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SEMINAR PROCEEDINGS

IMPLEMENTATION OF NONSTRUCTURAL MEASURES

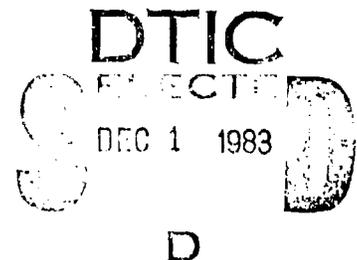
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of the U.S. Army Corps of Engineers

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15, 16, and 17 November 1983



Policy Study 83-G520

July 1983

DISTRIBUTION STATEMENT
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Remember that no one is presumed to have the answers to the myriad small and large problems under each generic nonstructural measure. Our meeting is not primarily a conference to update ourselves on known facts. It is a seminar -- an exploratory effort to articulate the questions and identify as many options as dialogue can yield.

-- Instruction to seminar participants

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## PREFACE

I find the results of this seminar noteworthy and personally satisfying. As I reflect on the deliberations and discussions of three full days given to the examination of nonstructural flood plain management measures, I am struck by the search for practical answers and the serious, positive attitude of all participants.

The seminar has carried forward the examination of policy and planning issues begun in the St. Paul District's 1979 "bluebook" discussion which was based primarily on our early experiences at Prairie du Chien. The specific focus of this seminar was on the need for new initiatives in areas such as research, information and experience transfer, procedural guidance and policy issues.

The seminar discussion gave strong support for consideration of structural and nonstructural measures on an equal basis rather than separate alternatives. We were also exposed to new perspectives related to just how essential a strong non-Federal role is to bringing nonstructural solutions -- as projects or in combination with structural measures -- to realization. This means that we must continue to work hard in the areas of institutional analysis and related social assessment. As the seminar dialogue progressed I came to a better realization of the strategic importance of at least two cooperative initiatives in the management of flood plains -- flood warning systems and emergency preparedness programs.

The Corps can be proud of its projects that represent pioneering efforts in devising innovative policies, techniques, and evaluation procedures. Where additional work remains to be done, I am encouraged that the commitment and skills exist to do it. Much of the remaining challenge lies in the practical application area; however, these Proceedings will, I hope, provide a basis for meaningful advancement in the nonstructural element of flood damage reduction.

The seminar distinctly benefited from the participation of officials of other Federal and state agencies (including a most welcome delegation from the United Kingdom) and representatives from the private sector. Their signal contributions to these Proceedings is both helpful and timely in the interest of charting future choices and actions.

Within the week I will be moving on to a new Corps assignment as Commander of the South Atlantic Division. Thus, I write these observations in early December 1982, during my last days as Acting Director of Civil Works. While it would be inappropriate to set commitments for others beyond my tenure, I commend the results of the seminar as reflected in these Proceedings to their attention.

Finally, I wish to extend my thanks to local, state, Federal and private sector representatives, as well as to the many experienced Corps field personnel, for their strong commitment and active participation in making this seminar the success I envisioned at the outset.

*Forrest T. Gay III*

FORREST T. GAY, III  
Brigadier General, USA  
Acting Director of Civil Works



## ACKNOWLEDGMENTS

This report of proceedings was prepared as part of the Fiscal Year 1982 Policy Studies Program by the U.S. Army Engineer Institute for Water Resources (IWR), for the Office of Policy, Office of the Chief of Engineers (OCE), U.S. Department of the Army.

The Seminar was designed and organized, and this Proceedings volume generally prepared and edited by Dr. Charles Edw. Simpkins of the Research Division at IWR. He has attempted to make the conversion from spoken to written English with a faithful preservation of ideas and literal content. For the further sake of fidelity, no interpretive themes were imposed on papers or dialogues either. Any distortions which occur despite these constraints are accepted as faults an editor must own.

The Seminar was in substantial measure made possible in its scale and quality by the generous work and co-hosting of Messrs. William P. Donovan, Jerome Peterson, and Robert Plott, on behalf of the active interest of Dr. L. H. Blakey, Chief, Planning Division, Office of the Chief of Engineers.

The monitor of the policy study, comprised of the Seminar and this Proceedings volume, was Mr. Donald B. Duncan, Chief of Policy Development, Office of Policy, Office of the Chief of Engineers.

Much help in early brainstorming for content appropriate to the seminar dynamics design was provided by Mr. Stuart Davis of IWR, whose expertise on nonstructural matters was invaluable in the selection of paper topics. We were joined in those early sessions and the participant arrangements by Cadet James McAree of the United States Military Academy.

The text, organization, layout, and general production editing on this volume were one by Ms. Joyce Hardyman of the Publications Division in the Water Resources Support Center.

The overall study effort was conducted with the personal interest and support of J. R. Hanchey, Director, IWR, and under the supervision and innovative spirit of Mr. Kyle E. Schilling, Chief of the Policy Division at IWR.

Finally we all join in thanking BG Forrest T. Gay, III who, as Acting Director of Civil Works, requested the study, personally worked in design sessions, and generously and enthusiastically motivated all participants by his own participation as presiding host for the 3-day meeting at Fort Belvoir.

AGENDA

Monday, 15 November 1982

0700-0800	Registration	
0800-0815	Welcome and Seminar Objectives	<b>BG Forrest T. Gay III,</b> Acting Director of Civil Works, OCE
0815-0830	Current Planning Trends	<b>L. H. Blakey,</b> Chief, Planning Division, OCE
0830-0845	Administrative Announcements and Seminar Procedures	<b>Charles Edw. Simpkins,</b> Institute for Water Resources

OVERVIEW: NONSTRUCTURAL MEASURES

0845-0925	<u>FIRST ADDRESS</u>	<b>William J. Donovan,</b> Chief, FPMS and Coastal Resources Branch, Planning Division, OCE
	<ul style="list-style-type: none"><li>o What are the authorities and requirements of nonstructural actions?</li><li>o What are the basic objectives of nonstructural measures?</li><li>o Is flood damage reduction the objective of a nonstructural measure, or is the objective NED?</li><li>o How does the rhetorical convention between "structural and nonstructural" persist? What physical-administrative-managerial-formula balance creates use of one name or the other?</li></ul>	
0925-0945	<u>Panel</u>	<b>Dan Mauldin,</b> South Atlantic Division <b>Brian Moore,</b> Los Angeles District <b>George Phippen,</b> Geographer and Flood Plain Management Consultant, South Hampswell, ME
0945-1000	Preliminary Q&A with Audience	
1000-1015	BREAK	

FLOOD EMERGENCY PREPAREDNESS

- 1015-1055      SECOND ADDRESS      **H. James Owen**, Flood Loss Reduction Associates, Palo Alto, CA
- o How can flood emergency preparedness plans best be implemented?
  - o How effective are the flood warning systems and what are the natures and costs of errors?
  - o How accurate are flood warning and evacuation plans in fact, rather than theory?
- 1055-1115      Panel      **Ronald Hilton**, Jacksonville District  
**Michael Burnham**, HEC  
**Roy Huffman**, OCE  
**Brian Moore**, Los Angeles District
- 1115-1130      Preliminary Q&A with Audience
- 1130-1230      LUNCH (catered)
- 1230-1310      THIRD ADDRESS      **Robert L. Carnahan**, Chief, Warnings Coordination, National Weather Service, Washington, D.C.
- o How can the costs and benefits of flood warning and evacuation be assessed, including its intangibles which have not been monetized?
  - o What is the role of state and local governments in implementing flood warning and evacuation plans?
  - o What is (and should be) the turf configuration among agencies in flood warning systems?
- 1310-1330      Panel      **Ronald Hilton**, Jacksonville District  
**Roy Huffman**, OCE  
**Michael Burnham**, HEC  
**H. James Owen**, Flood Loss Reduction Associates
- 1330-1345      Preliminary Q&A with Audience
- 1345-1400      BREAK

FLOOD PLAIN REGULATION

- 1400-1440      FOURTH ADDRESS      **Jon Kusler**, Attorney and  
Flood Plain Management  
Consultant, Chester, VT
- o How do flood plain regulations affect land values and opportunity costs?
  - o Are there externalities in affected values and opportunities? If so, to whom do they accrue?
  - o What are the legal strengths and weaknesses of various regulation measures?
- 1440-1500      Panel      **Bili Sinozich**, Huntington District  
**Larry Larson**, Association of State  
Flood Plain Managers, Madison, WI  
**Leonard Ratushewitz**, North Atlantic Division
- 1500-1515      Preliminary Q&A with Audience
- 1515-1555      FIFTH ADDRESS      **COL Gerald Galloway**, USMA,  
West Point, NY
- o What is the extent of use and effectiveness of various flood plain regulation measures?
  - o Are all instances of urban development in flood plains failures of regulation?
  - o Is environmental protection or enhancement the objective of flood plain regulation?
- 1555-1615      Panel      **William Holliday**, OCE  
**JON KUSLER**, Attorney and Consultant  
**John Helshe**, OCE
- 1615-1630      Preliminary Q A with Audience
- 1630-1830      SOCIAL HOUR (Springfield Inn Conference Center)

Tuesday, 16 November 1982

0755-0800 Announcements

ALTERNATIVE FLOOD PLAIN LAND USES

0800-0840

SIXTH ADDRESS

Frank Thomas, Special Assistant,  
State and Local Support Directorate,  
FEMA, Washington, D.C.

