. Program eligibility requirements and incentives also differ between agencies.

The Clean Water Act reauthorization presents a good example of failure to consider

multiple objectives. Both pending bills¹³ call for watershed based planning but neither mentions flood control as an element of watershed management, nor do they offer incentives based upon demonstrated flood reduction. This is an important benefit of watershed management, completely consistent with the primary goal of this legislation, i.e. reduction on nonpoint source impairments to water quality, but unrecognized due to the focus on water quality. Similarly, the concept of market establishment and trading to achieve environmental goals focuses on point and nonpoint discharges and overlooks opportunities which exist to trade for flood control such as payments from floodplain farmers to induce upland farmers to install land management practices which reduce flood peak and frequency.

The best parts of existing federal programs must be merged to encompass a holistic and synergistic approach to watershed management. Opportunities for change include current Congressional action on the Clean Water Act and reauthorization of the farm bill due in 1995. To most effectively capitalize on potentially forthcoming legislative authority, the federal government must begin 1) to coordinate and build upon ongoing watershed programs, focusing upon the most effective means of achieving on multobjective goals, and 2) re-targeting existing conservation programs to complement watershed management goals

Action: The Administration should establish an interagency task force, lead by USDA, to formulate a coordinated comprehensive approach to multiobjective watershed management.

Each agency undertakes a watershed program to achieve the goal or goals which are consistent with its primary mission. These goals may be only partly consistent with local, regional, or basin-level ecosystem needs. Success is measured by achievement of these goals irrespective of whether other attainable benefits are realized. For example, the Forest Service watershed program seeks to improve stream habitat through reduced siltation and temperature reduction. Success is measured by increases in fish population. Flood control and water quality are other goals which may accomplished with relatively small incremental

expenditures of expertise and money but are not considered in determining program success.

The task force will be able to provide an overview of watershed management programs thus far instituted by the federal government to ascertain both their effectiveness and to identify areas in which opportunities for improvements in efficiency and achievement are possible. Areas in which interagency missions coincide and are capable of achievement through watershed management should be identified and plans of action to stimulate interagency coordination should be fashioned.

Action: The Administration's legislative proposals for the 1995 Farm bill should support continuation and expansion of conservation and voluntary acquisition programs focused on critical lands within watersheds.

The Food and Security Act of 1985 and Food and Agricultural Commodity Trade Act in 1990¹⁴, the most recent Congressional actions on agricultural policy, contained strong conservation measures aimed at reducing soil loss and improving water quality through creation of incentives and disincentives, primarily through cross-compliance with other agricultural programs. Two programs were of particular importance. The Conservation Reserve Program (CRP), introduced in 1985, which provided payments to farm operators who agreed to protect highly erodible lands and the Wetland Reserve Program (WRP), established in 1990 to acquire agricultural lands from voluntary sellers and restore wetland conditions. We currently have about 34 million acres enrolled in the CRP program that will begin to come out of the program in 1996. If these acres are converted to row crops, runoff will increase, even with proper conservation practices.

The emergency supplemental appropriation for the Midwest floods established an Emergency Wetlands Reserve Program (EWRP) applicable to farmland damaged by flooding in the nine Midwest states. With modifications suggested below, the EWRP should be

continued to provide an alternative means of recovery for farmers.

These programs have determined that there is a large land base available for program purposes; the program constraints are financial. Thus it becomes important to target limited funds to acquire lands offering the greatest benefits per acre. The present selection criteria, which consider natural characteristics on a site-by-site basis, are economically and environmentally inefficient. For example, by focusing CRP contract renewals on selected areas within a watershed such as riparian borders rather than on all highly erodible lands, the amount of acreage under the program and program costs could be reduced while achieving similar or higher levels of benefit. Selection of candidates for program enrolment based upon previously identified watershed deficiencies and/or restoration needs offers a means of targetted program dollars for maximum benefit.

Yet another restoration program, the Environmental Easement Program, first established in the 1990 Farm Bill, should be continued and funds appropriated.

ENDNOTES

1. Executive Order 12319 -- River Basin Commissions, September 9, 1981, 46 FR 45591, 3 CFR, 1981. p 175; and, Public Law 89-80, 22 July 1965, (1965 Water Resources Planning Act - 79 Stat. 244, 42 USC 1962).
2. Rutherford H. Platt, "Geographers and Water Resource Policy" in Water Resources Administration in the United States: Policy, Practice and Emerging Issues. American Water Resources Association/Michigan State University Press. (East Lansing, 1993).
3. UMRCC Call to Action
4. Public Law 83-566, Clean Water Act, as amended, and FWS "An Approach to Fish and Wildlife Conservation..... 1994
5. Section 101(a) of NEPA of 1969, as amended. (PL 91-190, 42 USC 4321-4347, January 1, 1970, as amended by PL 94-52, July 3, 1975. and PL 94-83, August 9, 1975.)
6. Report of the Long' Peak Working Group on National Water Policy. 1992. "America's Waters: A new era of sustainability. December. Natural Resources Law Center".
7. Council on Environmental Quality, Annual Report. 1990
8. Council on Environmental Quality. 1990. Annual Report.
9. Upper Miss Conservation Cmtee.
- 10.
11. Cite statute
12. Section 319 of the Clean Water Act, and get cite
13. S. 1114 and H.R. 3948
- 14.

Chapter 6

REDUCE THE VULNERABILITY OF THE NATION TO FLOOD DAMAGES

Individuals and their investments in the floodplain will always be at risk. Though it is impossible to completely remove the risk and remain in the floodplain, it is possible to reduce the degree of risk.

The ideal solution is to evacuate floodplains and move people and their public and private investments out of harm's way. This is not always a viable or desirable solution. Mitigation techniques that either modify their susceptibility to flood damage and disruption, or modify the extent of the flooding may be more reasonable for cases in which evacuation is not feasible. The goal of the Nation is to appropriately protect those floodplain residents and activities whose continuing presence in the floodplain makes economic, social and environmental sense.

The lessons of the Flood of 1993 are clear. We, as a nation, cannot continue to tolerate the loss of life and the damage to our cities, rural communities and farms caused by major flooding, nor can we carry the burden of massive federal flood disaster relief costs that current policies generate each time a large flood occurs. During the 1993 flood, some reservoirs were completely filled by floodwater runoff and flows ran uncontrolled across their spillways; in other locations levees were overtopped - in both cases the design levels of protection had been exceeded. At some sites, levees failed; their integrity had been compromised. With both levee failure and levee overtopping came catastrophic flooding as

water rushed into the leveed area with enormous force. Even with the large infusion of federal funds, private donations, and volunteer assistance, the nine-state area has still not returned to "normal." Long-term effects to individuals, communities, and the agricultural sector will be felt for years. Many of these damages could be avoided through risk reduction measures.

Sidebar: Levee failure/overtopping

According to the FEMA Hazard Mitigation Team Report for Missouri, half the damages arising from the 1993 flooding in Missouri are agricultural related. " In the Midwest as a whole, two thirds of the more than 1500 levees along the upper Mississippi and lower Missouri rivers were breached or overtopped. Many of these were agricultural levees protecting farmland." Also according to the FEMA report, levees are not regulated by the State of Missouri and there is no coordination between levee districts. A special report by the Association of State Floodplain Managers, Inc., prepared in 1992 indicates that only 16 of the 48 contiguous United States regulate levees. These include in the Midwest: Kansas, Illinois, Minnesota, North Dakota, and Wisconsin.

SIDEBAR: Strategies for flood damage reduction

Protect population centers

What level of protection should be provided by federal flood damage reduction projects and programs? Risk of damage or loss from flooding is greatest where human life and property is concentrated in highly populated areas on the floodplain. For many years following the passage of the Flood Control Act of 1936, the federal government focused its efforts on protecting communities at risk from the largest flood they could expect to encounter. Over time, selection of this high level of protection diminished as the decision on level of protection came to be driven more and more by cost-benefit analyses based on economic criteria. A federal flood protection goal should be to provide the highest level of protection (lowest residual risk) to areas with significant population concentrations.

Action: *Protect population centers against the Standard Project Flood discharge.*

Protecting against or siting development above the water level associated with the *Standard Project Flood discharge* provides a greater reduction in residual risk than is provided by using the 1% annual chance (100-year) flood elevation. The SPF is intended to serve as a practicable expression of the degree of protection that should be sought as a general rule in the design of flood damage reduction works for communities where protection of a large population and high-value property is involved. Population centers occupy a small

segment of the total length of floodplains relative to agricultural areas, so the use of levees or walls for protection against the SPF discharge would have relatively minor effect on the hydraulics of the river system.

SIDEBAR: What is a STANDARD PROJECT FLOOD?

The Standard Project Flood (SPF) discharge in a river represents the flow that can be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographic region involved, excluding extremely rare combinations.

Protect critical infrastructure

There is a risk of imposing severe hardship on the public or endangering the public's health and safety when infrastructure that is critical to maintaining the well being of a community, region or nation is flooded. This is especially true in floods of long duration, such as the one that occurred in 1993. For example, when the city of Quincy, Illinois lost both of its crossings over the Mississippi River, it faced the situation of having no open bridge across the river between Iowa and Saint Louis, Missouri for over two months. People were put out of work, local businesses were isolated from their market areas, and the local economy was disrupted.

Action: *Protect critical infrastructure against the Standard Project Flood discharge.*

Critical Infrastructure can be defined as structures, facilities, and installations of such a type and function that: (a) if rendered inservicable would impose significant hardship on the public they serve, or (b) if flooded would pose a threat to public health, public safety and/or the environment. Examples include (but are not limited to): municipal drinking water facilities, wastewater treatment plants, interior drainage pumping stations, major highway

bridges, major passenger and freight railroads, critical access roads, major airports, hospitals and related medical care facilities, electricity generating plants, military bases, key government buildings (owned or leased), including those of the U.S. Postal Service and other quasi-public entities, facilities that generate, store or dispose of hazardous, toxic or radioactive materials. For some of these facilities, for example bridges, railroads and access roads, the element of flood duration must be considered in determining the applicability of the definition.

Vulnerability of existing federal facilities

One objective of EO 11988 (see Chapter 4) was to ensure that all federal agencies avoid, to the extent possible, the long and short term adverse impacts associated with the occupancy of floodplains. However, based on the Committee's contacts with state and local floodplain managers in the Midwest, federal and federally-sponsored facilities, including critical infrastructure, remain at risk. To prevent the possibility of major losses, the vulnerability of these existing federally owned or funded buildings and infrastructure should be assessed.

Action: OMB should direct all federal agencies to conduct an assessment of the vulnerability of flooding of a sample of federal facilities and those state and local facilities constructed wholly or in part with federal aid.

This vulnerability assessment should identify and quantify the total federal investment subject to flood damage. The new higher standard for protecting critical infrastructure (i.e., SPF) should be considered in the assessment. The assessment should also contain recommendations on mitigation measures to protect federal facilities.

Protect rural areas

The optimum flood damage reduction measure for rural areas is to move the populations, industry and the infrastructure to higher ground, allowing the lands to remain in agriculture without further development. If this is not possible, levees or some other protection measure may be warranted. Though it might be desirable to protect people, industry, infrastructure, and agriculture located away from population centers to the greatest possible level, the hard facts of benefit-cost analysis normally will preclude using the SPF as the standard for federal protection. Instead, the level of protection to be provided these areas would be determined by an analysis using the revised Principles and Guidelines for water resources development planning that allow for consideration of social and environmental values as well as the economic benefits and costs. Depending on the mix of population, infrastructure, industry and agriculture, the level of protection will vary from the 10% annual chance (10-year) flood to the SPF, but will normally fall between the 2% and 1% annual chance (50-year to 100-year) flood.

Action: Protect rural areas with major public infrastructure, industry and agriculture against a relatively infrequent flood discharge; specific level of protection determined on a case-by-case basis using procedures in the revised Principles and Guidelines.

Depending on the specifics of the situation, it is possible that a rural community and the associated infrastructure could justify being protected separately from the agricultural land. This would create the desirable situation of providing a higher level of protection for the rural community, where the residual risk is greater, than for the surrounding agricultural area. If the community's level of protection is determined to be less than the 1% annual chance (100-year) flood, the community would continue to be mapped as being in the special flood hazard area (100-year floodplain) under the NFIP. If a greater level of protection (but less than SPF discharge level) is provided, structures behind the levee would be required to purchase flood insurance.

Protect agricultural lands

Much of the land in the floodplains of the upper Mississippi River basin are isolated from the rivers by levees used to protect bottomland agriculture. The 1993 flood gave clear indication from the economics, river hydraulics and soil conservation standpoints that lower levees serve agriculture and the river environment better than higher ones. Economic studies of the feasibility of protecting just agricultural lands from floods have often shown that net economic development benefits maximize at about the 10% chance annual (10-year) flood level. Profitability to the individual farmers is maximized at higher levels of protection under current price support, disaster assistance, and crop insurance programs. Extended reaches of river lined with high levees have less capacity with which to convey and/or store flood waters, at least until the levees breach or overtop. Those isolated lands are also cut off during floods from the the natural process of fine-grained sediment deposition that creates the rich floodplain topsoils. Instead, much of this land was damaged by the deposition of sands when the high levees breached under the force of high water. These extensive reaches of levee also isolated wetlands from the river and significantly reduced the amount of riparian habitat available for native fish and wildlife.

Action: *Protect agricultural areas against the 7 to 10 % annual chance (15-year to 10-year) flood discharge.*

By protecting agricultural areas against lower level floods, the floodplain remains available to store and convey flow during larger floods, the potential for breaching by high heads of water is lessened, the lands are open to the sedimentation process, and connectivity between the various floodplain habitats is increased.

Maintaining viability of bottomland agriculture

Recognizing that agriculture can be an entirely compatible use of floodplains, incentives must be developed which maintain the economic viability of ownership under modified flood frequency or with periodic controlled inundation for natural resource enhancement. There are many incentives that could be offered to property owners who may consider lower level flood protection. Proposals for the 1995 Farm Bill will include discussions of easements, stewardship fees, and "green" payments for changes in farming practices on ecologically valuable lands. Further opportunities may arise with alternative agriculture in the floodplain..

SIDEBAR: CAN FLOODPLAIN AGRICULTURE SURVIVE WITHOUT FEDERAL SUPPORT?

Each agricultural producer in the floodplain makes farming decisions based on a collection of factors, many of which differ from location to location. Input prices tend to be the same at all locations, but production practices and potential yields will depend on the characteristics of the land. Cash receipts will depend on whether the farmer participates in a price support program. In addition, the level of flood protection will determine whether a given year's yield will be realized. For example, in a flood-prone area of Iowa, producer returns to farming would be \$____ per acre (\$____ if deficiency payments are included) if levee protection was provided, but only -\$____ (\$____ with deficiency payment) if a levee did not exist.¹ The per acre annualized costs of building, maintaining, and repairing the levee in the area would be around \$____. Other areas of the floodplain are more productive for agriculture. Another example showed that producer profits would be \$____ per acre (\$____ if deficiency payments are included) if levee protection was provided, but only \$____ (\$____ with deficiency payment) if a levee did not exist. The per acre annualized costs of building, maintaining, and repairing the levee in the area would be around \$____. In the first example, farm profits would not be high enough to pay for the full cost of the levee. In the second case, farmers would find it profitable to farm even without the existence of government programs. The examples are used only to illustrate that site characteristics and policies will determine a farmer's choices. Considerations of easements, levee set-backs, or "green" payments will have to take these factors into account.