- o What are the relative locational advantages of flood plain land for economic activities?
- o What is the ecological function of the flood plain?
- o What is the extent of upland development impacts on flooding (e.g., hazard, runoff, etc.)?
- o What are the effects of emergency assistance upon the distribution of various land use probabilities?

0840-0900

Panel

Bernie Ingram, Wilmington District  
John Belshe, OCE  
Grant Kelly, New England Division

0900-0915

Preliminary Q&A with Audience

0915-0930

BREAK

GENERAL ISSUES FORUM

0930-1130

ISSUES

(Further development  
of questions and  
answers)

George Phippen, Moderator  
DONALD DUNCAN, Policy  
Office, OCE  
COL. Gerald Galloway, USMA  
Robert W. Harrison, USR

1130-1230

LUNCH (catered)

FLOOD INSURANCE

- 1230-1310 SEVENTH ADDRESS **Edward Pasterick**, Assistant Administrator for Insurance Operations, FIA, FEMA, Washington, D.C.
- o How are actuarial flood insurance rates developed and applied?
  - o How are flood insurance rates modified by implementation of nonstructural flood damage reduction measures?
  - o What project benefits could be claimed based on changes in flood insurance rates and costs resulting from the implementation of nonstructural flood damage reduction measures?
- 1310-1330 Panel **Frank Incaprera**, Galveston District  
**William Johnson**, HEC  
**ROBERT W. HARRISON**, Senior Policy Advisor, ERM
- 1330-1345 Preliminary Q&A with Audience
- 1345-1400 BREAK
- 1400-1440 EIGHTH ADDRESS **Larry Larson**, Executive Director, Association of State Flood Plain Managers, Madison, WI
- o What has been the flood insurance program's effect on the location, type and cost of flood plain development?
  - o What has been the program's effect on costs and damages prevented?
  - o How does flood insurance relate to water resources planning and adoption of nonstructural measures?
- 1440-1500 Panel **David Burroughs**, Little Rock District  
**Jerome Peterson**, OCE  
**FRANK THOMAS**, FEMA
- 1500-1515 Preliminary Q&A with Audience

FORMULATING NONSTRUCTURAL PLANS

- 1515-1555 NINTH ADDRESS **William Johnson**, Planning Analysis Branch, Hydrologic Engineering Center (HEC), Davis, CA
- o Techniques for rough formulation and evaluation in early planning.
  - o The problem of degree of protection.
  - o Applying HEC models to the evaluation of nonstructural measures.

- 1555-1615 Panel **Milburn Smith**, Ft. Worth District  
**Paul Gaudini**, Philadelphia District  
**Robert W. Plott**, OCE

1615-1630 Preliminary Q&A with Audience

Wednesday, 17 November, 1982

0755-0800 Announcements

- 0800-0815 IWR Nonstructural Research and Development **James R. Hanchey**, Director, Institute for Water Resources

FLOODPROOFING

- 0815-0855 TENTH ADDRESS **Lawrence Flanagan**, Chief, FPMS, Lower Mississippi Valley Division, Vicksburg, MS.
- o What is the viability of floodproofing for new construction? For existing structures?
  - o How can floodproofing be justified as a special case for water supply, sewage, and other utilities?
  - o What are the basic economic facts encountered in floodproofing?

- 0855-0915 Panel **Brian Moore**, Los Angeles District  
**KYLE SCHILLING**, Chief, Policy Studies Division, IWR  
**David Burroughs**, Little Rock District

0915-0930 Preliminary Q&A with Audience

0930-0945 BREAK

FLOOD PLAIN RELOCATION

- 0945-1025 ELEVENTH ADDRESS Charles Edw. Simpkins,  
Research Division, IWR
- o What are the positive and negative externalities known to date?
  - o Is proxy counting or cost exclusion the most equitable approach to intangibles?
  - o What is the cost and effectiveness of a major relocation for flood damage reduction?
  - o Expanded management or technical assistance?
- 1025-1045 Panel Art Harnisch, Seattle District  
William Holliday, OCE,  
Dale Klemme, Prairie du Chien, WI
- 1045-1100 Preliminary Q&A with Audience
- 1100-1140 TWELFTH ADDRESS David J. Miller, Chief  
Economics & Social Analysis  
Section, St. Paul District
- o The St. Paul-IWR Prairie du Chien Relocation Post-Audit Study
- 1140-1200 Panel Dale Klemme, Prairie du Chien, WI  
Robert F. Post, St. Paul District  
Sam Sands, (BERH), Ft. Belvoir, VA
- 1200-1215 Preliminary Q&A with Audience
- 1215-1315 LUNCH (catered)
- GENERAL ISSUES FORUM
- 1315-1415 Issues Helen Ingram, Moderator  
LARRY LARSON, Assoc. of State Flood  
Plain Mgrs.  
L. B. Blakey, Chief, Planning  
Division, OCE  
James R. Blanche, Director, IWR
- 1415-1515 Questions & Answers
- 1515-1530 Closing Statement BG Forrest T. Gay III,  
Acting Director of Civil Works

## WELCOME AND OPENING REMARKS

BG FORREST T. GAY III:

Good morning and welcome to our seminar. I'm delighted to see such a great turnout here. You'd also be interested to know that we've attracted two people from England who have come all this way to find what is the state of the art of nonstructural alternatives to flooding problems. And we have people from all over the country representing the Corps, other agencies that are involved directly or indirectly in various aspects of nonstructural solutions, and interested observers.

It's intriguing for me to hear that this is going to a presentation of the state of the art, but, since nonstructural solutions really got started in earnest back in 1976, I guess the Corps has been somewhat the repository of information on the subject. Previously, approaches to solving flooding problems involved managing the water. Either stop the water with a dam and release it after the flood threat has passed, or direct the water past urban areas or rural areas through improved channels so that it wouldn't cause any damage. But there's another approach. You don't have to manage the water; you can manage the things and the people that are affected by the water. We've developed a whole system of floodplain principles which involve managing people and managing things, and the long term floodplain regulation keeps people out of the floodplain so they won't suffer the damages from disastrous floods.

But you can also manage the people by letting them know in advance that flood waters are coming by giving a flood warning. You can manage the people by taking things out of the floodplain--physically, from their structures--and relocating those structures. There are any number of ways of managing the people and the things, rather than the water, to prevent flood damages.

In a day when we're finding that we have fewer and fewer dollars with which to do our federal business, nonstructural alternatives seems to offer attractive and cost effective alternatives to the dams, channels, and other such flood control measures that we've taken in the past.

We've assembled a group of experts here from all over the country, and from Washington, who are prepared to discuss in great detail many aspects of nonstructural solutions. The question we hope to answer at the end of this three-day period is "Where are we going in the nonstructural alternatives fields?"

Now, although these experts whom we have gathered here are going to provide information that will help guide the discussion, the real answers are going to come from you in the audience. You are the smart people, the ones who have to implement these kinds of alternatives, the ones who have an active involvement and a real interest in nonstructural measures. So at the end of three days we hope to have reached some kind of consensus as to where we're going and how do we get there.

We are going to publish the proceedings from this seminar; we hope that they will provide some guidance for you in the future and that they will be

useful. And I particularly hope that the trip of our friends from England will have proved to be worthwhile, that when they leave here on Wednesday they will conclude that it was money well spent.

I myself am certainly looking forward to a productive three days, having spent some time in the St. Paul District, where we had one of the evacuation plans, for Prairie du Chien, Wisconsin, and we're going to hear a report on how that one is working out. That was where I first became intrigued with nonstructural approaches and their cost effectiveness.

## CORPS PLANNING OBJECTIVES AND NONSTRUCTURAL MEASURES

L. H. BLAKEY:

As General Gay has said, the purpose in being here for the next three days is to find out where we're going in nonstructural measures. In other words, it's an educational experience not only for the participants but also for those of us who'll be standing up here from time to time.

And that all fits in with what we've been trying to do for the last couple of years with the civil works planning program as a whole. We've been on a rather broad scale improvement effort, trying to improve not only the way we're organized but the techniques that we use in all facets of civil works planning. Most of you are familiar with the rewrite we've just completed of all our planning regulations--to boil down several thousand pages into a few hundred comprehensive, tightly written pages of six regulations and four supplements or pamphlets associated with those. The idea of nonstructural measures you'll find in those regulations and in our thoughts today. The reason for this is that a good idea will not go away. And a good idea will stand on its own merits. Nonstructural concepts are good ideas.

The recent revision of the principles and standards, which has eliminated the requirements that we carry forward an alternative with nonstructural features into the final analysis, is an interesting facet of this thing about a good idea not going away. Nonstructural does not need a demand that it be carried forward, but, rather, as a good idea it will be carried forward in those instances when it makes good sense. And where it doesn't, it won't. And so, we don't need principles and standards that tell us we must do something when our good judgment will tell us when it does have a good chance of being the final selected alternative and how far it needs to be developed.

One thing that has been very interesting to me, which I didn't realize--and we have a handout here that we'll give you later--is how much the use of nonstructural measures has become ingrained into our civil works planning over the past five to 10 years. If I had to give you a list of nonstructural projects that had actually been done, or nonstructural plans that had been recommended, I would probably have said (a few days ago) that maybe there were a few--Prairie du Chien, Charles River, Indian Bend Wash, and then continue a short list. But I found after further examination that if you look at the number of reports we've produced, we have literally dozens of applications of nonstructural techniques, in broad concept and some in quite limited concept. But we'll discuss those over the next several days and give you a much better feeling for the applicability of nonstructural methods.

I think you'll find the material that you'll hear in the next days will be interesting and will serve as one additional cornerstone in our effort to improve civil works planning--to take advantage of cost effective, modern, and productive techniques, of which nonstructural measures is one. And so I would join with you in a learning process over these three days, in which we learn what has been going on around the country and what the thought is to date for nonstructural measures.



# Seminar Proceedings



OVERVIEW  
OF  
NONSTRUCTURAL MEASURES

THE LESS TRAVELED ROAD: AN OVERVIEW OF  
NONSTRUCTURAL MEASURES IN FLOOD PLAIN  
MANAGEMENT PLANNING

William J. Donovan  
Chief, FPMS & Coastal Resources Branch  
Planning Division  
Civil Works Directorate

The Corps of Engineers has been addressing nonstructural measures for flood damage reduction in feasibility studies for close to two decades. Early efforts date back to the concepts developed for the feasibility study of Prairie du Chien, WI, completed in 1965, and the Charles River Basin Plan Study, MA, completed in 1972. Subsequently, there evolved policy and planning guidance that nonstructural measures be considered in feasibility studies. Our experience from these and other studies has been varied. We now need to give close scrutiny to our successes, failures, and limitations to determine where we are at and, more importantly, where we want to go. We need to clearly identify the problems, as well as the opportunities, that affect full consideration and implementation of nonstructural flood plain management measures in Corps planning. Consequently, this Seminar is intended to assess the Corps' implementation of nonstructural flood damage reduction measures and to identify needed improvements/changes in policy, guidance, procedures, and information transfer. In addition to Corps personnel, we have invited knowledgeable and experienced outside speakers and panelists to assist us in this effort. Our Seminar is a carefully planned, three-day, intensive effort. We expect it to be productive.

Vis a vis the application of structural measures, the Corps involvement in nonstructural measures and solutions has clearly been "the less traveled road" to date; none the less, we have established a definite, if limited, track record encompassing a variety of successes and disappointments. Those planners most closely involved in our nonstructural efforts can attest that they have involved much struggle--conceptually, analytically, institutionally, and technically--as well as much related effort to obtain the manpower and resources support to enable substantial progress in this newer planning arena. As staff of a so-called "construction agency", perhaps some have even suffered at least a partial "identity crisis" in espousing significant departures from "traditional" structural views, customs, planning, and engineering practices. However, even if our promises have outrun our performance on nonstructural measures to date, the important thing is that we have made some progress and learned a few things along the way; we are now past the stage of identifying, defining, and acknowledging the role of nonstructural measures. We now need to insure that all personnel operate from a common base. Thus, a review of the current state-of-the-art for each nonstructural measure is appropriate for this Seminar. The critical element, however, is the indepth

discussion and subsequent analysis of what we as planners have experienced in developing water resource improvement plans that include (or, in some instances, could have included) nonstructural measures and what has happened to them during the review, approval, and authorization process. A component of this effort is the recognition and evaluation of problems attendant on the inertia sometimes evidenced in our planning posture: not being able to accept, or only lukewarmly accepting, the validity of nonstructural measures in certain planning situations and conditions, mostly because this has not been part of our tradition; has not been the way we have come. If we can candidly discuss our problems, and share our views, experiences, and perceptions on these and related matters during the course of the Seminar, a responsible assessment can be made as a basis to influence future Corps progress.

In this paper I will attempt to accomplish the following: to outline an informal history of nonstructural measures in flood plain management planning, including pertinent legislative and executive milestones and early Corps guidance and policies responsive thereto; to identify and characterize the use of various kinds of nonstructural measures, encompassing both those that modify the susceptibility to flood damage and disruption and those that modify the impact of flooding on individuals and the community; to discuss current and emerging Corps guidance for inclusion of nonstructural measures in feasibility studies; to outline and evaluate Corps progress--and problems--in the application of nonstructural measures; to suggest some lessons that have been learned; and, finally, to reflect on possible organizational constraints and limitations, self-imposed or otherwise.

#### AN INFORMAL HISTORY OF NONSTRUCTURAL MEASURES

One way of thinking about how our policies and practices have evolved with respect to the consideration of various alternatives in flood plain management planning is to think of the approach as being represented in a kind of Hegelian thesis-antithesis form from which a new, more practical synthesis is emerging.

Initially, there's the tremendous interest in, and long-term application of structural alternatives dating from the Flood Control Act of 1917, the first direct federal commitment to flood control, the Flood Control Act of 1928 authorizing extensive work on the Mississippi River and its tributaries, the benchmark Flood Control Act of 1936 expanding the federal responsibility for flood control to national scope, and numerous subsequent FC Acts. All of these earlier, and historically most influential FC Acts, essentially define and undergird the long-established "structural" thesis.

Much later, we have the current emergence, widespread discussion, and a flowering of literature, studies, reports, and "guidance" espousing the need for, and efficacy of, "nonstructural" considerations and solutions in flood plain management planning, all of which define the antithesis. However, depending on the definition applied, the

origins--the distant origins--of the nonstructural concept (not then likely characterized or even perceived in that explicit sense) could well be traced from just prior to the turn of the present century; from the Act of 1897 relating to the forest reserves and the Weeks Act of 1911 authorizing the purchase of new national forest land, especially in the eastern states. These Acts, among their other intents, ameliorated water flows from the timbered catchment areas and thus, via nonstructural means, intendedly influenced--at least moderately--the flooding and flows of navigable streams. The extent of the influence of upland forest cover on water flows in rivers and streams was a scientific controversy of considerable sensitivity at the turn of the century.

However, the point of departure to characterize its contemporary form and essential focus may well be taken as the year 1966 with the publication of House Document 465, A Unified Program for Managing Flood Losses, a report by OMB's Task Force on Federal Flood Control Policy, chaired by the estimable Gilbert White. (Among others, White was assisted by Jim Goddard of TVA who shortly thereafter played a major role in establishing the Flood Plain Management Services program of the Corps). In my view this report is easily identified as the Magna Carta of contemporary nonstructural flood plain management planning; yet it simultaneously provided the impetus or thrust (assisted by subsequent reports and studies, variously authored and sponsored) toward a unified flood plain management program and planning view wherein all approaches are to be considered, most especially and practically, in many instances, a combination of structural and nonstructural approaches integrated in one plan. This latter defines the practical synthesis toward which much of flood plain management planning in the current federal arena appears to be evolving.

Although the earlier history is of interest, there is no disagreement but that significant Federal involvement in nationwide flood control endeavors begins with the aforementioned 1936 Act, as well as the follow-on FC Act of 1938 which provided for certain adjustments thereto. With these Acts the Congress authorized a nationwide program of multipurpose water resource development, a program which has been extended in purpose and depth by subsequent Acts. The 1936 Act directs the calculation of benefits "to whomsoever they may accrue" and states that whenever these benefits exceed the costs, a proposed project may be favorably reported. The intent was to provide a water resource program to prevent devastating floods such as the 1936 and 1937 disasters on the Ohio; the Congress assessed that it was beyond the capabilities of the individual states and their political subdivisions to come together without Federal help to control interstate streams. Therefore, only a national program would do, and the Federal interest in the program required that the benefits be calculated only from the national viewpoint.

Clearly, there was much to be done and the Corps, the nation's largest, most experienced planning and engineering agency, was assigned a major role. With so many areas to be protected, the Corps' initial involvement was through structural measures designed to "control" flooding--measures such as dams, levees, and channel

modifications. Yet, even as the 1938 FC Act extended and amended the 1936 Act with its strong structural thrust, it likewise brought about an awareness and concern that nonstructural alternatives be sought out; it did this by authorizing the Federal Government to purchase flood prone properties and to permanently remove development from those areas if such actions were less expensive than levees or floodwalls. Interest in nonstructural measures has developed gradually since the 1938 Act, with especially slow, almost indifferent progress in the early decades. However, in the early and mid-1960s interest began to pick up; in the past decade it has accelerated apace.

In the beginning, the Corps' primary thrust, and consequently the institutional infrastructure developed to support that thrust, was almost exclusively towards the planning, engineering, design, construction, operation, and maintenance of structural flood control plans and projects. The magnitude of the effort and the pressing need in the late 1930's and the early 1940's to protect as many rural and urban communities as practical and feasible and as soon as possible, left little time for other considerations. Thus, it was during this early era that the concept of controlling floods with structural measures became widespread, prevalent, and almost "institutionalized". Many have viewed this essentially singular approach as almost a Corps tradition, a tradition which has been a strong deterrent to the use of nonstructural measures in reducing flood damages.

By the 1960's and early 1970's, however, many authorities began to recognize that structural projects often gave a false sense of security and in some cases even encouraged unwise development in the flood plain. In addition, major flood control works in some cases created environmental problems. This helped make nonstructural alternatives more attractive, at least from an environmental perspective, a perspective given emphasis by passage of the National Environmental Policy Act (NEPA) and commencement of "the environmental decade" in January 1970. As a result, since the 1960's both legislative and executive initiatives have been taken to give greater emphasis to nonstructural measures as an important means of reducing flood damages. Added to this trend was the growing recognition that structural means of flood control were not a "cure-all" to the nation's flood problems. Regardless of major investments in structural flood control works, for a variety of reasons flood damages continue to increase. Damages sustained during major floods such as Tropical Storm Agnes in 1972 helped highlight the need for nonstructural measures such as flood evacuation, flood plain regulation, flood proofing, and flood forecasting and warning--even where the traditional structural flood control measures already existed.