Farmers who need flood protection to profitably operate on bottomlands should be given the opportunity to participate in a new program which balances levee protection at the 10-15 year level with compensation for damages from periodic flooding. The new levee

would have to be constructed to withstand overtopping and preclude the breaching that caused the great scour and deposition damages of 1993 (see Chapter 2). Compensation for crop losses during flooded periods would be from increased crop insurance coverage. Since current Federal Crop Insurance Corporation (FCIC) rules limit compensation to a maximum of 75 percent of the crop loss, additional coverage would be made available to participants in the new levee program. The benefits to the farmer would be having a federally guaranteed levee, periodic soil replenishment, and an assured income stream. The benefits to the nation would be to maintain agricultural production, with improved floodplain function (ecosystem, flood storage and conveyance).

Action: Provide ability to purchase increased Crop Insurance protection to farmers who participate in new levee program.

FCIC should establish a program that raises the maximum level of insurance coverage for flood-related damages above the 75 percent level for those farmers who are enrolled in the new levee program. The viability of bottomland agriculture would be maintained because farmers would then be able to bear the risk of periodic flooding. The federal government would pay the costs of any crop insurance subsidies for the increased coverage, but they would avoid disaster payments and gain environmental benefits.

Safeguard hazardous materials

Given that hazardous materials are used and stored in floodplains, there exists a need to identify those hazardous substances, where they are found, and address how they can be removed or contained during a flood event.

EPA's Resource Conservation and Recovery Act (RCRA) regulations for permitting hazardous materials treatment, storage, or disposal facilities have locational standards. For facilities located in areas with a one percent per annum chance of flooding (100- year

floodplain), the facility must be designed so that no wash out of hazardous materials occurs.²

EPA's draft regulations (1978) proposed the criteria be the 500-year floodplain. Public comment on the draft reflected difficulties with identifying the 500-year floodplain and a concern that EPA was holding these facilities to a higher standard than that required by EO 11988. Therefore, EPA's final regulations to address flood design were required only for those facilities located in areas with a 1% annual chance of flooding.³ This limitation appears inconsistent with the EO 11988 guidelines for critical actions.⁴ EPA requires that permitted facilities have contingency plans addressing notification and response for any unplanned sudden or non-sudden release. The regulations do not specifically require that the plans address flooding events, even for facilities in areas with one percent per annum chance of flooding where an obvious cause of releases could be flooding.⁵ Furthermore, there exists no feedback mechanism regarding plan effectiveness in the event of a hazardous material release.

Action: Revise RCRA's locational standards and contingency planning regulations for consideration of flood hazards in areas of the Standard Project Flood.

Revision of the siting regulations to recognize that releases of hazardous materials are critical actions for which "even a slight chance of flooding is too great" would provide a greater level of environmental and public health and safety and would be consistent with guidelines for implementing EO 11988.⁶ (Revision of the EO, proposed in Chapter __ would automatically trigger this revision.) Specifically requiring contingency plans to reflect the special activities and coordination required in the event of flood events would also decrease the risk of hazardous material releases and enhance governmental response. An additional requirement for review of contingency plans after hazardous material releases would provide the means to enhance pre-disaster planning.

Ensure Integrity of Federally Supported Flood Control Systems

The current development of flood control facilities in the upper Mississippi River basin is one of sharp contrast to that which exists in the lower basin. From the mouth of the Ohio River downstream to almost the Gulf of Mexico, there exists an integrated system of federally planned, designed, constructed and maintained facilities, including main stem and tributary levees, bypass floodways, interior drainage pumping stations and flood control dams. With the exception of some elements in the Missouri River basin, most of the upper Mississippi River basin facilities were not constructed in accordance with any system plan but were instead developed on a project-by-project basis, when and as need dictated, by a host of individuals, drainage and levee districts, and the federal government. On the Missouri, the systematic approach offered by the Pick-Sloan Plan was never fully implemented, and, in its place locally funded levees were constructed without consideration of the Plan's provisions to set levees back from the river bank.

The result is a collection of facilities of greatly varying structural integrity, of widely varying levels of protection for the same intended purpose and placed, in most cases, upon the floodplain without full regard to their impacts on the river upstream, across or downstream. They are placed without adequate consideration of the physiographics of the floodplain where they are situated, the forces the river itself will impose upon it during flood, or on the riparian environment in which they lie. Compounding this problem is the fact that five different federal agencies are engaged in repair of 1993 flood-damaged federal and non-federal levees, either by funding, designing and constructing or solely by funding, and not all to the same engineering standards. The water resources design and construction agencies, the USACE and the USDA/SCS, are now joined in the levee repair business by the FEMA, EDA and HUD, through their public assistance and community development block grant programs, respectively.

Over the years and in the future, the costs to the Nation of this approach, as measured in dollars and social and environmental impacts, have been and will remain tremendous. In addition many of these structures and their components are reaching the end of their original economic life and will need major repair and/or rehabilitation of some

components. In most cases local sponsors of these facilities lack the resources to fully fund the major work that will be required.

Over the past months USACE has been asked by the Congress to review the level of flood protection offered by levees in several areas of the Mississippi Basin. Given the lessons of the Flood of 1993, it would be unwise to consider a modification to any one levee without full consideration of the effects that levee might have on the entire system, and of more importance, how the entire basin should be treated. Following the disastrous flood of 1927, Congress charged the USACE with developing, within a 12- month period, a plan for protection of the lower Mississippi Valley. This blueprint, with modifications over time, has provided the systems approach for that region.

SIDEBAR: Differences in UMR and LMR

A systems approach will require that an element of the federal government be assigned that mission and that it be charged with both developing a plan for flood damage reduction and ensuring the integrity of those structures determined to be appropriate for inclusion in a federally supported (but cost-shared) system. This program also must ensure compatibility with river hydraulics, navigation and ecosystem goals. Such a program must be one that involves willing owners, the states and the federal government.

Action: Assign responsibility for the Upper Mississippi River and Tributaries (UMR&T) system plan and major maintenance and rehabilitation program to the Mississippi River Commission, operating under USACE.

As indicated in Chapter 5, the Mississippi River Commission (MRC) has had extensive experience in the planning, design, construction, operation, maintenance and repair of an integrated system of reservoirs, levees and other facilities which serve as an integrated

system for flood damage reduction in the lower Mississippi River basin. The MRC currently has statutory authority to operate and supervise activity on the river up to Rock Island, Illinois and conduct surveys of flood conditions and flood control needs upstream to the Mississippi River headwaters, in Minnesota. Employing such an experienced body, given additional authority for operational and supervisory responsibility up to the headwaters, would be the most effective way to implement this action in the immediate future..

Action: Seek authority from the Congress to refocus the USACE Floodplain Management Assessment on development of the UMR&T Systems Plan. Place this Assessment under the MRC.

The Floodplain Management Assessment (FPMA) of the upper Mississippi River basin was chartered by Congress in the Conference Report for the FY 1994 Energy and Water Development Appropriations Act, (House Report 2445) and the House Resolution (Docket 2423, dated 3 November 1993) to accomplish eleven objectives relating to floodplain management, flood damage reduction and flood control. Study responsibility was assigned to the USACE, which is currently managing the assessment through its North Central Division in Chicago, Illinois, with day-to-day management by the Saint Paul District. The refocused study would develop a general plan for flood damage reduction, including structural and non-structural measures, establish levee standards and assess the suitability of the current levees for inclusion in program. Details of the proposed federal levee program are contained in Appendix ____.

Under the program the USACE would be assigned responsibility for major maintenance and major rehabilitation (MM&MR) of levees that are determined by the USACE to be eligible for the federal program. USACE would also continue to carry out its responsibility for oversight of the routine maintenance performed by the local sponsors of levee projects. Expenditures for either major maintenance or major rehabilitation would be cost-shared: 75% by the federal government; 25% by the state government and local

sponsor.

All levees currently determined by the USACE to be eligible for flood emergency repair under the provisions of the PL84-99 program would be reviewed by the USACE within the ensuing 24 months to determine if increases in the level of protection currently provided would be appropriate. Included in the review would be a determination if any works required to ensure that the structure remained sound for the foreseeable future. Evaluation criteria used to determine the need to increase the level of protection or to renew the structure would be, in the aggregate: the work is economically beneficial to the nation, it would create social and environmental benefits for the region or the nation, it would not cause upstream or downstream flood problems that could not be mitigated at local expense and it would ensure the structural integrity of the levee for the design conditions.

Levees currently not included in the federal program would be offered the opportunity to become eligible for post-flood disaster assistance (but not inclusion in the PL84-99 program) if the sponsors agree to maintain the levee to USACE standards and to limit the height of the levee to the maximum of that needed to protect against the 10% annual chance (10-year) flood level. The 10-year flood water surface profile would be determined by the USACE .

Only existing levees would be eligible for the above programs. Any new levee would be permitted by the states and would require specific Congressional authorization for inclusion in the federal program . Authorization would be granted only to projects recommended by the Chief of Engineers as having met the requirements for eligibility in one of the above programs.

It must be recognized that some levees will not be accepted for various reasons.

Levees whose embankments do not meet the minimal standards of structural integrity established by the USACE, those that are determined to be situated in locations along the river considered to be vulnerable to high velocity attack and/or unsuitable foundation conditions and thus subject to repeated failure, and those that would cause adverse flood effects on the river during flood.

Action: Seek authorization from the Congress following completion of the survey to establish the UMR&T project.

Authorization of the UMR&T project is needed to assign responsibility to the USACE to develop and execute the federal program of major maintenance and major rehabilitation of those levees found to be eligible for inclusion . The UMR&T projects would be identified as a separate line item in the USACE budget and be funded by annual appropriation.

SIDEBAR: EXTENSION TO THE NATION

Though the Floodplain Management Review Committee's focus of investigation was on the upper Mississippi River basin and the actions described above are specific thereto, the benefits of establishing a program approach to ensuring the integrity of federally supported flood control systems could be realized elsewhere in the Nation.

Construction and repair of levees

The flood of 1993 brought with it the failure of many levees. Some were built by levee and drainage districts to protect farmland and routinely maintained, whereas others were little more than "potato ridges" pushed up by individual landowners with little or no intent to perform long-term maintenance. Although levees are like bridges and require standards, little engineering or design went into the construction of many non-federal and private levees, and they are maintained to widely varying standards. Stream bank erosion threatens main stem levees in some places, but levee owners responsible for maintenance put

off needed repairs because they believe it a USACE responsibility in relation to the 9-foot channel for navigation.

SIDEBAR: NAVIGATION LEVEES ?

Along the banks of the upper Mississippi River, above Locks and Dam No. 26 at Alton, Illinois, there are 885 miles of privately maintained levees that protect 746,000 acres within 76 drainage districts. Many of those levees were in place at the time the existing 9-foot channel for navigation was authorized (1930) and constructed. Consequently, in recognition that establishment of some of the navigation pools resulted in damage by seepage and backwater, the affected drainage districts were compensated in the form of lump sum payments authorized by Congress in the River and Harbor Act of 1958. Recent USACE review of the relationship between levees and the navigation project indicates that only 17 miles of levees in 8 drainage districts may fall within the category of aids to navigation.

Action: *Establish the USACE as sole levee construction/approval agency.*

The USACE has a long history in levee building and repair, and has the on-board expertise to serve as the government's sole representative in matters pertaining to levee construction and repair.

Floodfighting levees

In spite of the fact that there were many heroic levee floodfighting efforts made during the Flood of 1993 by threatened communities and owners of agricultural levees, these actions were made without knowledge or consideration of the effects that keeping the water off their portion of the floodplain had on the river level in proximity to that location. The act of raising a levee during rising flood conditions has the effect of increasing the river level in the immediate area and possibly upstream and downstream as well. The magnitude of the raise could be minor or significant and depends on many hydraulic factors pertinent to the specific levee and river reach being affected. If the water level raise is significant, it could cause greater damage than otherwise would have occurred to other nearby lands, especially in the case where it may result in another levee's failure.

Action: *FEMA and State officials should restrict funding support of floodfighting to those levees that have been approved for floodfighting by the USACE.*

The USACE would determine by advance planning, with the benefit of river hydraulic modeling analysis, those levees that can and those that cannot be flood fought without significant adverse impact on other properties in the floodplain.

ENDNOTES

1. The example given here is based on a study funded by EPA and conducted by the Center for Agricultural and Rural Development at Iowa State University and the Center for National Food and Agricultural Policy at University of Missouri - Columbia.
2. 40 CFR 264.18
3. Personal Communication, Felicia Wright, EPA Office of Solid Waste, April 26, 1994.
4. Water Resources Council, Floodplain Management Guidelines for Implementing EO 11988. 43 Federal Register 6030. February 10, 1978.
5. Personal Communication, Felicia Wright, EPA Office of Solid Waste, April 26, 1994.
6. Water Resources Council, Floodplain Management Guidelines for Implementing EO 11988. 43 Federal Register 6030. February 10, 1978.

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Chapter 7

FOCUS ATTENTION ON COMPREHENSIVE EVALUATION OF THE IMPACTS OF FEDERAL ACTIONS

The nature of water resources development actions taken and projects constructed by the federal government reflect the objectives set by the Administration and Congress. Some objectives are defined in laws such as PL 74-738, the Flood Control Act of 1936; PL 89-80, the Water Resources Planning Act of 1965; and the Water Resources Development Acts. Some are defined in reports to or reports of Congress such as the 1958 "Proposed Practices for Economic Analysis of River Basin Projects" report to the Inter-Agency Committee on Water Resources and the 1962 "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for use and Development of Water and Related Land Resources" commonly referred to as "Senate Document Number 97". Other objectives are defined administratively such as "Principles and Standards for Planning Water and Related Land Resources" commonly referred to as "Principles and Standards" or "P&S," established in 1973, and "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" commonly referred to as "Principles and Guidelines" or "P&G," established in 1983, at the recommendation of The Water Resources Council.

PROVIDE A BALANCED FOCUS IN PRINCIPLES AND GUIDELINES

The P&S was a rule that applied to water and land programs, projects, and activities carried out directly by the federal government and by state or other entities with federal financial or technical assistance and was developed to ensure proper and consistent planning and guide the formulation and evaluation of those projects. The P&S had two co-equal objectives of enhancing national economic development and enhancing the quality of the environment. The P&S was superseded when President Reagan approved the P&G on February 3, 1983, as guidelines rather than rules that apply only to USACE, SCS, Bureau of Reclamation, and the Tennessee Valley Authority. Under the P&G, there is a single federal objective to "contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements." Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Alternative plans to the NED plan are to be formulated which reduce net NED benefits in order to further address other federal, state, local, and international concerns not fully addressed by the NED plan. However, a plan recommending federal action is to be that with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan), unless the Secretary of a department or head of an independent agency grants an exception to this rule. Exceptions may be made when there are overriding reasons for recommending another plan, based on other federal, state, local, and international concerns. Exceptions to the NED plan have been limited.

The monetary focus on NED does not give adequate consideration to other unquantifiable environmental and social values. Due to their non-market nature, monetary values for environmental quality, ecosystem health, the existence of endangered species, and other social effects are not as easily quantified as are the NED benefits due to their non-market nature. This limits formulation of projects capable of striking a better balance

between flood control or other water resources development purposes and the environment.

Action: *Establish as new objectives for Principles and Guidelines-*

- (1) Enhancing the quality of the environment*
- (2) Enhancing national economic development*

The current national economic development objective of the P&G should be revised immediately through the issuance of an executive order, to focus on the two objectives of (1) enhancing the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems and (2) enhancing national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency. This will provide a balanced focus for guiding decision-making.