The significant contemporary history regarding nonstructural flood plain management measures is best characterized by a brief look at specific legislative enactments and related executive actions influencing the Federal agencies, as well as the specific Corps response thereto via its enunciation of civil works guidance and policies.

a. Legislative and Executive Milestones in The Evolution of Nonstructural Measures.

The legislative and executive actions described below in major part characterizes or suggests the essential Federal role in development and implementation of nonstructural measures and lend credence to the fact that their acceptance and use has been very slow.

1938 Flood Control Act - Section 3 authorized the Chief of Engineers to evacuate areas subject to flooding in lieu of protecting them by levees or floodwalls, provided the evacuation is economically feasible and is less costly than a structural project.

1944 Flood Control Act - Provided that projects were to be considered "on a basis of comprehensive and coordinated development."

1950 Flood Control Act - Implemented the objective of the 1944 Act by authorizing development of a comprehensive, integrated plan for a group of river basins.

1950 "Green Book" (and its 1958 Revision). The Green Book set forth the classic economic efficiency model as the standard against which to conduct the analysis of river basin projects encompassing a variety of purposes, including flood control. A report of the Inter-Agency Committee on Water Resources without "official" status, the Green Book was nonetheless widely used in agency analysis. While nonstructural concepts were not emphasized, it did provide that "allowance should be made in damage estimates for any alleviation of flood damage which may be expected to result from flood forecasting and warning services."

1960 Flood Control Act - Section 206 authorized the Flood Plain Management Services Program which gave the Chief of Engineers authority to compile and disseminate information on floods and flood damages, to provide technical assistance for planning wise use of the flood plain, and to provide engineering advice to local interests for planning to ameliorate the flood hazard.

Senate Document 97. This policy statement by the President in May 1962 established Executive policies, standards, and procedures for uniform application in the formulation, evaluation, and review of comprehensive river basin plans and individual project plans for use and development of water and related land resources. A forerunner of the "Principles and Standards", SD 97 directed, among other things, that: "All relevant means (including nonstructural as well as structural measures) singly, in combination, or in alternative combinations reflecting different basic choice patterns for providing such uses and purposes."

House Document 465. Mentioned earlier, this significant 1966 report recommended a "unified national program" for managing flood losses. It also called for dissemination of information on "alternate methods" to lessen the risk of flood losses. Nonstructural measures that were discussed as alternatives to structural means for controlling flood waters included floodproofing, flood plain regulation, flood forecasting, flood insurance, land acquisition, and relocation.

Executive Order 11296. A recommendation of House Document 465, this was the first flood plain Executive Order. Issued in August 1966, the EO directed Federal Agencies to encourage a broad and unified effort to prevent uneconomic use and development of the Nation's flood plains and to lessen risk of flood losses in connection with Federal lands and federally financed and supported improvements by evaluating the flood hazard before taking any action.

1968 Housing and Urban Development Act (National Flood Insurance Act of 1968 as amended). This act made subsidized flood insurance available to flood plain occupants and emphasized the need for improved land use planning via local flood plain regulations in order to reduce flood losses.

1973 Flood Disaster Protection Act. This Act amended the National Flood Insurance Act of 1968 by placing strict requirements and incentives for communities to participate in the National Flood Insurance Program. The Act also required States or local communities, as a condition of future Federal financial assistance, to participate in the National Flood Insurance Program.

The Principles and Standards. This policy statement by the President in September 1973 established the Principles (and the implementing "Standards") for improved planning in the use of water and related land resources to achieve objectives, determined cooperatively, through the coordinated actions of the Federal, State, and local governments; private enterprise and organizations; and individuals. Encompassing a dual objective framework, national economic development (NED) and environmental quality (EQ), it outlined a planning process involving "an evaluation of alternative means, including both structural and nonstructural measures, to achieve desired effects." Moreover, nonstructural alternatives were given explicit identity in the "efficiency test", one of the four test criteria applicable to alternative plans set forth in the "Standards".

Water Resources Development Act of 1974. Section 73 of this Act required the consideration of nonstructural measures in flood control projects and provided up to 20 percent non-Federal cost-sharing be required for recommended nonstructural measures. The inexplicitness of the cost-sharing phraseology created considerable policy interpretation difficulties, however.

Executive Order 11988. Issued in May 1977, this order outlines the responsibilities of Federal agencies in the role of flood plain management. Each agency is to evaluate the potential effects of its actions on flood plains and are not to undertake actions which induce growth in the flood plain unless there is no practical alternative. In addition, agency regulations and operating procedures for licenses and permits should include provisions for the evaluation and consideration of flood hazards. This E.O. superceded Executive Order 11296, previously mentioned. It reflects a contemporary environmental and planning view not yet legislated or fully directed in 1966. (At the direction of the White House this E.O. is currently under intensive review by FEMA. The review is scheduled for completion in May 1983.)

The President's Water Policy Message of 8 June 1978. Greater utilization of nonstructural measures was urged in this message. Specifically, it required:

(1) The formulation of at least one primarily nonstructural alternative plan where a structural project is being considered; (2) Revision of Federal cost-sharing to remove biases against nonstructural measures; and (3) Use of Federal programs to acquire flood-prone land and property.

A Unified National Program for Flood Plain Management, September 1979. This report was prepared by the Water Resources Council (WRC) and transmitted to Congress in late 1979. The report set forth a conceptual framework and identified the strategies fundamental to implementing flood plain management with particular emphasis on nonstructural measures but also recognizing the significance of structural measures. (From 1983 FEMA, assisted by involved Federal agencies, will have responsibility for the "Unified Program" and will establish a new Flood Plain Management Task Force).

Revisions to the Principles and Standards for Planning Water and Related Land Resources, published in Federal Register December 14, 1979. In response to a memorandum from the President to the Water Resources Council, the Principles and Standards of 1973 were revised. One of the major revisions required the preparation and inclusion of a primarily nonstructural plan as one alternative whenever structural projects or program alternatives are considered. Revisions also provided that alternative plans should not be limited to those that the Federal Government could implement and the cooperative role of local, state, regional, and Federal organizations in implementing alternatives was stressed.

b. Corps Guidance and Policies in the Use of Nonstructural Flood Damage Reduction Measures.

During the 1960's certain legislative actions and the Executive Order 11296, August 10, 1966 made clear the need for nonstructural approaches to flood control. By the late 1960's Corps planners began receiving specific directives requiring them to address nonstructural solutions to reduce flood damages. From 1968, numerous engineering circulars, regulations, and policy guidance papers were issued in an attempt to clarify the procedures which the Corps planner should follow in properly addressing the evaluation and development of nonstructural measures. The more significant of these are described below:

EC 1120-2-40 (26 April 1968), "Treatment of Non-Structural Alternatives". This EC required consideration of nonstructural flood plain management measures in all survey studies, including small projects. The EC stated that comprehensive flood damage prevention planning requires the integration of all alternative measures (including both structural and nonstructural) and that solutions may include structural, nonstructural, or a combination of both. (Rescinded)

EC 1120-2-49 (13 June 1969), "Progress in Treatment of Non-Structural Alternatives". This EC cited the office of the Secretary of the Army's favorable reaction with progress of the Corps toward full consideration of alternatives. The EC went further by stating that there should be no unfavorable reports when a program (structural, nonstructural, or some combination thereof) can be formulated. (Rescinded)

ER 1120-2-117 (17 August 1970), "Alternatives in Flood-Related Planning". This ER constituted the first articulation of the present Corps policy on nonstructural plan formulation. The policy established by it is still very relevant. It required the consideration of all relevant means and alternative approaches that contribute to the appropriate use of flood plains such as flood plain management. The objectives of NED, EQ, Well-Being of People, and Regional Development were stated as well as adherence to EO 11296 (forerunner of EO 11988). Measures to modify flood damage susceptibility included floodproofing, zoning, permanent evacuation, flood insurance, and flood warning. (Rescinded)

ER-1105-2-351 (13 June 1975) "Evaluation of Beneficial Contributions to NED for Floodplain Management Plans". Stated the principles, standards, and procedures for evaluating NED benefits for all floodplain management plans including nonstructural plans (Rescinded 1 June 1981).

ER-1105-2-200 (10 November 1975) "Planning Process: Multiobjective Planning Framework". Consistent with the Principles and Standards of September 1973, this ER required that alternative plans be formulated without bias toward structural or nonstructural measures. (Rescinded)

ER-1105-2-353 (4 April 1979), "Evaluation of Nonstructural Measures". This regulation provided instructions for the evaluation of National Economic Development (NED) benefits and costs for evacuation and relocation as nonstructural measures for flood plain management (Rescinded 11 May 1981).

ER 1165-2-26 (15 May 1979) "Implementation of EO 11988 on Floodplain Management." Sets forth general policy and guidance for Corps implementation of EO 11988.

Policy Guidance, Nonstructural Alternatives, DAEN-CWR-P, 15 October 1979. This Policy Guidance was written in the format of 16 questions and answers on issues pertaining to nonstructural measures. Its purpose was to clarify pending policy and requirements under ER 1105-2-353, as well as issues raised in a report by the St. Paul District, "The Development of Nonstructural Alternative.", (May 1979).