UPDATE PRINCIPLES AND GUIDELINES

The P&G is now more than 10 years old. Over the years, several areas have been identified that may require review. These areas were confirmed as a result of meetings of the Floodplain Management Review Committee with federal agency, state, and local representatives as well as interested groups and other individuals as a part of this study.

Structural versus non-structural approaches

A universal concern has been that there is a bias toward structural solutions to flooding problems and that non-structural alternatives are not evaluated in the same way as structural alternatives, such as levees. One of the differences in the evaluation is that for structural alternatives the reduction in flood damages is included as a measure of the benefits

of a project, while for non-structural alternatives, such as evacuation of structures from the floodplain, reduced damages must be separated into internalized and externalized damages. Then, only the externalized damages prevented (those borne by other than the floodplain residents) are claimed as benefits for the non-structural evacuation alternative. There is an economic rationale for doing this but the concern still exists that this results in a bias against non-structural type projects. In addition, there are many social benefits of removing people at risk from the floodplain and environmental benefits of a natural floodplain that are not adequately included within the evaluation. The P&G does not exclude these considerations, however, there are application deficiencies due to the non-market nature of the impacts.

System of accounts

A system of accounts analysis can provide critical information on market and non-quantifiable, non-market impacts necessary to provide the basis for trade-offs and support a sound formulation of alternatives process to include the efficient allocation of scarce resources. The system of accounts for displaying beneficial and adverse effects on: (1) national economic development; (2) regional economic development; (3) other social effects; and (4) environmental quality of various project alternatives, is not specifically required in the P&G. Although the system of accounts is not required, some agencies strongly encourage this comparison of impacts to the four areas mentioned in the system of accounts within their specific agency rules that implement the P&G. The system of accounts or something similar is needed to help ensure a balanced planning focus.

COLLABORATIVE PLANNING

Ecosystem, watershed, and large scale river studies lend themselves to collaborative approaches by virtue of their scope. Only by working in partnerships with other federal

agencies, state agencies, and private organizations can individual agencies look beyond their defined missions. A collaborative approach in an ecosystems context is needed for major watershed and floodplain management planning efforts to move agencies away from single agency problem solving. A more comprehensive evaluation of problems and solutions will be undertaken if a collaborative approach includes governmental interested parties at all levels as well as public and private stakeholders. Such collaborative partnerships also constitute a means of leveraging limited funds. While the P&G requires the responsible federal agency to contact the Governor or designated agency for each affected state before initiating a study, and requires the federal planning agency to provide the state agency or agencies responsible for or concerned with water planning with appropriate opportunities to participate in defining the problems and opportunities in scoping the study, and in review and consultation, a truly collaborative approach is not required or encouraged. The P&G also states that interested and affected agencies, groups, and individuals should be provided opportunities to participate throughout the planning process and that a coordinated public participation program should be established with willing agencies and groups. This falls short of establishing partnerships and collaborating within an ecosystems context on major watershed efforts. Benefits of collaborative approaches include improved efficiency and cooperation (both within and across agencies) and improved service to the public. The approach also serves to crystalize public opinion regarding problems and builds consensus for solutions. Criteria should be established to indicate where collaborative approaches are appropriate and recommend a mechanism for implementation to include single or separate agency funding of participation in the collaborative efforts. For cost shared feasibility studies, a determination should be made as to whether it is reasonable to require participation in collaborative funding by the non-federal cost sharing sponsor.

Action: *Establish interdisciplinary, inter-agency review of the P&G to address
(1) Structural versus non-structural project bias,*

- (2) Inclusion of system of accounts or a similar mechanism for displaying impacts, and*
- (3) Inclusion of collaborative planning in an ecosystems context for major studies.*

An interdisciplinary, inter-agency committee of individuals from potentially affected federal agencies should be established to focus on the new broadened objectives, recommended above, and make specific recommendations for revisions to the current P&G based on the three areas identified above and any others as appropriate. This committee should be convened as soon as possible with a goal of making all necessary revisions by December 1994.

APPLICATION OF P&G TO FEDERAL ACTIVITIES

The P&G provide an overriding philosophy and process for formulating alternative plans and weighing the impacts of each alternative in order to select a recommended plan for meeting the study needs. The NEPA requirements are included as part of the P&G process. This process can be applied to all federal agency evaluations of alternatives to most efficiently allocate scarce resources to meet the needs of this nation. Currently, however, the only federal agencies that are required to use P&G are the USACE, SCS, the Tennessee Valley Authority, and the Bureau of Reclamation. To increase efficient resource allocations, P&G should be extended.

Action: *Expand the application of P&G to the following areas:*

- (1) Federally constructed watershed and water and land programs,*
- (2) National parks and recreation areas,*
- (3) Wild, scenic, recreational rivers and wilderness areas,*
- (4) Wetland and estuary projects and coastal zones, and*

(5) Federal waterfowl refuges.

PUBLIC REVIEW

In order to ensure the coordination of planning principles occurs at the state, tribal, and local level, and that a balanced approach is being taken, any revisions to P&G should be published and provided for public review and comment prior to finalizing.

Action: *Submit P&G to public review*

The revised P&G should be subjected to public review by publishing it in the Federal Register with adequate review time given to receive public comments for consideration in the final version of the guidelines in accordance with the Administrative Procedures Act.

APPLICATION OF COMPREHENSIVE EVALUATION TO SPECIFIC FEDERAL ACTIONS

Some specific concerns have been brought to the attention of the Committee that deal with specific potential or improved applications of the principles of P&G or NEPA and in some cases difficulty in achieving those principles.

Demonstration of collaborative planning

The USACE is currently conducting a 18-month Floodplain Management Assessment study. This study provides a perfect opportunity to include other interested agencies as partners in a collaborative atmosphere. The study is currently being coordinated with other

interested federal agencies. Many of these agencies would prefer to participate as a partner in the Assessment. Active involvement by multi-agencies participants in all aspects of the USACE Floodplain Management Assessment would better ensure a holistic review of the area's floodplain management issues. A collaborative approach would likely identify a broad set of alternative solutions that address multiple problems or multiple state and local objectives. It would also likely build greater trust in and support for findings and recommendations of the report.

Action: *Apply collaborative planning to USACE Floodplain Management Assessment study*

Headquarters of the USACE should direct the North Central Division of the Corps to redirect their current planning process for the Assessment to include a partnership of federal agencies in a collaborative effort to assess the floodplain management objectives of the basin. Funding for this collaborative planning effort should be estimated by USACE, requested in a supplemental budget request, if necessary, and dispersed at the discretion of USACE, the lead agency, as it deems appropriate. If the supplemental request is not approved, USACE should provide the opportunity for other agency collaboration at the expense of each individual agency.

Funding of collaborative planning

Federal agencies are expected to be partners or collaborate in more and more planning situations as the trend is toward ecosystem or watershed based planning. Currently most federal agencies are limited in their ability to participate from an agency funding standpoint without reprioritizing their agency funds. USACE districts are particularly limited due to the project specific nature of their funding and the fact that feasibility studies are cost shared with the non-federal sponsor on a 50-50 basis and their interests are more limited to their particular study area than to the entire watershed. Additional funding is needed for all

federal agencies for the purpose of collaborative planning. While collaborative planning will cost more initially, it is an investment in the future and should significantly reduce future project specific planning expenditures.

Action: Congress should increase funding for federal agencies to support collaborative planning participation with other federal agencies

For major planning studies of an ecosystem or watershed nature, the lead federal agency should budget for adequate funding to reimburse other key federal agencies for their collaborative participation in the study. For studies that are not watershed in scope or which have not been adequately funded to support a multi-agency collaborative effort, individual agencies will have to budget for their own participation monies.

Programmatic NEPA documents

Many times independent NEPA document, on a similar but individual project basis, are inefficient and time consuming approach to decision making. There are efficiencies that can be realized by analyzing all the anticipated actions as a group and applying NEPA on a programmatic rather than an individual project basis. Also, application of multi-agency programmatic environmental impact analyses performed at the watershed scale allows agencies to focus on issues that are geographically related or have timing, impact, or other subject matter similarities. In addition, the programmatic NEPA process provides a formal public involvement mechanism to address strategic decisions. Subsequent impact analyses need only focus on project specific purpose and need and those issues ripe for decisions.¹ Where subsequent plans comport with the programmatic analysis, analysis is focused, costs are reduced, and planning is made more efficient.

Action: *Hold a Council on Environmental Quality workshop on the use of programmatic NEPA documents in the planning process*

A workshop should be sponsored, on strategic and programmatic application of NEPA, by the Council on Environmental Quality so that agencies' success stories in this area can be shared. This will build knowledge about the applicability of these approaches, their utility, and the means of undertaking broad program-level analyses.

Federal agency NEPA participation

Currently lead agencies designate those agencies that should cooperate in the NEPA process. Where agencies have not been designated by the lead agency but specifically request participation due to its vested interest, these agencies should be allowed to cooperate in the process. There is currently no mechanism to require the lead agency to include these other requesting agencies in the process.

Action: *The Council on Environmental Quality should revise the regulations implementing the National Environmental Policy Act to require lead agencies to allow participation by requesting agencies.*

The Council on Environmental Quality should revise the regulations implementing NEPA to require the lead agency to designate those federal agencies formally requesting cooperating agency status, where appropriate. This would assist in meeting the goals of establishing collaborative planning among pertinent federal agencies.

DEVELOP BASIS FOR QUANTIFICATION AND ASSESSMENT OF

ENVIRONMENTAL IMPACTS

Many socially valued aspects of life, such as environmental quality or species diversity, are environmental services that are not sold in conventional markets. Therefore, evaluation methods that do not depend on market prices must be used to estimate the benefits of these services. The non-market value that one would like to obtain from each affected individual is the amount of income the person would be willing to pay which would leave them indifferent between not having the environmental service and having the service (but less money).

Significant research has been done on non-market evaluation techniques. The predominance of this research has been applied in the estimation of recreation benefits, and not to evaluate "passive" services such as ecosystem health. There are two primary approaches used to estimate the value of non-market goods: indirect and direct.² The indirect approach is used with the travel cost method (TCM) and hedonic analyses which are based on the premise that the value people place on services is revealed by the choices they make in consuming them. These techniques depend on the observation of behavior in a particular circumstance and cannot be used for hypothetical situations such as the restoration of a wetland.

The direct approach uses survey techniques to directly elicit a person's value or willingness to pay. The most widely used approach is the contingent valuation method (CVM). Respondents are presented with information about the proposed environmental service (either an improvement or degradation) and then they are asked what the change would be worth to them. The direct approach can also be used to evaluate existence values (the satisfaction an individual receives from simply knowing an environmental amenity exists, or will continue to exist, even though the individual will never use it) and non-existing or hypothetical situations which indirect methods cannot handle. The reliability of estimates from surveys in these situations is often questionable. Experience with the CVM indicates it can be very successful in estimating values associated with recreation outputs for which the

potential user is familiar, for which the product can be clearly defined, and for which a plausible market can be defined. Applications become less successful when the respondent lacks familiarity with the product or the amount, quality, or other attribute of the product can not be clearly defined. This is especially true in trying to measure changes in the quality of environmental amenities or other management actions.

Action: The Administration should direct that scientific research be accomplished to identify state-of-the-art techniques or applications for estimating and assessing environmental and social impacts

Research should identify practical methods and improved techniques to allow a greater consideration of difficult to quantify impacts, both positive and negative, for which there is no market system to assist in the evaluation of the economic value of an output or the willingness to pay to avoid an impact. Research is also needed to improve techniques for measuring the social or environmental outputs and to establish criteria for assessing the significance of the outputs from a regional and national perspective. Many federal agencies, universities, and private consulting firms are currently focusing on research in these areas. A highly respected scientific approach is desired that will cut across individual agency perspectives in an objective manner. The National Academy of Science or some similar organization should be considered as a potential focal point for this research. Federal oversight should be provided by the Council on Environmental Quality. Research and case studies should be completed and recommendations made to the Administration, concerning the appropriate state-of-the-art techniques, within 3 years of initiation of studies.

ESTABLISH PERIODIC REEVALUATION OF FEDERAL WATER RESOURCES PROJECTS

Many water resources projects were constructed a number of years ago. There is a concern that: (1) these projects will eventually need major maintenance expenditures, (2) conditions have changed that make them less effective (such as headwaters development that increases runoff and stages causing level of protection downstream to be lessened), and (3) consideration is not adequately given to changing societal goals with regard to potential modifications to the projects themselves or modifications in the operation of them.

Action: Procedures should be established by the Water Resources Council for the periodic reevaluation of federal water resources projects to include potential operation and maintenance modifications.

Projects for which construction was completed 40 or more years ago should be reevaluated to consider potential project modifications and insure project integrity. Other projects less than 40 years old should be reevaluated when known major problems exist, where conditions have changed that impact the effectiveness of the project, or where changing societal goals demand modifications be considered. Specific procedures should be established and legislation provided in a Water Resources Development Act, or other appropriate legislative mechanisms, to provide the water resources construction agencies with the blanket authority to address these issues, where appropriate, without the need for project specific study authorizations by Congress.

ENDNOTES

1. Council on Environmental Quality. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. 40 CFR Parts 1502.20

2. There are many excellent summaries of non-market evaluation techniques (Smith, 1993; Ribando and Hellerstein, 1992).

Chapter 8

LEVERAGE EXISTING FEDERAL PROGRAMS TO PROTECT AND ENHANCE THE ENVIRONMENT AND INCREASE NATURAL STORAGE

SIDE BAR: "Even before the Great Flood of '93, we had started to realize that some of the areas within our levees should have never been cleared for farming. The events of the last year have driven this point home. Many farmers with marginal and submarginal land are tired of fighting the river and want to find a way to get out from under their financial burdens." - Letter from Union County Board of Commissioners to US Senator Paul Simon (D-Ill), April 1994.

BETTER COORDINATE AND FOCUS FEDERAL LAND ACQUISITION EFFORTS

A number of federal programs exist for fee title or easement acquisition that can be coordinated to provide landowners with alternatives to current land use. Land acquisition did not emerge as a viable risk reduction option early in the 1993 post-flood response period because of limited funds and lack of a participatory mechanism for mixing funds from different agency programs. These programs are implemented on a willing seller/willing buyer basis, and include the SCS Wetland Reserve Program, Emergency Wetland Reserve Program; the COE Missouri River mitigation program; the FWS private lands, refuge acquisition, and the FS forest acquisition program. All of these programs share capabilities

of restoring native fish and wildlife species habitats and addressing the needs of landowners who may wish to discontinue row cropping or who may wish to sell fee title interest altogether. Additionally, non-government organizations (NGOs) also can contribute financially and can assist in coordination between landowners and the range of government agencies. At this time, there is no single federal agency charged with leadership of land acquisition for the federal government. During visits with government agencies and landowners, the Committee found an interest in establishment of one agency as the lead for land acquisition.

SIDE BAR: Multiple agencies after the same land.

Mr. Stan Hinnah's farm on the Missouri River near Glasgow, Missouri was devastated by the 1993 floods. His farm lies in one of the river's high energy zones, where an old channel bed occurred (See Figure Doerenwind geomorphology). When Mr. Hinnah's levee broke, unconsolidated sands in the old channel were scoured out by a surge of water and were deposited across the remainder of his fields. Mr. Hinnah owns other lands in the nearby uplands, and would like to sell his Missouri River bottomland and get on with his farm operations at another location "out of harm's way". When FMRC members spoke with Mr. Hinnah he was frustrated because even though several federal and state acquisition programs were available, none were clearly defined, or able to get funding approved and released to complete the sale. Mr. Hinnah was also confused by the number of governmental units involved in buyouts, and was hesitant to make a deal with any one of them for fear another agency might make him a better deal. Such confusion and delay is not in the best interest of the government or the landowner.

SIDE BAR: NGO INVOLVEMENT IN BUYOUTS!

Nongovernmental organizations (NGOs), such as the Iowa Natural Heritage Foundation and the Conservation Fund, played significant roles in acquisition of the Louisa No. 8 Levee District on the Iowa River, near its confluence with the Mississippi. Louisa No. 8 had a long history of repair from past floods, and although it was eligible for repair under the COE PL 84-99 program, affected landowners expressed an interest in alternatives to continued farming. Due to administrative and authority limits in the land acquisition programs of the federal Disaster Field Office participants, they were unable to directly pool

funds to initiate a land acquisition process. By utilizing funds from the various agencies, the Conservation Fund, the Iowa Natural Heritage Foundation stepped in to provide the brokerage service between the government and the landowners.

Action: *Establish a single agency as land interest/acquisition coordinator/clearer.*

Sharing land acquisition authority between several federal agencies creates confusion and provides opportunities for landowners to "shop around", promoting bidding wars between interested agencies. Taken together, all government land acquisition/easement programs provide a tremendous opportunity to address both landowner and natural resource system needs. Because the mission of the DOI FWS "...is to conserve protect and enhance the Nation's fish, wildlife and habitat for the continuing benefit of the American people...", the FWS should be in a position to effectively guide land acquisition by the federal government. This role does not imply ultimate exclusive ownership and management by FWS but provides for leadership in the identification of the capabilities and interests of other federal agencies, states, tribes, and local resource managers, as well as individual landowners in such ownership and management.

During discussions of federal land acquisition with individuals and local governments, the impacts of lost tax revenue on converted lands was revealed as a significant issue. For acquisitions involving DOI, the Revenue Sharing Act (RSA) of is intended to reduce the financial hardship of lost tax revenues. Further discussions of the RSA with DOI staff indicated that funding of the RSA has not approached the amounts authorized by Congress, and has limited the attractiveness of federal land acquisition in ceratin areas of the country, especially the Midwest.

Action: *Increase funding for the Revenue Sharing Act.*

This, in conjunction with review and revision of implementing regulations will assist in equitable distributions among regions, and address the concerns of local governments where tax base impacts could negatively affect schools and infrastructure.

IMPROVE FLEXIBILITY IN AND USE OF EXISTING AUTHORITIES

In examining the overall federal response to the flood, the Committee was informed of difficulties encountered in developing natural resource enhancement opportunities that also consider landowner needs. In general, interest in full or partial land sale or easement acquisition was limited by uncertainty in the federal ability to execute timely real estate actions. This limitation is due to statutory features of the various agencies' easement/acquisition authorities that prevent spending without completing full procedural cycles. In an disaster response situation, procedural flexibility would be advantageous for both participating agencies and economically distressed landowners.

Action: *Develop emergency implementation procedures for land acquisition.*

To be most responsive to economic hardships during the immediate post disaster period, it is necessary to waive certain procedural components of land acquisition programs that require extended intra and interagency review and comment. It is likely that during non-emergency periods, a programmatic land acquisition plan could be developed by regional agencies that would address full procedural requirements, such as those of NHPA, CWA, NEPA, and ESA, for natural hazard areas.

Action: *Fund programmatic acquisition plans using existing authorities.*

Under the leadership of one agency, all agencies with jurisdiction or special expertise will participate in flood hazard area acquisition planning. Each agency will likely have a particular program specific interest in individual areas within the aggregate hazard area, but within the context of a programmatic document these interests can be integrated to articulate the range of federal, tribal, state, and local interests. Thus during disasters, those lands within previously identified hazard areas could be acquired immediately as funds are available. This would be a similar approach to that used by FWS for acquisition of available parcels within preidentified Waterfowl Production Areas, but will involve a larger group of agencies, depending on the locality.

Action: *Seek legislative authority for flexibility in use of programmed funds*

PL 84-99 provides the USACE with flexibility to reprogram funds from other agency accounts to fund, Presidentially declared, flood response efforts, early on. This enables the COE to more efficiently use appropriated funds to address emergencies and disaster response in a timely manner. Similar legislative authority and flexibility should be provided to other agencies. This would expedite landowner relief and enhance federal ability to capitalize on environmental enhancement opportunities. Any funding used could be reimbursed (if necessary) from supplemental appropriations (when they become available and as appropriate), or by reprogramming funds from other sources within the agency. As an example, FWS was unable to access several million dollars in Land & Water Conservation (LAWCON) funds. If those funds, which had been programmed for other uses, could have been accessed, another option for realignment of some levee repairs could have been made available to land owners, and newly created habitats acquired. The LAWCON account could have subsequently be reimbursed either by special appropriation or transfer from other accounts.

PROVIDE BETTER FOCUS IN ACQUISITION

Federal agencies have begun to focus on ecosystem management in recognition of the function relationships between living resources and physical features of the landscape. This is evidenced by the March, 1994, "Ecosystem Approach to Fish and Wildlife Conservation" promulgated by the USFWS; the April, 1993, "Ecosystem Management Principles and Applications" document prepared by the USFS for the Eastside Forest Ecosystem Health Assessment, and the "Reinventing Environmental Management" document prepared by the National Performance Review, September, 1993. These documents speak to the need for greater interagency coordination and a resultant collaborative approach to managing the health of whole ecosystems.

Action: *Focus land acquisition efforts on problem river reaches/areas with high habitat values*

Ecosystem management plans and programs are in their infancy, as agencies begin to ecosystems and component programs in their charge. Therefore, funding has been minimal and plan development is incomplete. In their absence, DOI should focus leadership of land acquisitions and easements on problem river reaches where known habitat values and threatened and endangered species opportunities exist. In the meantime, Congress should fund and DOI should develop and implement cooperative ecosystem management plans with the states and other agencies. The NBS currently operates a major GIS system for the Upper Mississippi River mainstem, and is in the process of developing GIS capability for the Missouri River mainstem. These facilities should be expanded to cover the resources of the entire basin (funding required), and used in collaboration with the states, NGOs, and other agencies to identify critical habitats, significantly impacted ecosystems, and ecosystem

management opportunities. Ecosystem management opportunities should be implemented by participating states and agencies under site-specific, collaborative management plans developed as part of their own operations.

INCREASE ENVIRONMENTAL ATTENTION IN FEDERAL O&M, CONSTRUCTION, AND RESTORATION

Construction of various federal navigation and flood control projects have impacted federal interest species in many rivers of the Mississippi River Basin.^{1 2 3 4 5} Operation and maintenance of some of these projects continue to impact important fish and wildlife resources, and in some cases accelerate those losses. These problems reached their apex on the Upper Mississippi in the 1970's and 80's, resulting in formation of cooperative interagency management efforts (i.e. Great River Study,^{6 7 8} Upper Mississippi River Master Plan⁹, and Upper Mississippi River Environmental Management Program¹⁰). These programs address both development and natural resource needs, and have satisfied many former interagency conflicts and problems on the Upper Mississippi. However, there remains a need, across the basin, to develop and implement ecosystem management plans, especially on the Missouri River. Such plans would help ensure protection of fragile ecosystems and address the needs of interjurisdictional federal interest species. However, a funding mechanism does not presently exist for development and implementation of such plans. As a matter of practice, agencies responsible for operating and maintaining major development projects should procure funding for representation and participation of sister federal agencies in their major study and implementation efforts. While this is possible through the USACE-FWS Memorandum of Agreement for fund transfers related to Fish and Wildlife Coordination Act compliance during the planning process, there is no authority to transfer funds for support of post construction ecosystem planning. There are no similar funding

mechanisms for state or local participation in either the planning or post construction phases of water resources development.

Action: Require agencies to co-fund ecosystem management using Operation and Maintenance funds

Ecosystem management funding should be provided annually as a standard component of each federal agency's budget, just as annual funding is provided for operation and maintenance of agency development projects (which often impact the subject ecosystem). One of the steps in developing ecosystem management plans would be to document natural resource needs, and to identify those actions which federal agencies can take to offset development impacts and enhance ecosystem sustainability. Implementation of plan components should be funded as part of the development agency's project operation and maintenance or construction budgets. Costs of minimizing environmental impacts would thus become a standard part of a project's "cost of doing business", and be more closely reflected in the cost/benefit ratios of federal projects. The USACE sponsored and DOI/state implemented Environmental Management Program, Long Term Resource Monitoring Program (EMP/LTRMP) should take the lead for development of ecosystem management plans on the Upper Mississippi. Programs similar to the EMP/LTRMP should be authorized and funded elsewhere, especially on the Missouri River to expedite this process.

Action: Provide a report on the ecological effects of relocating slackwater navigation dam control points under the COE Navigation Rehabilitation Study

A potential opportunity to enhance Upper Mississippi River resources exists through alteration of dam regulation operations (dam versus hinge control points) on some USACE slackwater navigation dams.¹¹ Complete evaluation of dam operations should be conducted

under the on-going USACE Navigation Rehabilitation Study to determine if moving all hinge points from mid-pool locations to the dams is feasible and will produce significant benefits. If benefits are significant, and attendant land acquisition is feasible, modification of dam regulation schedules should be implemented.

Action: *Formalize environmental considerations in restoration activity through a coordinated multi-agency effort.*

The 1993 floods caused major infrastructure damage throughout the Missouri and Mississippi Basins. The August 1993 letter of cooperation between the USACE, EPA, FEMA, USDA, and DOI signalled the administration's awareness that disaster response activities must critically reviewed, and provided an impetus for innovation actions using the SCS's Emergency Wetland Reserve Program, Section 1135 of WDRA 86, and the public private partnership for acquisition of the Louisa No. 8 Drainage District. The success of such actions was limited by lack of experience and institutionalization of recovery and response alternatives. The letter established somewhat ad hoc relationships between agencies and programs, that with refinement, should become part of all disaster response activities.

Many drainage districts contain remnant natural features that have been hydraulically disconnected from the mainstem river. During the PL 84-99 review process, resource agencies and landowners sought but were unable to realize structural modifications to levees that would allow for periodic controlled flows between the river and former oxbows or channels. By providing off-channel habitat during spawning periods, such areas could be managed to contribute to the river fishery, as well as maintaining wetland values during other periods. Because PL 84-99 is authorized only for emergency structure repair and not for modification to authorized serviceable projects, new construction for other purposes was not possible. The USACE environmental enhancement authority provided by Section 1135 of WRDA 1986 was discussed with several landowners and drainage district representatives, but

not accepted due to the burden that the cost-share provisions for Section 1135 added to their cost-share responsibilities under PL 84-99. Currently, other federal agencies, such as the FWS, are not able to participate as cost share sponsors and thus unable to pursue natural resource restoration and enhancement opportunities.

Action: *Enact legislation allowing cost-share participation in WRDA 1135 and 906 by federal, state, tribal, and non-governmental organizations.*

By expanding an array of possible cost-share sponsors, and by providing for cost-sharing consistency between Section 906 (Mitigation for constructed projects) it is anticipated that more enhancement opportunities can be leveraged by cooperating federal, state, tribal, and local interests.

Action: *Provide an early report in the USACE Upper Mississippi River - Illinois Waterway Navigation Study of environmental enhancement opportunities in the Upper Mississippi River*

Using the information generated during the DOI ecosystem needs investigation discussed in Chapter 5, the UACE will develop a report detailing the relationship of its ongoing operation and maintenance activities as well as those of new navigation construction alternatives to ecosystem needs identified in the DOI report. Because the Committee believes that it is necessary to identify and act on environmental enhancement opportunities as soon as possible, it is imperative that the USACE establish this report as a milestone in the in the overall study schedule for the Navigation Study. The milestone will be based on the report completion date provided by DOI. The Committee recognizes that the DOI-lead investigation will be collaborative and will include the USACE throughout the investigation, in order to take advantage of information generated by the USACE.

SIDE BAR: COMMERCIAL AND RECREATIONAL USE OF THE UPPER MISSISSIPPI!

The Upper Mississippi River 9-foot navigation project provides for a wide range of recreational uses (e.g. hunting, fishing, boating, swimming, site seeing, etc.). Such recreational use supported over \$1.2 billion in national economic benefits in 1990 (1990 price levels) and over 18,000 jobs. Boating (33.2%), fishing (28.8%), and sightseeing (15.8%) were most popular activities. Visits included 62.7% to developed areas, 26.3% to marina slips, 7.0% to sightseeing areas, and 4.0% to permitted docks.¹² Management of the project for commercial navigation produces some well documented impacts on the River's natural and recreational resources,¹³ including conflicts between recreational and commercial use of the locks. Many impact issues remain unanswered¹⁴.

Action: *Allocate funds for mitigation lands in concert with and at the same pace as project construction.*

Development projects often require agreement to purchase mitigation lands before project construction plans are approved. Although mitigation measures and acquisition of mitigation lands may be authorized, and although agency policy encourages concurrent mitigation, funding of mitigation land acquisition has not proceeded on the same schedule as construction funding. In some cases this has led to unmet mitigation over periods of years. The administration must assure an equitable funding stream where mitigation is required as part of authorized projects.

Action: *Coordinate and support federal stream and riparian area restoration*

Stream and riparian area restoration is vital to watershed management and, for a relatively small investment, holds promise of large returns for improved water quality, habitat and flood control. Ongoing federal agency efforts designed to restore nonurban stream and riparian areas include those of the Bureau of Land Management and Forest

Service.¹⁵ Additionally, nonprofit groups and private and local interests have focused on similar activities in nonurban areas. Unfortunately, stream and riparian sites located within urban and suburban areas are typically degraded, undervalued, and ignored by federal programs. Properly restored, urban streams provide the same benefits as restored rural streams, and often becoming centerpieces for urban revitalization. The need for stream and riparian restoration is clearly recognized, and legislation has been recently introduced in Congress¹⁶ to establish a national urban watershed restoration program. Unfortunately, stream and riparian area restoration activities are largely uncoordinated and unconnected, nationally, and federal expertise in this area, while available, is decentralized and underutilized. Consequently, much valuable information concerning costs, techniques and effects is being lost. Because of the importance of stream and riparian area restoration to water resource management, the federal government should establish a stream and riparian area restoration program within the DOI, and act as a clearinghouse and source of technical assistance for state, local and private restoration activities.

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CHAPTER 9

IMPROVE THE NATIONAL FLOOD INSURANCE PROGRAM

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), is a primary component of the nation's floodplain management strategy. The Congress created the NFIP in 1968 in response to mounting flood losses and escalating costs to the general taxpayer for disaster relief in the belief that insurance is preferable to disaster assistance. NFIP flood insurance is available only in communities that adopt and enforce floodplain management regulations that meet minimum NFIP requirements. The program's objectives are 1) reducing flood damages to new and existing structures, 2) indemnifying property owners from flood losses, and 3) reducing federal disaster assistance expenditures. To encourage participation by communities and in recognition that many floodplain buildings were built or purchased without knowledge of the flood risk, the premiums for buildings built prior to the issuance of a FEMA Flood Insurance Rate Map (FIRM) are heavily subsidized. New construction (post-FIRM construction) is charged an actuarial premium that fully reflects the property's risk of flooding. Currently, 57.8 percent of the policies are charged a full actuarial rate and 42.2 percent are subsidized.