Policy on Land Acquisition for Nonstructural Projects, DAEN-CWR-R, 12 April 1982. This policy was issued by the Assistant Director of Civil Works and recommends that acquisition of land for projects be undertaken by local interests since there is no opportunity for the Corps to obtain specific Congressional authorization for land acquisition and conveyance as an element of a project under the Continuing Authorities Program.

Much of the Corps initial guidance and policies on nonstructural actions has been rescinded in accordance with the Regulation Reform Action Program (RRAP) instituted in early 1981. Current and emerging guidance and policies are covered following the section below.

## THE IDENTIFICATION OF NONSTRUCTURAL MEASURES

As indicated earlier, the basic features of nonstructural measures are fairly well established. It will be useful, however, to briefly review them. One significant approach is to recognize that nonstructural measures are considered to be those flood control alternatives which guide human behavior into desired paths to reduce flood damages. This is in contrast to structural measures which direct flood waters into desired paths.

Nonstructural measures can be thought of as falling into two broad categories. First, those that modify the susceptibility to flood damage and disruption and, second, those that modify the impact of flooding on individuals and on the community.

### a. Nonstructural Measures Modifying the Susceptibility to Flood Damage and Disruption.

In this group belong those measures or actions which are designed to eliminate the uneconomic, undesirable, or unwise use of the flood plain. These measures include:

(1) Flood plain regulations imposed at the State and/or local level. States frequently require the review of proposed activities that may affect flood flows. Local tools include building codes, zoning and subdivision ordinances which restrict the use of structures and land.

(2) Public Development and Redevelopment Policies governing the location, construction, and use of public buildings sewers, roads, and utilities. In effect, these policies direct private development away from the flood plain.

(3) Public Acquisition of Flood plain Land can ultimately be more effective and feasible than regulation. The drawback with this measure is the considerable expense of land acquisition.

(4) Permanent Evacuation may be a useful tool for specific parcels of land, particularly where redevelopment efforts are involved.

(5) Disaster Preparedness Planning including flood forecast and warning and evacuation, has proven to be most effective in reducing loss of life and property.

(6) Floodproofing has proven useful in minimizing damages to structures and their contents. Floodproofing measures encompass:

- (a) Elevation on columns or walls.
- (b) Elevation on fill.
- (c) Temporary relocation or protection of contents.
- (d) Small ring levees or walls around structures.
- (e) Use of water resistant materials (wet floodproofing)
- (f) Elevation of equipment and utilities.

b. Nonstructural Measures Modifying the Impact of Flooding on Individuals and on the community.

In the second group are those nonstructural measures which are designed to assist individuals and communities in their preparatory, survival, and recovery responses to floods. Such measures include:

(1) Information and education, the key to helping the public understand the nature of the flood threat in order to prevent unwise use of flood plain land and to make wise decisions before, during and after flood emergencies.

(2) Flood Insurance, providing compensation to those who suffer losses from flood damage by spreading the cost of compensation over time and among a large number of people at risk.

(3) Tax adjustments, which can be valuable by both encouraging and discouraging certain land development patterns through incentives as well as providing tax relief to flood victims.

(4) Flood Emergency Measures, such as flood fighting, rescue, and temporary floodproofing (sandbagging) can be effective during actual floods.

(5) Postflood Recovery, including meeting such needs as clean-up, temporary shelter, food, water supply, and medical care. Longer term recovery includes grant and loan assistance and disaster aid.

However, regardless of the categories or classification of nonstructural measures, and these are numerous, the important thing is to recognize their application and general function. It is also important to recognize that various combinations of nonstructural measures frequently provide the most comprehensive approach when considering such measures as a singular approach or conjointly with structural measures. Consequently, a good working knowledge of nonstructural measures is the basic requirement for proper consideration of any application.

CURRENT AND EMERGING GUIDANCE FOR INCLUSION OF NONSTRUCTURAL MEASURES IN FEASIBILITY STUDIES

Current Corps guidance with regard to consideration of nonstructural alternatives is provided in Chapter 3 of ER 1105-2-20, entitled "Project Purpose Planning Guidance", and in three policy papers, as follows:

(a) Policy Guidance, Nonstructural Alternatives, DAEN-CWP-F, 15 Oct 1979; (b) Policy on Nonstructural Flood Damage Reduction Measures, DAEN-CWR-P, 6 Jan 1981; and (c) Policy on Land Acquisition for Nonstructural Projects, DAEN-CWR-R, 12 April 1982.

Consistent with ER 1105-2-20, nonstructural measures are defined as those intended to modify the ways in which people would otherwise occupy and use floodplain lands and waters. Based on Section 73 of the Water Resources Development Act of 1974, (PL 93-251), ER 1105-2-20 presents:

several important guidelines with regard to conduct of feasibility studies. All planning elements responsible for conducting feasibility studies are to conduct their studies in accordance with the following guidelines:

- a. There is no minimum level of protection for nonstructural plans.
- b. There is no requirement that a certain proportion of project benefits must be flood damage reduction, recreation, or environmental quality benefits.
- c. Corps participation in implementing nonstructural measures is generally limited to permanent evacuation and relocation, flood proofing, and the provision of equipment devoted exclusively to flood warning systems or temporary evacuation when these are elements of an overall flood damage reduction plan.
- d. When a nonstructural measure is recommended, non-Federal participation is 20 percent of the flood damage reduction plan. (Note that under the Administration's proposed new cost sharing policy, the non-Federal share of capital costs for urban and rural flood protection and rural drainage, will be variable, but no less than 35 percent. The possibility should be noted that the greater concern for non-Federal cost sharing may influence local communities to take a more serious look than heretofore at the long-term advantages of nonstructural measures.)
- e. Nonstructural cost eligible for costs - sharing include the cost of:
  - (1) acquiring improvements.
  - (2) land or interests in land.
  - (3) floodproofing existing structures.
  - (4) relocation or removal of existing structures.
  - (5) reestablishing existing public facilities when they have been relocated.

As of the dates of this Seminar, 15-17 November 1982, the Water Resources Councils "Principles and Standards" (P&S) requiring presentation of a primarily nonstructural alternative are still in effect; however, in early 1983 they will be replaced by the Administration's proposed "Principles and Guidelines" (P&G). Consequently, the nonstructural requirement of the P&S is not discussed herein.

While development of a nonstructural plan will not be a requirement, the P&G does give considerable attention to nonstructural measures in alternative plans, indicating that such "measures should be considered as means for addressing problems and opportunities." Such measures "include modifications in public, management practice, regulatory

policy, and pricing policy", thus reflecting considerable potential flexibility and range of prospective application. These are alternatives to "traditional" structural measures and may, indeed, be blended or combined with "traditional structural measures to produce a complete alternative plan".

Additional, specific guidance on nonstructural alternatives is provided with regard to economic evaluation procedures applicable thereto in the area of urban flood damage.

In addition to ER 1105-2-20, there is a proposed Engineering Regulation, ER 1165-2-122, entitled "Use of Nonstructural Measures in Planning for Flood Damage Reduction" which has provided some guidance to the field. While the proposed ER was written under the "Principles and Standards" and, if published, will be revised to conform to the proposed "Principles and Guidelines", nonetheless it is important that consideration of potential nonstructural measures remain a vital aspect of plan formulation. In that regard, the following should be considered:

(1) The "without condition", the base against which the impact of alternative plans are to be measured, should reflect "the most probable" future.

(2) Nonstructural measures not instituted at the time of study should not be imputed to the "without" condition even if they are well within the authority and competence of non-Corps entities and could be feasibly instituted at any time.

(3) Such readily feasible (but as yet uninstituted) nonstructural measures should, collectively, be considered as one of the alternative plans evaluated by the Corps.

(4) This not only provides means of measuring and presenting the benefits potentially available without Corps involvement but also, if a Corps project is not recommended, leaves an alternative that the Corps can positively support in its conclusions (which, it having been made clear to local interests that this is their only recourse, may speed helpful local actions which otherwise might be long delayed).

In addition to ER 1105-2-20, several policy guidance papers referred to above have been issued in the last three years. Of these, perhaps the paper written on 6 January 1961, entitled, "Policy on Nonstructural Flood Damage Reduction Measures" is the most comprehensive.

Some of the major points raised in the guidance were:

(1) as a prerequisite for Federal implementation of a flood damage reduction project, the local sponsor is required to adopt floodplain management programs in and adjacent to the project area; (2) more emphasis is placed on recreational or environmental use of evacuated floodplain land; (3) formulation of plans to provide a level of protection that would insure wise use of the flood plain rather than some predetermined level; (4) that the local share of costs for recommended nonstructural measures will be 20 percent of the first cost;

and (5) when flood warning and/or temporary evacuation are elements of the adopted plan, the Federal sponsor can participate in the cost of equipment exclusively devoted to flood warning systems and/or temporary evacuation.

Corps guidance provides that all planning studies are to be conducted in an open atmosphere to attain public understanding, trust, and mutual cooperation and shall provide the public with opportunities to participate throughout the planning process. An important aspect of this is close coordination with Federal agencies involved in the development of water resources. With regard to flood control studies, actual participation by certain Federal agencies is frequently required. The fact that other agencies, including the Federal Emergency Management Agency (FEMA), the National Weather Service (NWS), the Soil Conservation Service (SCS), the Tennessee Valley Authority (TVA), and others have done research and work in the area of nonstructural flood damage reduction suggest they can be valuable participants in Corps flood plain management feasibility studies.