SIDEBAR: NFIP Floodplain Management Requirements

Communities participating in the NFIP must adopt and enforce floodplain management ordinances that:

- Prohibit encroachments in the floodway portion of the floodplain that increase flood stages
- Require that new and substantially improved or damaged residential buildings be elevated to at or above the 100-year flood elevation
- Require that new and substantially improved or damaged non-residential buildings be elevated or floodproofed to at or above the 100-year flood elevation
- Meet any more restrictive state regulations

Critical to achieving program objectives of reducing disaster expenditures and better indemnifying property owners from flood losses is achieving high levels of flood insurance coverage among floodplain occupants. Dependence is currently placed on the mandatory flood insurance purchase requirement contained in the Flood Disaster Protection Act of 1973 and voluntary purchase by other property owners at risk. The 1973 Act requires the purchase of flood insurance by property owners that receive federal grants or loans or loans from a federally supervised, regulated, or insured lender for the acquisition, construction or improvement of structures located in identified special flood hazard areas (100-year floodplain.) Overall for the nine-state region, it appears that no more than 20 percent of structures in the floodplain carry flood insurance, which is substantially below optimal levels.

ISSUES RAISED BY STATES AND COMMUNITIES

At least one state expressed a concern that NFIP requirements were not being adequately enforced by some communities. The Committee is not able to comment on how well communities are enforcing their floodplain management regulations. Most communities the Committee visited have had little floodplain development since the community joined the NFIP. The most critical test will be how well these communities implement the floodplain management requirements that apply to buildings substantially damaged by the Midwest

flood.

States and communities have suggested that FEMA amend its minimum floodplain management criteria to require freeboard, include a more restrictive floodway requirement, and to discontinue the practice of issuing Letters of Map Revision to remove properties from the floodplain that are elevated on fill. Other issues that were raised include providing access above the 100-year flood elevation to all development in areas subject to deep flooding and appropriate standards for agricultural buildings.

SIDEBAR: Insurance is preferred to disaster payments.

The purchase of insurance should be encouraged because it internalizes the risk of locating investments in the floodplain and because it more adequately indemnifies property owners from flood losses. The Midwest flood again confirms the Congressional findings in the Flood Disaster Protection Act of 1973, which states, "... the Nation cannot afford the tragic losses of life caused annually by flood occurrences, nor the increasing losses of property suffered by flood victims, most of whom are still inadequately compensated despite the provisions of costly disaster relief benefits; and it is in the public interest for persons already living in floodprone areas to have both an opportunity to purchase flood insurance and access to more adequate limits of coverage, so that they will be indemnified for their losses in the event of future flood disasters."

Action: *Promote the NFIP Community Rating System as a means of encouraging local floodplain management initiatives.*

Many of the more restrictive floodplain management requirements suggested by states and communities are currently credited by the NFIP Community Rating System which provides discounts on flood insurance premiums in those communities that have implemented floodplain management programs that exceed the NFIP minimum.

INCREASE MARKET PENETRATION FOR FLOOD INSURANCE

Lender compliance/current market penetration

The success of the NFIP in indemnifying property owners from flood losses and reducing federal expenditures for disaster assistance is dependent on property owners purchasing and maintaining flood insurance coverage. The NFIP has not been able to achieve the levels of participation necessary to fully achieve these objectives. This is evidenced by the assistance provided to individuals and businesses during the Midwest flood. While 16,167 flood insurance claims were filed, FEMA approved 89,734 applications for the Disaster Housing Program and 38,423 applications for Individual and Family Grants. SBA approved 20,285 loans for individuals. While many of these applications may be from persons out of identified flood hazard areas or from renters who do not normally purchase flood insurance, many, including most of those who obtained SBA loans, should have had flood insurance either because it was required or because they were at risk.

Estimates of those covered by flood insurance nationwide range from 20 to 30 percent of the insurable buildings in identified flood hazard areas. Initial estimates in the Midwest flood area ranged from below 10 percent up to 20 percent. However, none of the available estimates is authoritative since there is no nationwide inventory of floodprone structures. The Committee was able to obtain reliable structure counts for a number of Midwest communities. Sources of this data include inventories conducted by state and federal agencies, data from community geographic information systems, data submitted by communities participating in the NFIP Community Rating System and counts obtained by Committee members when visiting Midwest communities. Market penetration in these communities ranges from less than 5 percent to more than 50 percent. Market penetration in small rural communities generally appears to be less than 10 percent. For most medium to large communities market penetration appears to be in the 20 to 30 percent range. For a few large communities which have middle income floodplain populations and where there is a high degree of flood hazard awareness on the part of community officials, lenders, and

individual property owners, market penetration can exceed 30 percent and in one instance 50 percent. (Detailed information regarding market penetration estimates may be found in the Appendix).

SIDEBAR: NFIP Market Penetration for Selected Communities

There has been a considerable amount of attention placed on lenders' compliance with the mandatory purchase requirement as evidenced by pending legislation. The concern has been that lenders do not require purchase of flood insurance at closing or do not ensure that flood insurance coverage is maintained for the life of a loan. While there are differences of opinion over how well lenders have complied with the mandatory purchase requirement, it is generally agreed that there is need for improvement and that increased compliance would increase NFIP market penetration. No other explanation would fully account for the low level of program participation. The Committee did not independently obtain data documenting non-compliance by lenders in the area impacted by the Midwest flood.

However, the current dependence placed on the mandatory purchase requirement to drive high levels of market penetration may be unrealistic. According to the American Housing Survey for 1989, 42.4 percent of the owner occupied housing in the nation are owned free and clear of mortgages.¹ An additional percentage of those that are mortgaged were financed by sellers or other individuals or by other lenders that are not covered by the mandatory purchase requirement or were financed prior to the implementation of that requirement. For the nation as a whole, it appears that over half of the owner occupied properties are not subject to the mandatory purchase requirement.

There are additional reasons why NFIP market penetration in the Midwest flood area is not higher than it is. The most striking characteristic about the floodplains in the Midwest communities visited by the Committee is that they appear to be predominantly low income areas with higher than usual percentages of their populations that are renters, elderly, or on public assistance, and a high percentage without mortgages. Also, the nature of housing ownership and sales differs in small rural communities when compared to urban or suburban

communities. Sales occur less often, are often cash sales, financed through land contracts or loans from lenders who are not federally insured or regulated, or are among family members. These small communities are precisely the areas where the mandatory purchase requirement would be applied least often and where voluntary purchase of flood insurance is least likely.

In the view of the Committee, other explanations for low market penetration in the upper Midwest include the false sense of security due to agricultural levees, the reluctance of insurance agents to market flood insurance where there are few potential buyers, and a low level of awareness of the risk to those on the fringes of the floodplain.

Negative Incentives

There is a perception that disaster assistance is far more generous than it actually is. A particular concern expressed by communities and others after the Midwest flood is that disaster victims, particularly those with lower incomes, who obtain disaster assistance from the Individual and Family Grant Program, the Disaster Housing Program, the Red Cross, and other programs may end up as well off as those who purchase flood insurance and are paid claims. The government may have done too good a job in publicizing the availability of disaster assistance and may have raised unrealistic expectations among floodplain occupants. This combination results in negative incentives for the purchase of flood insurance. The government and the insurance industry must ensure that the public is fully aware of the advantages of flood insurance and the limitations of disaster assistance. Floodplain occupants must be aware that disaster assistance is only available during a Presidentially declared disaster while flood insurance claims are paid any time there is a general condition of flooding.

Identification of Those at Risk

Several state and local officials are concerned that there are rural counties with low populations that are not mapped by FEMA but do have floodplains. These areas were not mapped by FEMA because their low populations and minimal development did not warrant expenditures for mapping or because base mapping was not available when the initial identification of floodprone communities was done in the mid-1970s. Funding constraints have limited FEMA's ability to subsequently map these communities given the mapping priority for communities with greater amounts of development. Without floodplain maps the sanctions on federal assistance do not encourage community participation.

In communities that are currently mapped, it is difficult to quickly and accurately identify individual structures located in the floodplain. An inventory of these structures would make it possible to target specific addresses to inform residents of the flood risk and the availability of flood insurance.

Action: *States should actively encourage flood insurance purchase by their citizens*

States must play an active role in improving market penetration for flood insurance by working with communities and lenders, and by assisting in education efforts.

Action: *Increase NFIP market penetration through improved lender compliance with the mandatory purchase requirement.*

The Committee supports current attempts in pending legislation (S. 1404 and H.R.3191) to improve the level of lender compliance. This should include establishment of penalties for lenders who do not require the purchase or maintenance of flood insurance coverage

Action: *Provide for the escrow of flood insurance premiums or payment plans to help make flood insurance affordable.*

The escrow of flood insurance premiums in those instances where the lender escrows property taxes and hazard insurance would ensure that coverage is maintained over the life of a mortgage. Additionally, those who may not be able afford a one time annual payment of a flood insurance premium would be more likely to purchase and maintain flood insurance coverage if it were possible to spread the cost of the premium through the escrowed flood insurance premiums. Payment plans should be provided for those who do not have mortgages and voluntarily purchase flood insurance.

Action: *Develop improved marketing techniques.*

Although improved lender compliance is critical to achieving increased market penetration, it will not by itself drive the levels of insurance purchase necessary to fully achieve program objectives. Additional measures will be required to increase voluntary purchase of flood insurance by those property owners not subject to the mandatory purchase requirement.

Action: *Map all floodprone communities.*

FEMA should map all unmapped communities that have flood hazard areas. This will provide communities currently participating in the NFIP with the information necessary to enforce floodplain management regulations and ensure that individuals at risk purchase flood insurance. Mapping the floodplain will provide an incentive for nonparticipating communities to join the program because federal assistance for acquisition and construction of buildings is not available in designated flood hazard areas unless a community is participating in the NFIP.

INSURE THOSE BEHIND LEVEES

The Midwest flood brought to the forefront issues regarding the residual risk behind levees, the catastrophic damages that can occur, and the false sense of security that develops among floodplain occupants. Most of the levees that were overtopped or failed were agricultural levees not credited as providing 100 year protection. However, levees at Chesterfield, Missouri, and Elwood, Kansas, that were overtopped or failed were credited as providing 100-year protection. Behind these credited levees, the mandatory purchase requirement and floodplain management regulations do not apply. New structures were not protected from flood damage and many buildings were not insured. Other credited levees that protected urban areas were threatened and could have overtopped or failed had floodwaters been higher.

Currently, if a levee meets minimum criteria established by FEMA, that levee is credited as providing flood protection and the area protected is mapped as Zone B or X. In these zones, the application of floodplain management requirements and the purchase of flood insurance are not mandatory. FEMA criteria require that the levee be at or above the elevation of the 100 year flood plus three feet of freeboard and meet certain structural requirements. Levees built by the USACE or other federal agencies are certified by that agency.

The Committee is concerned that the minimum level of protection provided for in NFIP levee criteria and the level of protection the could result from current USACE procedures for selecting the design level for a federally constructed levee are not sufficient given the residual risk to new construction and existing buildings behind levees. The residual risk to a building constructed behind a levee designed to provide protection from a 100-year flood is substantially greater than the risk to a building which is elevated to or above the 100-year flood elevation due to the catastrophic damage that would occur if the levee is overtopped or fails. This difference in residual risk warrants a reevaluation of current federal policies toward levees and levee construction.

SIDEBAR: The Monarch-Chesterfield Levee at Chesterfield, Missouri, is an excellent example of a levee inducing floodplain development and the residual risks that result from dependence on that levee for flood protection. The Monarch Levee was an agricultural levee with an extensive emergency repair history that was upgraded during the 1980's to meet earlier versions of these NFIP standards. Subsequent to the completion of the levee and its being credited by the NFIP as providing 100-year protection, an industrial area developed behind the levee. When it became apparent that the levee might overtop or fail, many property owners were able to purchase flood insurance and received claims payments. Other property owners were not insured because they did not have flood insurance or did not meet the five-day waiting period for coverage. The Committee was able to identify at least 67 flood insurance claims payments behind the Monarch Levee that totaled \$13.2 million. This represents nearly 5 percent of the total flood insurance payments for the nine State region. The flooding of this industrial area had severe impacts to the area not only due to the insured and uninsured damages, but also to the temporary or permanent loss of jobs.

Action: *Require actuarially-based flood insurance behind all levees that provide protection less than the standard project flood.*

Areas behind levees designed to meet current minimum NFIP criteria, but which do not provide protection from the Standard Project Flood (SPF) should be designated as an AL zone. The mandatory flood insurance purchase requirement would apply within this AL zone and new buildings would be charged flood insurance premiums based on actuarial rates. FEMA could establish floodplain management requirements for these areas although elevation or floodproofing to or above the 100-year flood elevation should not be required. This recommendation is similar to a recommendation in the 1982 National Academy of Sciences National Research Council report, A Levee Policy for the National Flood Insurance Program. Further discussion regarding the selection of the SPF for levee protection is contained in the chapter of this report titled "Reduce the Risk to Vulnerability."

A mandatory flood insurance purchase requirement behind these levees would have a number of benefits to the public and to property owners:

- Property owners would be indemnified from the very real possibility that the levee is overtopped or fails.
- Federal expenditures for Disaster Assistance would be reduced.

- Property owners would be more fully aware of the residual risk in building or locating behind a levee.

- Communities would have an incentive to seek higher levels of protection.

Existing Flood Insurance Rate Maps should be revised where appropriate to reflect AL zones.

INCREASE THE WAITING PERIOD FOR FLOOD INSURANCE

Under the NFIP, there is a five-day waiting period between the time that a flood insurance policy is purchased and when coverage becomes effective. If a property is sold and flood insurance is purchased at closing, coverage becomes effective immediately. The intent of the waiting period is to ensure that property owners cannot wait and purchase flood insurance only when floodwaters threaten their building.

The Midwest flood demonstrates that a five-day waiting period is not sufficient for main stem flooding. Of the 16,167 losses due to the Midwest flood, 3,224 (including 476 closed without payment) were for policies purchased after July 1, 1993. Payments for these losses totalled over \$65 million. Most of the losses were for properties in downstream areas behind levees in Illinois and Missouri. Owners of these properties purchased flood insurance after watching upstream levees overtop and fail. In at least one instance a gallant flood fight was undertaken not in expectation of protecting a school, but instead to keep it from flooding until the five-day waiting period had expired. The five-day waiting period provides a disincentive to purchase flood insurance coverage on main stems until flooding is imminent. It is also unequitable for those policyholders who have bought and maintained coverage for a period of years. If the practice became widespread, it could threaten the fiscal soundness of the National Flood Insurance Fund. One consequence of this flood is that some policyholders in the lower basin may drop their coverage in expectation of having time to purchase coverage based on flood forecasts.

Action: *Establish a 15 day waiting period for flood insurance*

The five day waiting period is too short for main stem riverine flooding such as occurred in the 1993. FEMA should consider whether longer waiting periods than 15 days are advding.

REDUCE RISKS TO BUILDINGS THAT ARE SUBSTANTIALLY DAMAGED OR REPETITIVELY DAMAGED

NFIP minimum criteria require that substantially damaged or otherwise substantially improved buildings meet most requirements for new construction including the requirement that residential structures be elevated to or above the elevation of the 100-year flood. Substantial damage means that the cost to repair the building to its before damage condition equals or exceeds 50 percent of the market value of the building prior to the flood. Buildings that are substantially damaged are also subject to actuarial rates for flood insurance.

The substantial damage requirement has been difficult to enforce because property owners often do not have the funds necessary to meet it or to obtain replacement housing. The substantial damage requirement is an integral part of the NFIP's strategy to reduce future damages to existing floodprone development.

For the Midwest flood and for several other recent catastrophic disasters, FEMA has allowed communities to use replacement cost instead of market value for calculating substantial damage except where state regulations are more restrictive. The use of replacement cost usually means that far fewer structures will substantially damaged. This change has been a source of controversy in the Midwest for two reasons. First, the change was not communicated to many communities early enough. Some communities had already made determinations based on market value and now had to recalculate based on replacement cost to placate affected property owners. Second, because fewer buildings are substantially

damaged using replacement cost, some states and communities believed that continuing to use market value would have been consistent with sound floodplain management since more buildings being elevated, demolished, or relocated. Persuasive arguments can be made for using either market value or replacement cost to define substantial damage. It is necessary to decide on a definition and be consistent.

A related issue is that of repetitively damaged structures (damaged on two or more occasions since 1978). These buildings currently account for 35.9 percent of all NFIP losses and 44.2 percent of all payments. Unless these buildings are substantially damaged by one flood event, no regulatory requirements apply and flood insurance continues to be available at highly subsidized rates. There are significant numbers of these repetitive loss buildings (including buildings that have had as many as eight losses) in areas in Missouri and Illinois.

**SIDEBAR: NATIONAL FLOOD INSURANCE PROGRAM REPETITIVE LOSS
BUILDINGS IN NINE MIDWESTERN STATES 1978-1993**

State	Buildings	Losses
Missouri	3,268	10,038
Illinois	1,351	3,774
Iowa	287	565
Nebraska	247	608
Minnesota	201	627
Kansas	175	441
North Dakota	142	713
Wisconsin	66	177
South Dakota	16	35
Total	5,723	16,978

St. Charles County, Missouri alone has 1,055 of these buildings which have sustained a total of 3,625 losses. Other communities in the surrounding counties of Missouri and Illinois also have large numbers of these buildings. These are areas with chronic flooding problems. Because many of these repetitive loss buildings were probably substantially damaged by the Midwest flood, rigorous implementation of the requirement should reduce the numbers of these buildings.

Action: *Continue to enforce substantial damage requirements. Decide on a definition of substantial damage and stick to that definition.*

FEMA should decide on a definition of substantial damage/substantial improvement and stick to that definition. This will eliminate confusion and improve the overall level of enforcement of NFIP regulations.

Action: *Provide insurance coverage for mitigation actions to comply with local floodplain management regulations*

Critical to continued enforcement of the substantial damage requirement is providing NFIP flood insurance coverage for the costs of elevating, floodproofing, or relocating substantially damaged buildings. Currently, the flood insurance policy pays only for the repair of physical damage to the building. Mitigation insurance has a number of advantages:

- It provides for consistent enforcement of the substantial damage regulatory requirements.
- It more fully indemnifies policy holders from flood related losses.
- It is funded by flood insurance premiums and not by appropriated funds.
- The flood insurance claims adjustment procedure is an efficient way to deliver assistance.

The National Flood Insurance Reform Act of 1993 (S. 1405 which has passed the Senate) authorizes the NFIP to provide mitigation insurance. Similar legislation pending in the House of Representatives (H.R. 3191) provides for a study of mitigation insurance.

Action: Develop a program to reduce losses to repetitively damaged properties

Repetitive loss buildings still account for a disproportionate percentage of NFIP losses and represent a significant liability for the NFIP. FEMA should develop a strategy to address these losses that includes flood insurance premium surcharges and increased deductibles. This should more accurately reflect the increased risk to these buildings and provide an incentive for protecting the buildings from flooding. Mitigation insurance should cover mitigating losses to the worst of these structures. Buy-outs and other mitigation initiatives recommended in Chapter 10 should place a high priority on these buildings. When these structures are substantially damaged, the requirement should be rigorously enforced.

IMPROVE ACCURACY AND TIMELINESS IN NFIP MAPPING

At the core of any floodplain management program is knowledge of the floodplain boundary. It is imperative, as a nation, we have an adequate floodplain mapping program to achieve our floodplain management goals.

The flood risk information presented on the NFIP's Flood Insurance Rate Map (FIRM) forms the technical basis for the administration of the NFIP and is utilized nationwide. Since the creation of the NFIP 25 years ago, approximately 23,000 communities have been identified as floodprone. Nearly 21,000 of these communities have been mapped. Over 18,300 communities are participating in the NFIP.

SIDEBAR: USERS AND USES OF NFIP MAPS

<u>WHO</u>	<u>WHY</u>
Communities participating in the NFIP	Enforce floodplain management ordinances
State and local floodplain managers	Enforce regulations and support decision-making
State and local emergency managers	Response and recovery planning
Federal agencies	Ensure compliance with EO 11988
Federal Insurance Administration	Establish actuarial rates for flood insurance
Insurance companies and agents	Rate flood insurance policies
Lenders	Make determinations on the requirement for flood insurance
Designers of floodplain development	Determine design requirements
Disaster response agencies	Disaster response and recovery activities

States and communities indicated to the Committee that for some areas, the maps are out of date, inaccurate, take too long to get revised, or may not exist. Others encountered difficulty in obtaining copies of the maps. FEMA's current program for maintaining and distributing maps is funded entirely by the flood insurance policy holders through a \$25 surcharge on each flood insurance policy. The annual mapping budget is \$36 million. This surcharge also covers all administrative costs of the NFIP. This level of funding allows FEMA to initiate about 250 studies per year and to respond to requests to update maps based on local or state supplied data. A small portion of the budget goes to the digital conversion of the maps. About \$4 million annually goes to the printing and distribution of the maps.

FEMA is striving to automate the mapping process as much as possible under current funding constraints. Beginning in FY 95, all engineering studies contracted by FEMA will be submitted in digital format. A tool for automated review of engineering models has been developed. The mapping program has recognized the benefits derived from using digital technology, but it has not been fully implemented through to the final phase of the map production process. Because there exists a large inventory of old, traditionally mapped FIRMs that do not meet national map accuracy standards, the addition of horizontal control to the FIRM has become part of the digital conversion process. The current level of production of digital map panels is slightly over 2,000 panels per year. Given the level of funding and current procedures, it would take 40 years to complete the digital conversion of 80,000 map panels nationwide.

FEMA is currently drafting a plan for flood studies maintenance that will provide a method to inventory and prioritize nationwide floodplain mapping needs every five years. This plan has not been finalized; therefore, the inventory has not begun.

Action: *Fund some floodplain mapping from appropriated funds.*

Appropriated funds should be added to the money currently supplied by the flood insurance policy holders. Flood insurance payments for the 1993 flood totaled \$297 million, a small percentage of the federal payments for this disaster. Clearly, the federal government has an interest in maintaining and updating the NFIP's \$1 billion investment in floodplain mapping to ensure that all levels of government and individuals have the information necessary to manage their floodplains and reduce future damages.

Action: *Utilize technology to improve floodplain mapping.*

FEMA should investigate alternative methods of expediting the conversion of the FIRMs to digital format. Digital conversion will result in a long-term cost savings because of the ongoing map maintenance requirements. The digital format will enable the efficient accommodation of large as well as small changes to the maps and result in more accurate maps. Digital floodplain boundary information combined with land parcel records from a community or street address range data such as is available from the U.S. Bureau of the Census TIGER files will efficiently enable many floodplain management applications. The simplest and most common use is to look up the flood risk data for a specific address. Some areas in which FEMA would realize savings and increase efficiency are in processing certain revisions, verifying insurance ratings, analyzing repetitive loss data, assuring local compliance, and marketing.

Action: *Support structure-based data for Geographic Information Systems (GIS) and use at the local level.*

Floodplain mapping should be an easy tool for local communities to use. Ideally, a community would have a land parcel database in their GIS containing structure locations. Combining the community's GIS with digital floodplain mapping would quickly provide information about flood risk for a specific site. Furthermore, structure-based data at the local level are useful for any type of hazard identification and all emergency situations.

Action: *Determine buildings at risk making full use of available Geographic Information Systems.*

A national inventory of structures should be performed to determine the number, building type, and functional uses of structures at risk in the Nation. This data and the risk analysis that would become possible could for the first time allow the Nation to focus mitigation and pre-disaster planning at specific areas of high risk. At the same time, funding for these activities could be targeted and adjusted in relation to the degree of exposure to the relative risk. In the event of a disaster, an immediate assessment of response needs would be available in summary format. Other possible potential users of such a database are communities, lenders, planners, citizen groups, and underwriters. This database would serve as a cornerstone in the national spatial data infrastructure recommended by the National Performance Review and endorsed by the Federal Geographic Data Committee.

ENDNOTES

1. U.S. Department of Commerce and U.S. Department of Housing and Urban Development, "American Housing Survey Data Chart," Washington, D.C., 1989.

Chapter 10

STREAMLINE FEDERAL PRE-DISASTER, RESPONSE, RECOVERY, AND MITIGATION PROGRAMS

A floodplain management plan that attains the national goals described in the vision statement is dependent on the ability to tie together pre-disaster, recovery, and mitigation programs with long-term floodplain planning efforts. Many federal agencies have programs designed to help a disaster-struck area, but improvements can be made by streamlining the system so that each part is a natural extension of the other. Comprehensive pre-disaster planning and mitigation efforts will reduce risks and damages during the emergency and recovery efforts will be coordinated and be consistent with long-run floodplain management goals. Improvements in federal coordination were made before the 1993 flood event, and communities reported that things worked "better than expected." There were still many problems in the system and there is room for improvement. This chapter builds on the lessons that were learned and offers recommendations for streamlining federal and state programs.

INCREASE PRE-DISASTER PLANNING

In 1980, the Office of Management and Budget ordered coordinated federal post-disaster response to identify means to mitigate hazards and established a FEMA-led Interagency Hazard Mitigation Task Force¹. Thirteen federal agencies agreed to participate in

FEMA-led interagency hazard mitigation teams established for each Presidentially-declared disaster². There has been strong participation by the USACE, Soil Conservation Service, and National Weather Service in the teams and these agencies' state counterparts. While the MOA does not establish the state's role in the teams, FEMA has encouraged states to lead these teams to build expertise transferrable to disasters not needing federal disaster assistance. Participation by the other federal agencies is typically limited (see Table 10-1), probably because of limited staffing and travel resources and the perceived tangential nature of this activity to agency mission and lack of high level support, however, for the Midwest flooding, most federal agencies participated. Activation of the 13 agency team is not necessary for each Presidentially-declared disaster event; however, high level coordination at the regional level is desirable to review and determine each agency's desired level of involvement for each Presidentially-declared disaster.

While the Federal Interagency Floodplain Management Task Force³ and the Interagency Hazard Mitigation Task Force provide for interagency exchange of information, neither has successfully created the interagency dynamic and commonality of purpose regarding activities in floodplains. Separation of the two Task Forces serves to perpetuate a distinction between hazard mitigation and floodplain management when, in fact, the former is a key component of the latter. Neither has provided a link between emergency response and recovery, hazard mitigation (including multiple hazards) and floodplain management at large. While both provide some information transfer, they do not coordinate federal funding (to focus on priority problems), provide research oversight, planning advice, nor issue resolution. Coordination between emergencies among federal agencies needs improvement. An emergency's high priority issues fade into agencies' daily activities with little resolution. In 1986, the Army and Soil Conservation Service signed an Memorandum of Agreement⁴ to establish engineering standards for levees. In 1993, when the flood occurred this had not been done and as a result, created additional confusion. This same MOA established the levee repair responsibilities of the USACE and SCS; however, no attempt to map this distinction was made until months into the flood recovery.

Action: *Enhance the link between response, recovery and floodplain management activities.*

Increasing the amount of coordination between the Interagency Hazard Mitigation Task Force, the Interagency Floodplain Management Task Force, and other groups involved with emergency response, will help link these activities into a seamless organized set of functions. Increased support and interest, of all federal agencies, in between disaster events, by active participation in these Task Forces as well as other groups addressing issues germane to floodplain management would facilitate and enhance all facets of floodplain management, including disaster planning, recovery, and hazard mitigation.

Action: *Hold an interagency strategic planning meeting for all Presidentially-declared disasters.*

Coincident with deliberations regarding each proposal for a Presidential disaster declaration, FEMA should hold an interagency strategic planning meeting to review and determine necessary or desired the level of involvement of each agency. This would enable each agency to be briefed on the situation and determine its level of involvement. More efficient interagency coordination, early enlistment of agencies, and clear direction regarding agency level and type of involvement should result.

Action: *Continue to seek state leadership of interagency hazard mitigation team.*

State leadership of Hazard Mitigation Teams formed in response to a Presidentially-declared disaster would recognize the state floodplain management responsibility. In addition, the experience gained by the states' participants will facilitate pursuit of hazard mitigation opportunities on state or locally declared disasters and should decrease federal expenditures in the future through implementation of additional hazard mitigation activities.

Table: 10-1
INTERAGENCY HAZARD MITIGATION TEAMS

This table is based on a review of all FEMA Interagency Hazard Mitigation Team Reports for disasters between June 1992 and the 1993 Midwest floods.

	<u>June 1992 - July 1993</u>	<u>1993 Mid-west Floods</u>
Total Number of Teams Activated	14	6
<u>Federal Agencies Number of Times Participated/Contributed</u>		
Federal Emergency Management Agency	14	6
USACE of Engineers	12	6
Soil Conservation Service (USDA)	11	6
National Weather Service (DOC)	10	6
US Geological Survey (DOI)	5	2
Housing and Urban Development	5	5
Small Business Administration	4	2
Environmental Protection Agency	3	3
Department of Energy	2	0
Forest Service (USDA)	2	1
Economic Development Commission (DOC)	1	2
Department of Transportation	1	3
Public Health Service	1	1
Bureau of Reclamation (DOI)	1	NA*
US Fish and Wildlife Service (DOI)	1	3
Bureau of Indian Affairs (DOI)	1	1
National Ocean Survey (DOC)	1	NA
National Park Service (DOI)	0	1

* NA = Not Applicable

PRE-DISASTER PLANNING

Pre-disaster planning needs to include and coordinate individual, business, community, state, and federal personnel and activities to minimize human health and safety impacts as well as environmental risks and assure adequate response. Awareness of flood threat is the first step in pre-disaster planning and relies on individuals understanding their risk and planning for disasters. Individual responsibility in knowing what to do (e.g., closure household gas lines, when to evacuate, where to evacuate) in the event of an flood (or other) emergency is essential; but needs in significant improvement. The Committee learned from communities of numerous circumstances where mobil home trailers (on wheels) and farm equipment were not removed from low lying areas and where individuals refused to voluntarily evacuate but later required evacuation by air or boat).

Pre-disaster planning is also a corporate responsibility. Facilities generating, storing or disposing of hazardous materials -- including farmers that use herbicides, pesticides, and fertilizers -- also need plans for their removal should they lack the capability to assure no materials will be released. Local emergency managers need to be aware of locations of hazardous materials within their jurisdiction; local hospitals and fire companies and others potentially involved with response need to be knowledgeable about threats posed by these materials, their treatment, containment, and removal in the event of an unplanned release. Emergency managers and facilities responsibilities obviously extend far beyond hazardous materials response. However, several emergency managers involved in the Midwest flood, noted to the Committee, the need for more pre-disaster information about and during coordination with facilities and persons generating, storing, and disposing hazardous wastes.

Pre-disaster planning requires action, involvement and cooperation between not only the floodplain residents, businesses, and industries, but also across and between local, state, and federal governments.