#### CORPS PROGRESS AND PROBLEMS IN THE APPLICATION OF NONSTRUCTURAL MEASURES

As indicated earlier, the various executive and legislative actions, published guidance by the Corps and actions by Federal/State/and Local governments provided a rather extensive diet of nonstructural measures. In some cases, various Corps offices responded by integrating the planning for nonstructural measures into project formulation efforts. Because the concepts were new (relatively speaking) full implementation was not achieved by all Districts. The level of effort and the degree of consideration has varied extensively. Part of this varied approach undoubtedly reflects the diverse views of numerous Districts, as well as the character of the problems and opportunities under study. Unfortunately, there are relatively few cases where a major nonstructural plan has been developed by the Corps and moved toward implementation. These major efforts perhaps are known to all. Regardless, an attempt will be made to summarize them herein. Additionally, a further attempt will be made to summarize the various problems encountered by the Districts in applying nonstructural measures, including what appear to be the significant lessons learned.

In this necessarily limited discussion, no attempt will be made to identify and characterize the many successful nonstructural actions by other Federal Agencies, States and particularly local governments. A comprehensive discussion of these is included in Appendix B of Vol. III, of the Water Resources Council's report on "Regulation of Flood Hazard Areas to Reduce Flood Losses". That Appendix has been printed as a separate document and is titled "Innovation in Local Flood Plain Management". Subsequently, it will be included in Vol. III, expected to be published sometime in 1983.

The discussion is presented in two parts: one relating to Corps application of nonstructural measures, the other to an evaluation of progress and problems.

a. Corps Projects Involving The Application of Nonstructural Measures.

During the last two decades, a number of proposed Corps projects have included nonstructural measures. Only a few, however, incorporate what are considered to be major nonstructural features. Some projects like Indian Bend Wash, Arizona; Littleton, Colorado; and Upper Charles River, Massachusetts contain provisions for acquiring undeveloped or sparsely developed flood plain land to be used for flood storage. A second group such as Praire du Chien, Wisconsin; Allenville, Arizona; Baytown, Texas; and Midland, Michigan involve permanent evacuation and relocation outside the flood plain. Others, such as Peachtree and Nancy Creeks, Georgia include flood warning, floodproofing and evacuation measures. A description of these classic examples of projects incorporating nonstructural flood damage reduction measures follows.

Indian Bend Wash, Arizona. This project combines interdependant local and Federal actions to provide a floodway corridor and recreation space through the City of Scottsdale. The flowage and recreation area are local responsibilities. The Federal features are a flow concentrator and siphon to bypass a major irrigation canal at the upper end and a collector and channel to carry the floodwaters to the receiving river at the lower end. The original project called for channelization throughout. The project was authorized in 1965 and received its first funding in FY 75. The project is nearing completion.

Littleton, Colorado. This project is a modification of an authorized channelization project downstream of Chatfield Dam. In place of the upper end of the channel, an overflow area of some 750 acres is being acquired using both community and Federal funds for open space and recreation. The Federal funds come from the savings in cost in the authorized channelization without this upper segment. Because flood-flow trainers are required to get the overflow back into the channel after it leaves the area, a direct trade off is not involved. The project was authorized by the 1974 Water Resources Development Act. Most of the overflow area has been acquired and converted to park land. Acquisition is continuing.

Upper Charles, River Basin, Massachusetts. This project provides for fee acquisition of more than 8,000 acres of of natural flood storage area in the glacially deranged drainage near the headwaters of the Charles River. Acquisition by Federal and State actions would preclude development accompanying storm-water drainage and filling, which would ultimately eliminate this natural storage. The beneficiaries are the heavily developed communities lower in the basin (hence, unsuitability of ordinances in upper basin) which, without the project, would eventually be victims of a substantially increased flood threat. This project was authorized in 1974 and acquisition is currently underway.

Prairie du Chien, Wisconsin. This project consists of permanent evacuation and relocation of the residential properties from an often flooded river island and the adjacent mainland to flood-free areas of the community. The few remaining buildings--public, commercial and industrial--are being floodproofed to the design level adopted. Relocation is being phased in over a five-year period to reduce the impact of dislocation on the relocatees, particularly the elderly. The project was authorized in 1974 and is at least a few years from completion.

Allenville, Arizona. This Section 205 project provided for the reduction of flood damages in Allenville through relocation of the entire community out of the Gila River flood plain, thereby not only eliminating flood damages but preserving community cohesion as well. The cost was shared - 80 percent by the Federal government and 20 percent by the State of Arizona. The local sponsor (Arizona Division of Emergency Services) acquired all the necessary real estate. The Corps constructed the streets and utilities, community center, park, and replacement houses at the new site. The Detailed Project Report was approved by OCE in July 1980. Construction began in 1981 and is now virtually complete.

Baytown, Texas. Baytown is an area of major ground subsidence due largely to groundwater withdrawals. Properties at the head of Galveston Bay are becoming increasingly prone to tidal flooding. Subsidence is expected to continue despite efforts to correct the problem. The project calls for removal of residential structures within an area which has a 2 percent chance of being flooded in any year. However, this project has not received local support.

Midland, Michigan: In the early 1950's, a structural project was authorized for this community as part of a basin-wide plan. Much of the justification for the structural plan was lost when Dow Chemical proceeded on its own to construct levees to protect its property. However, the levees did not protect vulnerable residential areas with several hundred inhabitants. Subsequently, severe floods in the area helped stimulate a reformulation of the authorized plan. This reformulated plan proposed the acquisition and removal of about 100 residential properties from the floodplain. In addition, the City of Midland has a definite recreation plan for the flood plain land to be evacuated. This recreation plan would produce more benefits than those which would derive from reduced flood damages. This project, as a result of the reformulation to a nonstructural alternative, required special OCE approval. This approval was provided on 8 June 1981. Its estimated first cost and benefit-cost ratio in 1976 figures were \$4 million and 1.16, respectively. While the project is authorized, there has been no construction to date.

Peachtree and Nancy Creeks, Atlanta, Georgia. The project is located along two urban creeks which are subject to flash flooding. The creeks are surrounded primarily by residential developments in one of metropolitan Atlanta's most attractive neighborhoods. Although the flood problem has long been recognized and structural solutions

exhaustively investigated in earlier studies, no major flood has occurred in the memory of current residents. This factor complicates local acceptance of a plan with significant local cost. The plan involved all of the approximately 700 residential properties in the 100-year floodplain. It provided for floodproofing most of the residences by raising them; others would be acquired and demolished. The first cost estimate of \$45 million made this the most expensive nonstructural alternative to reach a stage near recommendation. Its estimated benefit-cost ratio of 1.00, however, was similar to those of other recommended nonstructural projects. In addition, many area residents doubted that the flood threat is as critical as the Corps determination indicated. They objected to the local share of the cost which, under the 20-percent non-Federal cost-sharing formula, would be about \$9 million. Others believed that the aesthetic values of the wooded area outweigh the flood risk. Further, some community officials feared the loss of the tax base if the proposed project was implemented. Due to the lack of local support this project has not been authorized.

b. Evaluation of Progress and Problems in the Application of Nonstructural Measures.

The level of effort and experience in dealing with nonstructural measures varies extensively between Districts. Even the efforts described above had to overcome serious obstacles because new ground was being broken. Recognizing this, several attempts were made to evaluate the Corps' progress in implementing the consideration of nonstructural measures.

Perhaps the first major evaluation was the 4-6 May 1976 Seminar on "Nonstructural Flood Plain Management Measures", co-sponsored by the Hydrologic Engineering Center (HEC) and the Institute for Water Resources (IWR). Up to 1976, much had been accomplished towards implementing nonstructural measures in Corps planning. The problems identified in the 1976 Seminar, however, clearly showed that the Corps faced some very tough but not impossible obstacles. It was apparent that clearer policies and planning guidance were required to identify the federal role and more clearly establish cost sharing arrangements. The benefit/cost analysis also presented a difficult challenge.

A second evaluation was the 1978 study done by the Hydrologic Engineering Center, "Physical and Economic Feasibility of Nonstructural Flood Plain Management Measures." Basically, the study concluded that overall, nonstructural measures can play an important role in reducing flood damages and that they are physically and economically feasible in specific cases and within prescribed limitations.

Another significant milestone in the evaluation of the Corps effort was the May 1979 report by the St. Paul District titled "The Development of Nonstructural Alternatives - A Policy Discussion by the St. Paul District". The study concluded that the Corps had recommended and undertaken very few nonstructural projects to date and that changes in policy and study procedures are necessary to facilitate further successful application.

The January 1981 Research Paper titled: "Corps of Engineers Implementation of Nonstructural Measures," by Allen E. Chin, Water Resources Planning Associate from the Los Angeles District, clearly identified specific residual problems being experienced by the Corps District offices. Since the 1976 Seminar referred to above, more specific policy and guidance has been issued on the application/inclusion of nonstructural measures in flood plain management planning. Regardless, according to Chin, District planners still are faced with significant problems and difficulties. Perhaps the focus has changed somewhat since Mr. Chin found that the lack of local support or acceptance of nonstructural measures is now at the top of the list of problems, followed closely by the difficulty in showing economic feasibility for most nonstructural measures. This latter problem appears to be related to the earlier identified problems of adequate economic justification. Other issues such as lack of policy guidance on cost sharing, degree of protection and plan formulation were also identified.