Action: *Enhance pre-disaster planning and training.*

FEMA, in coordination with the EPA, USACE, USDA, DOT and other federal agencies involved with aspects of emergency response, should increase state, local, public and corporate awareness of risk and preparation and practice implementation of pre-disaster plans. EPA should work with FEMA and states to emphasize local pre-disaster planning, including notification and coordination procedures, for response to releases of hazardous materials. Development of pre-disaster plans for spilled hazardous materials would allow pre-event identification of suitable containment areas and development of coordinated response of the emergency network.

Action: *Encourage States and communities to develop and implement floodplain management and hazard mitigation plans through the NFIP Community Rating System and through other incentives.*

The irony of the Midwest flood is the sharp contrast between the nearly \$800 million that is now available for buy-outs and other mitigation actions and the almost complete lack of funding available for on-going mitigation programs. Pro-active on-going mitigation programs can significantly reduce federal expenditures in future disasters and can be more cost effective than programs established or funded through supplemental appropriations. In addition, the floodplain management and hazard mitigation plans and technical expertise developed in administering these on-going programs provides a foundation for success mitigation programs after major disasters.

Funding for on-going mitigation and planning activities by states and communities should be provided that is not dependent or triggered by a specific disaster. One source of funding could be a fund established out of NFIP premium dollars (such as that provided for in S.1405 and H.R. 3191). A portion of these funds would be available to assist states and

communities in developing floodplain management plans. Funds would be limited to insured structures. These bills allow for state delegation and state or community applications. Other sources of funding could include a percentage of the moneys appropriated for the FEMA Disaster Fund or other appropriated funds.

STREAMLINE PROGRAMS FOR BUYOUTS AND OTHER HAZARD MITIGATION ACTIONS PRIOR TO AND FOLLOWING FLOODS

Hazard mitigation includes all actions that can be taken by individuals and communities to reduce damages from flooding or any other hazard. Examples of hazard mitigation actions that are commonly taken after a flood are buy-outs (acquisition and relocation), elevation, or floodproofing of damaged buildings, construction of structural flood protection measures, establishment of flood warning systems, flood hazard awareness programs, and similar actions.

The administration has established buy-outs of flood damaged properties as the first priority for mitigation funds available for the Midwest flood. As of April 25, 1994 applications from 61 communities for acquisition or relocation of 4,181 buildings had been approved. Other applications are pending and as many as 6,000 buildings will be acquired or relocated in areas that were impacted by the Midwest flood. The buy-out initiative represents a significant turning point in flood recovery policy since it is the first time that buy-outs have been attempted on such a large scale.

Buy-outs are the appropriate response by the federal government for this flood and for floods like it. Many of the buy-out neighborhoods have been repetitively damaged by flooding, are subject to deep and long duration flooding, and were isolated by floodwaters for extended periods of time. In addition, a significant percentage contain older, lower value housing, much of it poor quality and in need of rehabilitation. Under the right circumstances

the buy-outs will not only reduce flood damages and protect people and property, but also achieve other objectives such as improving the quality of affordable housing, increasing recreational opportunities or wildlife habitat, and general betterment of the community.

Prior to the current buy-out initiative, the primary federal response to mitigating damages to flooded structures was the substantial damage requirement implemented by communities participating in the National Flood Insurance Program (NFIP). Buildings that are damaged by a flood, or other event, so that the cost of repair is equal to or greater than 50 percent of the market value of the building prior to the flood are substantially damaged and must meet program requirements for new construction such as elevating buildings to above the 100-year flood elevation. Substantially damaged structures also become subject to actuarial rates under the NFIP. While enforcing a substantial damage requirement is critical to achieving long-term objectives of reducing flood damages, financial assistance will be required to assist those property owners who cannot afford to elevate or relocate their buildings or obtain replacement housing. The buy-out initiative in part meets this need.

Individuals and communities impacted by the Midwest floods appear to be far more receptive to buy-outs than after past floods. The duration of the flooding and the multiple flood crests and flood fights created incredible stress for floodplain occupants and for communities. By the end of the summer, floodplain occupants just wanted out. Often in the past, a flood was regarded as a one time event. If there was interest in acquisition or relocation, this interest often waned with time as memories of the flood faded.

Implementation of the buy-out has not been without problems. There were significant obstacles that had to be overcome to make the initiative work with resulting confusion and uncertainty among states, communities, and individuals. Since no federal or state agency had ever attempted a buy-outs on this scale, policies and procedures had to be invented and the relationship between programs established during the recovery period. Mechanisms had to be created to coordinate programs and provide technical assistance to small communities with limited resources and expertise and expedited procedures developed for compliance with the NEPA, Historic Preservation, and other federal mandates. While the Committee applauds

the work of the federal and state agencies in adapting existing programs to make buy-outs work, much still needs to be done to consolidate the gains that have been made and to position the government for future buy-outs and other hazard mitigation initiatives.

A critical issue is how to transfer the experience gained on buy-outs and other mitigation actions gained from the Midwest floods to other flooding events. The Midwest Flood is a unique event that covered a nine state area, impacted over a thousand of communities, and required large supplemental appropriations. For more typical floods there are no supplemental appropriations and mitigation actions must be funded out of the Section 404 Hazard Mitigation Grant Program, FEMA's Section 1362 program and other existing programs.

SIDEBAR: PRINCIPAL SOURCES OF FUNDING FOR BUY-OUTS

Department of Housing and Urban Development Community Development Block Grants (CDBG)-The 1993 Supplemental Appropriation included \$200 million for the CDBG program to assist in acquisition and relocation and in meeting other housing needs. The 1994 Earthquake Supplemental included an additional \$250 million for a total of \$450 million.

Federal Emergency Management Agency Section 404 Hazard Mitigation Grants-The Hazard Mitigation and Relocation Assistance Act of 1993, signed into law on November 19, 1993 revised the formula for determining the amount of Section 404 Hazard Mitigation Grant in the Stafford Act and changed the cost share to 75/25. Under the revised formula the available Hazard Mitigation Grant Program funds were increased to \$134.9 million for the Midwest Flood.

Economic Development Administration (EDA) Grants-The 1993 Supplemental Appropriation included \$200 million for EDA for grants to States and communities to preserve or create jobs or upgrade infrastructure. The funds can be used to assist in the relocation of businesses or for the infrastructure needed to support those businesses.

National Flood Insurance Program Section 1362 Flood Damaged Property Purchase Program-Several million dollars from the appropriation for the NFIP Section 1362 program for acquisition of insured properties were available. These funds are paid for out of the National Flood Insurance Fund using premium dollars.

Other Programs-Funds were available from other Programs such as the FEMA Public Assistance Program to assist in various aspects of buy-outs and relocation. SBA loans are available to help individual property owners not eligible for CDBG moneys.

One of the themes throughout the Committee's meetings with states, communities, organizations and interest groups has been the need for common policies and procedures among federal agencies participating in buy-outs and other mitigation activities. The current initiative with multiple programs, applications, and eligibility requirements is overwhelming to communities even with the improvements that have been made to date. As a corollary there is a need for sufficient flexibility in these programs to be able to respond to a variety of flooding conditions or other circumstances up to and including responding to other types of disasters. While federal and state agencies have done an admirable job in working within the constraints of their current programs to make buy-outs work, there is a need to consolidate the gains that have been made and to make long-term fixes that can improve federal agency response for future disasters. The appropriate time to make these fixes is before the next event not during it.

The Committee agrees that expedited decisions on buy-outs would reduce uncertainty by property owners and avoid some needless expenditures to make minimal repairs to houses that are subsequently purchased. However, this duplication cannot be entirely avoided. Time is required to properly conduct a buy-out, particularly for relocation of buildings or neighborhoods. There will continue to be situations where making minimal repairs to a structure will be more cost effective than providing rental assistance through FEMA's Disaster Housing Program.

Action: *Maintain sufficient flexibility in hazard mitigation programs to allow use of the most cost effective and appropriate mitigation techniques.*

Buy-outs are the optimal solution for many neighborhoods impacted by the Midwest floods due to the depth and duration of flooding. However, there are circumstances where other mitigation techniques may be the most cost effective methods for reducing flood damages with the least impacts on the community and the environment. In areas of shallow, short duration flooding, elevation of structures on site may be the preferred alternative.

Where high groundwater or sewer back-up floods basements in or out of identified flood hazard areas, the optimal mitigation action could be drainage improvements, upgrading a sewer system, or installing backwater valves. Future mitigation initiatives must be flexible enough to appropriately respond to these differences.

Action: *Establish a task force to develop common procedures for federal programs for buy-outs and other mitigation actions.*

A federal interagency task force effort is needed to coordinate pre- and post-disaster buy-outs and other hazard mitigation actions. The task force should include representatives of those agencies which could be involved in a buy-out program as well as those agencies with responsibilities for consultation and oversight on compliance with laws and executive orders. The task force should (1) develop common policies and procedures among agencies for buy-outs and provide for increased flexibility in programs to respond to the unique circumstances of a disaster, (2) address compliance with the NEPA, applicable Executive Orders, Historic Preservation requirements, and other federal mandates during multi-agency buy-outs, (3) design delivery systems to expedite buy-out decisions to be responsive to disaster victims and minimize duplication of assistance in instances where properties are to be bought out, (4) identify statutory and regulatory barriers to conducting buy-outs and other mitigation actions and propose changes where appropriate, and (5) make recommendations on whether all funds from future supplemental appropriations should be channelled through a single program such as the Section 404 Hazard Mitigation Grant Program rather than provided through multiple agencies and programs. Coordination issues that arise during future disasters should be resolved through the Interagency Hazard Mitigation Task Force.

Action: *Encourage the establishment of task forces chaired by state government to coordinate buy-outs and other hazard mitigation activities in each state.*

One of the success stories of the Midwest floods is the creation and operation of state task forces to coordinate buy-outs and other mitigation actions. These task forces include participation by representatives of state agencies and of field offices of various federal agencies. In some cases, communities have had to make only one application to the task force which determines the funding sources and how much to make available to the community. These task forces have proven to be important forums for resolving differences between agencies and for coordinating buy-out programs. They have had the additional benefit of involving agencies that previously had not done floodplain management. Operating at the state level, they could effectively coordinate future buy-out programs and package 404 funds with other available state and federal funds.

Action: *Provide states the option of receiving Section 404 Hazard Mitigation Grants as a block grant.*

States should be given the option of obtaining Section 404 Hazard Mitigation Grants in the form of a block grant subject to general federal requirements in those instance where the state has adopted a hazard mitigation plan. Allow the states the flexibility to use 404 funds and other federal funds in conjunction with other state, and local moneys in the most efficient way.

States have indicated an interest in coordinating buy-outs and other mitigation actions after disasters and feel they could expedite these actions if they could obtain Section 404 Hazard Mitigation Grants in the form of a block grant. The Committee agrees that there is merit to a block grant and this should be an option if the state has adopted a floodplain management or hazard mitigation plan. This would have the added benefit of providing greater flexibility to the benefit of individuals and all levels of government. The block grants would still be subject to cost share and to general federal requirements. In addition, a prerequisite for receiving a block grant should be the adoption of a state hazard mitigation plan. Issues such as compliance with NEPA, the Endangered Species Act, Historical

Preservation, E.O. 11988 (as revised) and other federal mandates and Executive Orders would have to be addressed. While HUD under the CDBG program is authorized to delegate these responsibilities to states and communities, FEMA is not. It should be noted that, under the current program, states currently have considerable latitude in establishing priorities and allocating Section 404 moneys.

Action: For major disasters where supplemental appropriations are made for buy-outs and hazard mitigation, provide those funds through the Section 404 Hazard Mitigation Grant Program.

For the Midwest flood funds for buy-outs and other hazard mitigation activities were provided to several agencies and programs. For major disasters such as the Midwest flood which require supplemental appropriations, a better approach is to make the supplemental appropriation to the Section 404 Hazard Mitigation Grant Program. FEMA should issue mission assignments to other agencies that have expertise in community development and can provide technical support to states and communities in developing buy-out programs. Because the money would be provided to a single agency, there would be a single set of policies and procedures. This approach should be reviewed by the task force developing common policies and procedures.

PROGRAMMATIC BUYOUTS AND OTHER HAZARD MITIGATION ACTIONS

The current buy-out program is funded primarily through supplemental appropriations which are made only after extraordinary floods and other disasters. Most flood events impact on much smaller geographic areas and may not even result in a Presidential disaster

declaration. Programs need to be in place to accomplish buy-outs and other appropriate mitigation for these floods.

SIDEBAR: Beatrice NE, Austin, MN - Places that budget for buy-outs.

Action: Establish a programmatic buy-outs and hazard mitigation program with funding authorities independent of disaster declarations.

The money currently available for mitigation activities is that in existing programs -- such as the Section 404 Hazard Mitigation Grant Program, the NFIP Section 1362 program, SBA loans to individuals -- and any moneys remaining available from funds allocated to the state, and its communities, through CDBG and EDA. Recent changes to the Section 404 Hazard Mitigation Grant Program to increase the available funding will help.

Mitigation insurance coverage through the NFIP also should be a component of such a program. Mitigation insurance would provide coverage that pays the costs of bringing insured buildings that are substantially damaged by floods into compliance with community floodplain management regulations either by elevating, floodproofing, demolishing or relocating the building. The coverage would be funded by flood insurance premiums and be part of the claims adjustment process. This insurance coverage would support community floodplain management regulations, increase the effectiveness of flood insurance in meeting the financial needs of policyholders, and, over time, reduce the need for federal subsidies for pre-FIRM floodprone buildings.

A further element of the program should include cost shared funding for on-going pro-active planning and mitigation independent of disasters. This element should include provisions for a mitigation fund financed out of NFIP premiums (such as that provided for in S. 1405 and H.R. 3191) for state and community mitigation projects and planning. Projects financed by the mitigation fund should principally help insured buildings. In addition to this mitigation fund, the program should grant FEMA discretionary authority to allocate a

percentage of its annual appropriations for Disaster Assistance Fund for state and community hazard mitigation planning and mitigation.

Action: Federal agencies should encourage the use of CDBG, EDA, and other funding to do acquisition and relocation and take other mitigation actions where consistent with objectives of that program.

The Midwest flood of 1993 demonstrates that there is often a commonality of objectives between mitigation actions to protect neighborhoods and businesses from flooding and the missions of the various federal housing and development programs to provide safe and sanitary affordable housing and create and preserve jobs. For example, many of the neighborhoods that were most severely impacted by the Midwest flood are low income neighborhoods that contain substandard housing. Often these neighborhoods further deteriorate as a result of floods or the threat of floods. Similarly, efforts to create or preserve jobs are stymied in some communities by a flood threat that prevents businesses from expanding or results in their relocation to other communities or regions. Agencies administering these programs should continue to be active participants in floodplain management initiatives.

SIDEBAR: Pending Legislation

Legislative initiatives are pending that provide for increased financial assistance for mitigating flood damages. The National Flood Insurance Reform Act (S. 1405) has passed the Senate. The bill provides for mitigation insurance that would pay for the additional costs of elevating, floodproofing, demolishing or relocating substantially damaged or repetitively damaged buildings (2 in 5 Years averaging 25%). A mitigation program funded by \$20 million from the national Flood Insurance Fund is also established at a 75/25 match for State and community mitigation projects to reduce damages to other insured buildings. A portion of these funds are available for State and community mitigation planning.

Similar legislation (H.R. 3191) that has passed committee in the House of Representatives provides for a study of mitigation insurance and establishes a mitigation fund of more than \$30 million per year for State and community mitigation projects and planning. These projects through a surcharge on flood insurance policies. Neither bill addresses mitigation for uninsured buildings.