The Corps study approach initially was to consider nonstructural measures as a separate solution to the flood damage problems. Plan formulation proceeded considering structural measures either singly or in combination. Several factors contributed to this approach. During the early phases, most planners lacked knowledge of details of nonstructural measures. Consequently, the assignment for the non-structural plan (or measures) fell to an individual most acquainted with those measures, normally not the person possessing project formulation expertise. Thus, the "add-on" nonstructural "solution" resulted. In other words, the nonstructural plan was not integrated into the various alternatives but represented an essentially separate approach which basically could not stand by itself. Progress has been made, however, and more Districts are planning nonstructural measures in an integrated manner. Those that do not, however, are likely to find undesirable/un-economical/unimplementable plans a commonplace, a waste of scarce resources, talents, and time.

It is said that Confucius, when asked what his first deed would be if he were to be made Emperor of China, replied, "I would re-establish the precise meaning of words". Perhaps he had the definitional difficulties in mind presently inherent in the separation and classification of solutions into the neat, tidy "structural" and "nonstructural" categories. Thus far, the gray area of interface between these two categories defies precise definition. It is thus easy to have rather involved discussion between knowledgeable, experienced water planning professionals regarding the appropriate category. For instance is "floodproofing" really and truly--and in every instance, a "nonstructural" measure? Another example is that of a low levee around 1-2 structures. Normally, this is considered a "nonstructural" measure. However if the levee is extended around an increasing number of structures, at what point does it become a "structural" measure? Views on this can vary extensively. One solution might be to disregard seemingly inflexible classifications and consider the overall affects.

## LESSONS LEARNED AND WHAT CAN BE DONE

As indicated in this review, Corps-wide experience in considering nonstructural measures is quite broad and varied. There has been some limited success but, more frequently, the opposite has occurred. Lack of support or local cooperation following substantial plan formulation and evaluation effort has been a not uncommon occurrence. While some lessons have been learned, the "learning curve" is steep and rising, and much learning lies ahead. To date, it is rather difficult, perhaps even misleading, to draw too many conclusions; to be too specific, or even too speculative, as to what the full range of lessons learned might be, or is likely to be.

This paper has been prepared for the 15-17 November 1982 Corps Seminar on the Implementation of Nonstructural Flood Plain Management Measures. Among other things, it is one of the primary purposes of the Seminar to assess Corps experience to date in this regard, to share ideas and experiences with each other and with knowledgeable people from other agencies and the private sector. The written papers, summaries of panel participation, the results of the general issue forums, and the verbatim transcript of the exchanges between speakers, panelists, and the general audience will be carefully assessed for practical lesson content. Although this assessment will be initiated during the Seminar, it will not come to fruition until some months thereafter.

In the meantime, however, several obvious items can be summarized based on the known general consensus of individuals closely involved in those planning and evaluation efforts which have taken nonstructural considerations into account. Some useful, basic lessons from this consensus are:

a. Nonstructural measures are not equivalent to, nor a substitute for, major structural measures in dealing with existing development. (Basic economic dictates that nonstructural solutions are generally a better answer to the reduction of future flood damages than to the reduction of current damages.)

b. Most successful application of flood plain regulations is to control future development in known and suspected flood hazard areas.

c. Most flood proofing measures are more feasible in areas subjected to shallow flooding.

d. Emergency preparedness plans can always be implemented. However, the degree of possible success in reducing flood damages by this means is related to the topography of the area.

e. It is difficult to economically justify nonstructural measures based on current benefit evaluation policy.

While many things can be done to strengthen the Corps effort in nonstructural planning, as a minimum, the following actions could be taken in the near term:

- a. Review current Corps policy for nonstructural measures in the light of current Administration policy.
- b. Review published Corps guidance and directives pertaining to nonstructural measures and revise as appropriate.
- c. Reemphasize the role and significance of nonstructural measures as a means of reducing flood damages.
- d. Evaluate the Corps' current capability to incorporate the planning of nonstructural measures into feasibility studies. Determine need for additional training for district personnel.
- e. Reemphasize the integrated approach in planning for the incorporation of nonstructural measures in project formulation.
- f. Review the planning and technical assistance that the Corps can provide to States and local communities to help them to help themselves in applying nonstructural measures appropriate to their needs.

#### CONSTRAINTS AND LIMITATIONS

All organizations, especially public organizations, function and perform subject to various constraints and limitations. A paramount, abiding, and continuing concern is that of having sufficient money, manpower, and materials to conduct agency business and fulfill its objectives. However, while recognizing the obvious importance of obtaining the necessary resources to accomplish an agency's mission, there exist significant "constraints and limitations" of another kind; a kind much less easy to identify and delineate, never mind quantify. Basically, these constraints and limitations are derivative of what might be called "habituated thinking," or the way an old-line agency perceives itself, including its traditions, custom, and manners; its comfortability with settled relationships, long-nourished areas of influence and, in general, with time-honored, established patterns and "ways of doing things." At the same time, and this is probably a significant general Federal planning limitation, many agencies are institutionally and constitutionally so organized that they characterize or define problems almost exclusively in terms of the solutions ordinarily available to them. This, of course, can severely constrain the range of alternatives given serious consideration, thus limiting the notion or idea of "comprehensive planning."

Given its history, the Corps has been characterized as an agency "Possessed of an almost instinctive affinity for structural solutions." As an agency that, leaning on its proud traditions and past accomplishments--"days of glory," etc.--tends to function via an established "mind set" of passed along customs, practices, and traditions. Many see these customs, practices, and traditions as obstacles to bringing about fundamental change; and, relating to the essential thrust of this seminar, as views and practices that are antithetical to the goal of bringing about the ordinary and routine incorporation of nonstructural considerations in flood plain management planning. If a "breakthrough" is needed, it is in our thinking, not our technology.

If it is to even modestly flourish, however, the application of nonstructural techniques in flood plain management planning need suitable incentives and the fair allocation of manpower and resources to its conduct. Agency leadership and the institutional framework which reinforces that leadership must be overtly supportive. But that support must relate to priorities and commitments, not the mere rhetoric of nonstructural ideas and possibilities; that support must be seen, indeed "felt" in the districts, divisions and throughout the Corps-wide system, as a genuine commitment to seriously address such matters within the conditional situation--hydrological, technical, social, environmental, institutional, etc.--unique to each planning setting.

Where in some few Corps districts a nonstructural initiative may flourish, in most districts, not strongly encouraged, it languishes. Moreover, even after ideas and innovations are conceived, tested, and articulated, the Corps institutional framework influences the rate at which these "a-traditional" ideas are absorbed and diffused throughout the system and, critically, the alacrity with which resources are made available and planning mixes or outputs can change. If we or, indeed, any agency, are hidebound and inflexibly wedded to past traditions in need of adjustment and adaptation (however justly proud these are), then new policies will not likely spread rapidly, and resources may not readily shift to their best use or combination of uses. As a result, the public may not be well served.

Finally, let me conclude by pointing out that in common parlance the Corps of Engineers, along with such sister agencies as the Bureau of Reclamation, the Soil Conservation Service, and the Tennessee Valley Authority, is frequently referred to as a "construction" agency. Actually, there is nothing wrong with that cognomen as far as it goes. However, it does not go far enough. The Corps is, indeed, a large construction agency but it is much more; it is a major planning, engineering, design, resources management, and technical assistance agency, as well. Moreover, the Civil Works mission of the Corps of Engineers is not that of construction per se; rather it is one of providing solutions to specific water resources problems. And the solutions we recommend and apply to the water problems we are asked to address may be structural, nonstructural, or innovative combinations thereof as the instant planning situation may command.

PANEL I, FOLLOWING DONOVAN ADDRESS

DAN MAULDIN:

As we look at experiences that we've had out in the field and share those, we can come back and fit it in with what Bill has had to say and generate some comments. Bill referred to the son of P&S; I thought perhaps he was going to liken that to the son of Frankenstein, and perhaps that's a good description. We can look at our experiences and relate them to the guidance that comes down and see how they all fit together.

In the South Atlantic Division we began with mixed success as far as the implementation of nonstructural measures is concerned; Bill mentioned one of those. But I personally believe that this alternative has advanced as much as we should have anticipated or even expected that it would to this point. By and large, we find that individuals who are experiencing flood damages prefer a structural solution as opposed to nonstructural if, of course, that is feasible. There are special cases where a nonstructural plan may be preferred, and we are addressing one of those currently in the Atlanta area where there is a limited number of very expensive homes.

But I would like to recount a couple of our experiences to illustrate some points that I would like to make. One effort was a success and the other was a failure. We have an implementation plan on one of those, and the other we couldn't get the local folks to agree with. And these comments are based on hindsight, which you realize is always more enlightening than foresight. We have had flooding in the Peachtree and Nancy Creeks in the metro Atlanta area for many years. Several studies were never able to find an economical plan there. The flooding is in the heart of a flood area of the city. The costs of all the structural plans were simply prohibitive.