PROVIDE INCREASED FOCUS IN RECOVERY EFFORTS

FEMA was established to consolidate all the federal emergency management programs. Over the last several years, the leadership of the recovery portion of disaster response for larger disasters has been assigned to other agencies in an attempt to provide a more responsive system.⁵ However, these agencies do not have the collective experience in disaster recovery offered by FEMA nor an expansive knowledge of federal floodplain management goals and existing recovery and hazard mitigation (including multiple hazards) and programs and opportunities. A single agency is needed to coordinate federal flood response and recovery activities because: 1) response and recovery are integrally linked, and 2) it develops and allows maintenance of a core knowledge of the full suite of federal programs available to assist recovery. By decoupling flood response from flood recovery, hazard mitigation and floodplain management opportunities may be diminished as other agencies do not have as great a financial stake in ensuring change toward sustainable activities in the floodplain. By thwarting these goals, these actions may serve to put more people and property at risk and will increase long-term federal taxpayer support for disasters.

A balance must be struck between being responsive and flexible while not adding to the inherent confusion resulting from any disaster.

Action: *Issue an Executive Order integrating federal flood response and recovery under FEMA.*

Integrating coordination response and recovery activities under one agency (FEMA is suggested)) will serve to establish the link between response and recovery and help further achievement of floodplain management goals. Development of a Federal Response and Recovery Plan to incorporate national floodplain management goals and reflect state floodplain management responsibilities would identify agency roles, responsibilities, and establish consistent rules and priorities and, therefore, streamline both response and recovery activities of the federal government.

Endnotes

1. Memorandum dated July 10, 1980. From: Director of the Office of Management and Budget; To: Heads of Agencies; Subject: Non-structural floodplain measures and flood disaster recovery.
2. Memorandum of Agreement on Interagency Hazard Mitigation. Signed December 16, 1980 by 13 Agencies.
3. This Task Force was established in 1975 within the US Water Resources Council. In 1982, OMB assigned its responsibilities to FEMA, which assumed the role of chair. Federal Interagency Floodplain Management Task Force. A Unified National Agenda for Floodplain Management. FEMA Document 248. April 1994.
4. Army/SCS MOA on levees 1986

5. In 1992 after Hurricane Andrew, President Bush tasked the Secretary of Transportation with recovery and in response to the 1993 flooding disasters, the Secretary of Agriculture was tasked.

Chapter 11

USE SCIENCE AND TECHNOLOGY TO GATHER AND DISSEMINATE CRITICAL WATER RESOURCES INFORMATION

ESTABLISH A COMMON DATA BASE ON THE UPPER MISSISSIPPI RIVER BASIN

By leveraging science and technology, vast improvements can be made in gathering and disseminating the critical information needed to successfully operate in the water resources environment. This generates the need to access information about natural and manmade physical features, cultural resources, living resources, and basin hydrology. There is a lack of knowledge in some areas in the social and physical sciences and research is required.

General Data Base

Vice President Gore's National Performance Review (NPR) contains recommendations regarding the use of information technology to create a government that works better and costs less. The NPR advocates the creation of a national spatial data infrastructure that would establish standards for data collection and cataloging, and create a clearinghouse for finding, accessing, and sharing spatial data, in addition to addressing other

related issues.

As indicated in the NPR report, "Data collection is duplicated at the federal, state, local and private levels for different purposes. Moreover, different entities (e.g., federal and local agencies) are often unaware that much needed data have already been acquired by another party. Even when specific spatial data are known to exist, non-standardized collection procedures and lack of easy access often restrict their use."¹

The most difficult effort in assembling this report was obtaining and compiling useful data regarding what exists in the region, what the damages were, and the expenditures related to disaster response and recovery. Useful data were collected, but difficult to use because they were not spatially referenced or were in incompatible formats and/or structures. Precise answers to many questions were difficult, if not impossible to obtain. Some examples are: How many structures are in the 100-year floodplain along the Mississippi and Missouri Rivers? How many structures were affected by the flood? Where were levees and what level of protection did they provide? How many people applied for assistance in a given county (or community)? Where is critical infrastructure located with respect to the floodplain? What is the expected flood crest given a certain flow in the river? During a flood fight, the availability of such information is key to making correct decisions. Other important data, such as the 100-year floodplain, were not in digital format and had to be digitized. Federal Information Processing Standards (FIPS) are not uniformly applied in the collection of disaster response and recovery data in both the public and private/nonprofit sectors.

The Scientific Assessment and Strategy Team of this Committee, an interdisciplinary group of geographers, scientists, engineers, and other specialists, was responsible for gathering data on the Upper Mississippi River basin. Information and geographically referenced data were gathered regarding the physical and environmental characteristics of the basin, flood impacts, and federal expenditures for the 1993 flood. Several hundred gigabytes of information have been collected with the help of states, local communities, and federal agencies. The results of this effort must continue to be shared and maintained with the help of all entities having an interest in the upper Mississippi River basin.

Action: *The USGS should establish a federal clearinghouse for data gathered for this report.*

In order to manage floodplains, mitigate flood damages and respond to and recover from a disaster, basic data must be readily accessible to analysts and decision makers. These data can be used to audit disaster expenditures and identify loss concentrations to help formulate new preparedness and mitigation strategies. The USGS should coordinate with the Federal Geographic Data Committee and take the lead in establishing a federal clearinghouse consistent with that outlined in the National Performance Review for accessing and updating the data acquired and developed for the nine state region. This effort is an excellent demonstration of the use of science and technology and results should be shared with states, communities, and all basin interests.

BUILDING ON THE DATABASE

Hydrologic: Flow Analysis

The committee originally wanted to answer some "what if" questions about the flow characteristics for the entire reach of the Mississippi River from Cairo to St. Paul, and for the Missouri River from the mouth to Gavins Point. However, a model does not exist to enable the performance of this task over the entire Mississippi and Missouri Rivers. Five USACE districts are involved in these river reaches, and the models used by each district contain various qualities of topographic data and there is no single model.

The most widely used model for flood elevation determination is HEC-2, a steady-state, one dimensional, rigid boundary model. However, this model cannot simulate levee breaches or take storage effects into account. UNET, a one-dimensional unsteady flow model used for this report, has the capability to assess the impacts of levee breaches and the associated storage effects. A systemwide unsteady flow model of the Upper Mississippi and Missouri River is needed for the evaluation of the impacts of any new structures being

considered for the floodplain, for flood fighting, and for floodplain management decisions.

It is necessary to periodically update flood flow frequency curves as the period of record increases. Estimated Mississippi River flood stages for the 5-, 10-, 50-, 100-, and 500-year floods were constructed by the USACE in 1979. Flood insurance rate maps for this area are based on 1979 data. Profiles for the Mississippi and Missouri Rivers should be reviewed to determine the need to update these profiles to include the most recent data.

Action: *Develop a basin wide UNET model for the Upper Mississippi System.*

As part of its ongoing Floodplain Management Assessment Study, the USACE should complete development of a basinwide UNET model, and enhance its expertise with this model. The UNET model will also assist in coordinated hydrologic, hydraulic and ecosystem modeling.

Mapping

Critical to the development of any computer model used to estimate flood elevations is detailed topographic information. Topographic information in a digital format can be more efficiently used in computer models. Topographic information does not exist in a digital format for many locations in the nine state region, or the nation, at a scale useful for floodplain management or for use in engineering models. Generally, contour intervals of two feet or less are preferred for floodplain management. Technologies are beginning to emerge that will enable the production of accurate, high resolution digital elevation models at reasonable costs and be available to the general public.

SIDEBAR: NASA has developed a scanning laser device (LIDAR) that operates from a commercial aircraft, and collects digital terrain data that can be converted into a digital elevation model. These data can be collected in a variety of weather and day or night conditions. As part of a technology transfer initiative, the Houston Advanced Research Center, in close coordination with NASA, has developed an aircraft mounted prototype that is suitable for a wide range of commercial applications. High resolution color video imagery are acquired concurrently with the LIDAR data, and can be digitally draped over the terrain data to visualize land-use. A test of the system's products for an area downstream of Gavins Point, Nebraska will be conducted in June 1994.

The USGS, working in conjunction with DOD, is testing the use of IFSARE (InterFerometric Synthetic Aperture Radar for Elevation), a radar technology employing a jet aircraft-based data collection platform. Digital elevation data as well as synthetic aperture radar (SAR) imagery will be generated. DOD is the program sponsor for this technology development, and has been working with the Environmental Research Institute of Michigan and the Jet Propulsion Laboratory. Data have been acquired in the vicinity of Iowa City, Iowa, to provide sample data for applying this technology to the development of hydraulic models.

NASA, USGS, and DOD have agreed to test these technologies along a reach of the Missouri River in the vicinity of Glasgow, MO. These tests are expected to be initiated in June 1994.

Action: *Invest in development and acquisition of detailed digital topographic data in floodplain.*

Detailed topographic data in floodplain areas are utilized for many application, such as floodplain boundary delineation, habitat and land cover/land use mapping, and restoration projects.

Education and Outreach

Most individuals have a general lack of knowledge of how and why floods occur. This reflects a lack of knowledge of natural physical processes, such as the hydrologic cycle, geomorphology, and hydraulics. The concept of flood risk (described in Chapter One) is also not widely understood. One result of inadequate awareness of flood risk and vulnerability is the inappropriate development of floodprone areas. Another result is that

only a portion of the public usually responds appropriately to flood warnings, and this lack of response sometimes has grave results.²

Floodplain information is not distributed widely beyond floodplain regulators, federal and state agencies, and the insurance and lending industries. Many individuals may not even be aware that flood hazard information exists for their community.

Action: Federal agencies involved in floodplain management should include information regarding floodplain management in their education and public affairs initiatives.

Floodplain information should be made available to the general public in formats that they can understand and use. All agencies involved in floodplain management should continue efforts to inform and educate the public about the nature of flood hazards, the natural values of floodplain, and the various strategies and tools available for comprehensive floodplain management.³ Agencies should also adhere to guidance given in EO 11988 (or in a revised EO on floodplain management) regarding the conspicuous delineation of past and probable flood heights on property used by the general public in order to increase awareness.

Action: State floodplain management officials should encourage local communities to include natural hazard education in their curriculum

Education regarding the existence of natural hazards, such as floods, should be introduced into the elementary and secondary education curricula in order to provide an early awareness and understanding of how and why floods occur. Information should include what to do in the event of a natural hazard emergency.

RESEARCH NEEDS

General

In preparing this report, the committee investigated some of the benefits and costs, of floodplain occupancy and agriculture and the associated floodplain management measures. This investigation included consideration of national productivity, the impacts on natural values and the equitable distribution of costs and benefits. The National Science Foundation should consider funding research to fully examine these issues.

This study focused on floodplain hazards associated with levee breaches. However, the committee encountered other special flood hazards that warrant further study. These include moveable stream channels, and storm drainage overflow and backup. The National Science Foundation and interested federal agencies should establish a cooperative, jointly funded program to develop methods for mapping, regulation and identifying natural values in these areas. Data gathered by the Scientific Assessment and Strategy Team would form a foundation for further investigation.

Many questions posed by the committee in the early stages of its effort have gone unanswered, due to time or resource constraints, or a lack of information. Even when information was available, the information led to new questions and new areas to be explored. Listed below are several topics that merit additional study.

Environmental Impacts

Many socially valued aspects of life, such as environmental quality, species diversity, and environmental services are services that are not sold in conventional markets. Therefore, evaluation methods that do not depend on market prices must be used to estimate the benefits of these services. Significant research has been done on non-market evaluation techniques. There are several methods, each with its own strengths and weaknesses, as

outlined in Chapter 7 that have been developed. The federal government must establish guidelines for quantifying environmental impacts.

Action: The Administration should direct that scientific research be accomplished to identify state-of-the-art techniques or applications for estimating and assessing environmental and social impacts.

Geomorphology

Satellite imagery and data analyses provide evidence that levee failures along the Missouri River coincided with old active river channels (See Figure). There is also evidence that these levees were largely responsible for raising the water to levels which generated the high energies necessary to overpower and blow the levees, creating huge scour holes, and generating the sands which devastate the very farmlands the levees were designed to protect. There is further evidence that levees placed in such high energy zones would not hold, even if it were possible to excavate all the sand from the old channel and place the levees on a clay core. If these relationships exist, levees should not be reconstructed in such high energy erosion zones. Instead they should be set back to allow high energy zones to remain within a designated, functioning floodway. A mix of compatible land uses (i.e. dry year farming, open space, recreation, fish and wildlife habitat, etc.) could occur within such a high energy floodway. However, any such use should not be eligible for future emergency federal disaster assistance. A study should be implemented immediately to better define, document, and map such high energy zones, at least along the Missouri River.

Action: The USACE should conduct research to better define relationships between high energy erosion zones and levee failure.

Benefits of non-structural flood control measures

The Minnesota Valley National Wildlife Refuge was established in the lower Minnesota River Valley near the Minneapolis/St. Paul metropolitan area, in part, to maintain the floodplain as a naturally functioning ecosystem and flood water storage/conveyance mechanism. The Upper Mississippi River National Wildlife and Fish Refuge was not established as a mechanism for flood damage reduction and control, but it has been postulated that the refuge played a significant role, at least locally, in reducing flood damages in the Upper Mississippi River Valley. Non-structural flood reduction and control capabilities of floodplain land uses such as green spaces and wildlife refuges have not been adequately evaluated.⁴ Such an evaluation should be completed as soon as possible.

Action: *The USACE, in collaboration with DOI, should evaluate the flood control capability of non-structural flood control measures.*

The USACE Floodplain Management Assessment should address this issue for the upper Mississippi River.

Wetland & agricultural impacts on flood storage and flood peaks

The water storage capabilities of wetlands lost to drainage over the past century in the Mississippi River Basin has been described by environmental interests as contributing to the heights of the 1993 floods.⁵ At the same time, agricultural interests have claimed that drainage tiles installed to dry out wetlands and wet soils provided a positive benefit in reducing flood heights by voiding the soils of water and creating a capacity in the soils for water storage. However, once rains exceed a threshold level and soil surfaces become sealed, the ability of rain water to infiltrate into the soil is lost and the water runs off rather than percolates in.⁶ It has been suggested that drainage tiles may actually contribute to flood

heights rather than to lessen them. The role of wetlands and drainage of wetlands for agricultural purposes needs to be better evaluated. The conditions where wetlands can best contribute to flood reduction need to be identified.

Action: *The USDA should evaluate the effect of natural upstream storage on main stem flooding.*

Bioengineering

State, local and private engineers and planners rely heavily on the design manuals of the federal government. Currently these manuals do not address bioengineering techniques, and these practices have not been incorporated into the federal government standards. Federal agencies responsible for establishing guidelines should test and incorporate these methods into their design manuals.

Action: *Federal agencies should research and incorporate bioengineering techniques into design manuals.*

TO BE ADDED:

Applications of hydrologic methods to determine flood frequency probabilities

Other suggestions from SAST

ENDNOTES

1. NPR Accompanying Report, Department of Interior, Washington, D.C., US GPO, September 1993.
2. Federal Interagency Floodplain Management Task Force, Floodplain Management in the United States: An Assessment Report. (Washington, D.C., 1992).
3. Natural Hazards Research and Applications Center, Special Publication 25, Action Agenda for Managing the Nation's Floodplain, (Boulder, CO., 1992).
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5. Hey, D. 1992. Prairie potholes. pp. 505-509. In: National Research Council. 1992. Restoration of aquatic ecosystems. National Academy Press, Washington, D.C. 552 pp.
6. Satterlund, D.R. and P.W. Adams. 1992. Wildland watershed management. John Wiley & Sons, Inc. New York. 436 pp.