During the last study, Section 73 became law and we decided to take a fresh look at the nonstructural approach. We tried to develop a plan to cover as much of the damaged area as we could justify, and in hindsight I think that was probably a mistake. We included people who did not think that they were getting damaged sufficiently to require them to move out of the area, and they simply preferred to live where they were and to accept the flooding that they were receiving if we couldn't find a structural solution. There were enough of those people to mount a campaign to defeat the entire plan.

Now, in a more recent study effort down in Village Creek in the heart of Birmingham, Alabama, in a low income area, we took a somewhat different approach. We developed a plan for a minor storm wherein all the residents were getting flooded on a relatively frequent basis and, in the final analysis, although we did experience some opposition, there was a city referendum and we gained approval of a plan calling for the removal of some 574 structures. That was opposed to the district engineer's recommendation at the time for some 993 structures.

The point I want to make is this: if we try to maximize our coverage, as we do initially in our planning process, we may be creating problems for ourselves later on. Opposition develops from those who don't wish to be included in

some of the fringe areas, and that opposition is sometimes sufficient to defeat even a reduced-scope plan in the later processes of our planning. On nonstructural planning I believe we should think small initially, gain the public support, and then utilize that support to expand as much as we can where that is desired.

I'd like to briefly make some other points. I think we are going to have to take the double standard out of our economic analysis if we expect to move out with nonstructural plans. The fact that we can claim on structural plans the total average annual damages as a flood control benefit, whereas on nonstructural plans we must deduct the so-called administrative expenses such as flood insurance premiums and deductible, is simply not realistic. With the 50 percent increases in premiums and deductibles, justification of nonstructural plans is going to be even more difficult. And why do we have this double standard as we look at these two alternatives?

The language in Section 73 also creates problems. It says that we must evaluate floodproofing, and this is almost impossible to implement. You can't force this on the property owner. The local governments in our area have said repeatedly that they can't spend public funds on private structures. And besides, O&M for floodproofing is impossible.

We are planning to floodproof a structure on one of the projects that we have approved now, but in that particular case the local sponsor will be purchasing the building and then they will use it afterwards as a recreation center in the evacuated area. But widespread use of this alternative is, I believe, most unlikely.

The law also says that we should consider relocations. This normally anticipates removing and re-erection of buildings for continued use in the new locations. Bill mentioned earlier a study effort or project where they were doing some relocation; I'd be interested to hear more of that. But without specific project authority, there is no authority to acquire new building sites to reconstruct the buildings and to follow through with disposal at fair market value. The complications in this, of course, are awesome. What happens if all the relocated buildings can't be sold? I believe our planning should concentrate on those procedures which can be implemented even if condemnation is necessary.

One quick additional point, and this is perhaps a personal concern of mine. I'm not sure that I see a national scope for a project which only includes a relatively small number of structures, for instance, a 205 project which proposes the evacuation of five or six houses. I'm not suggesting that this be curtailed where we need it. However, it is a concern which I believe will be seriously challenged if and when this level of nonstructural project becomes more numerous.

Those are some quick comments and thoughts of mine on the overall nonstructural approach that we've been taking. Perhaps they will generate some questions or comments from you; I hope so. I think in doing that we will all benefit more.

BRIAN MOORE:

I'd like to amplify one of the points that you brought up toward the end. I think that we have come a long way in nonstructural planning; I think that's pretty clear. There has been a lot of new projects proposed, but the thing that is interesting to me is that you can count the number of plans that we have actually built on the fingers of your hands, so we are not doing everything 100 percent correct, but at least we are making some progress. And I am wondering why haven't we got more plans implemented in the nonstructural area.

I think one of the points that Bill was bringing up is that of course we are an engineering organization staffed with engineers, and we have a need for doing structural plans for years and years. And our guidance is pretty clear on how you proceed for structural plans. We have reams and reams of regulations and guidelines on how that is done. We have engineers who know how to design channels and dams, and they can evaluate; we can ask them, "What is this flood going to do with this size channel?" And they can answer us right off the bat very easily. We have economists who know how to evaluate those kinds of proposals, too. Our organization has been geared toward that end of the spectrum.

But when it comes to nonstructural plans, and your field planner is asked to evaluate these plans and develop them, just who does he turn to? There is not really in most organizations a group or an area of expertise that this individual can turn to and say, "Help me in this analysis and evaluation of nonstructural plans."

In Los Angeles we have done something that we think we help in that area, and I suppose a lot of other businesses have done the same thing. We asked our floodplain managers group to also do nonstructural evaluation in addition to their floodplain management duties. And I think that this has helped us out quite a bit. These people are charged with expertise in all the nonstructural areas and floodplain areas, and it has given our field planners a much better input.

There is one other thing that sort of backs up what I'm talking about. One of our field planners went to the Planning Associates Program for the Board of Engineers, and he developed a questionnaire as part of a paper on nonstructural alternatives. He sent this questionnaire to each and every district and asked the districts what they saw as the problem areas of nonstructural planning. There are about 10 areas that the districts responded in; 18 of those responses picked their top choice as lack of local response or acceptance, and about 16 picked their top choice as difficulty with economic feasibility or analysis.

It is interesting to ask ourselves why did 18 districts pick lack of local support or acceptance as the key area for having difficulties in nonstructural solutions. I wonder if it really is more oriented toward outside the organization. In other words, is this really a problem with locals, or is this an internal problem too, in that we haven't really developed in our planning capabilities the same expertise that we have in structural areas.

Maybe our confusion, our lack of guidance as compatible and equal to structural guidance, has led to the confusion on the part of locals and made it more difficult for them to accept the plan.

Another thought I had was that in the early 1970s when we were having problems with our structural plans because of the environmental movement and people didn't think that structural was the way to go necessarily, our organization changed significantly. We became very good at adapting to the environmental problems, the social problems, and we developed a planning process at that time that really helped us in our structural plans. I'm wondering if we have done the same thing in the nonstructural area, a fact that's perceived as a lack of local support or acceptance in nonstructural planning. That is something that I hope that we can get into perhaps in this seminar.

The economic feasibility or analysis problem is a real problem, as Dan pointed out too, in that it is just not consistent. Our evaluation is not consistent with what we do in the structural areas. I'm hoping that we can have some discussion on that and maybe eventually propose some changes to that. To sum up, I think that our planning efforts in the nonstructural area are not quite compatible to our planning efforts in the structural area. I'm hopeful that we can make some changes there, and I am looking forward to some more discussions in this seminar which can maybe iron some of these problems out and come to some solution.

GEORGE PHIPPEN:

Bill has hinted at what I think is really a major problem here, in understanding, and that is while I was glad to see that nonstructural was put into the floodplain management context---and Bill emphasizes that structural is there also, I still find sort of an underlying current that this is somehow separate. I think that as long as we think of it as something separate and important in or of itself, we are going to stay in trouble. What we are talking about here is the planning approach to an area which is subject to flooding, and if we segregate these ideas of structural and nonstructural and make one seem a little bit better for some and a little bit not so good for others, I don't think that we are going to get around the problem.

It is interesting, and Bill knows, where he refers to some early guidance in 117, for example, that the word "nonstructural" doesn't appear. I think that it might be interesting for you to consider that we tried very hard to keep that out of 117; we worked for hours just on that one point alone. But we saw right away the problems that were going to creep into the whole analysis picture if in fact this was set aside as something special and unusual in itself. I think we have to face the fact that most of the examples, certainly all the ones we talked about this morning by name (with the possible exception of Allenville), have been those types of projects where we got to so called nonstructural solutions only after we've exhausted every other possible structural consideration that existed. So while they are good examples, they are not good examples of planning.

The one project I notice that is missing is the Four Mile Run project right across here. As I recall, the upstream area involved, not those directly at

the project area but upstream folks, were required to assure the Secretary of the Army or the chief, or both, that land use changes in their jurisdiction would not increase flooding downstream. I bet such an area was completely omitted from what we consider Corps interests. I don't see how you can say it is not part of the planning process.

Obviously another thing that's cropped up in remarks of Mr. Moore, I think, is that many of the things that we're talking about here are not actions that the Corps of Engineers is going to take on its own. They are actions that in large measure are taken by others, people at the local level. And so we have to recognize that part of the planning process is integrating ideas at the local level right along with the development of the plans so that you don't have the surprises that Dan's worried about. I'm worried about those too; we all are. We sell a bill of goods, we try to sell it, we find that the bill of goods we started with is not the one that somebody wants, and that prejudices the whole case.

DISCUSSION FOLLOWING DONOVAN ADDRESS

CARL H. GAUM:

I was wondering if in this economic period we should not be looking at financial, as well as economic analysis. In other words, the individual communities and people have to put choice priorities on their expenditures. And with the local cost sharing going up, this is going to become more critical to them. Perhaps a financial discussion in our planning reports would help people understand what was going on. That might be given some consideration, and in addition to that, the "help yourself" program that was used out in the North Central Division for the shoreline erosion program. And you folks here in Washington recently put out the booklets for the ocean shore; perhaps a report of that "help yourself" type for nonstructural operations, for the community and the individual, might be of benefit.

WILLIAM J. DONOVAN:

You're referring to the Section 54 pamphlets that were recently put out?

GAUM:

Yes, something like that might help communities better understand nonstructural measures.

DONOVAN:

Those are certainly sound suggestions. In an era of change in cost sharing toward an increasing nonfederal share and a period of economic stress the suggestion of financial analysis in addition to economic evaluation is certainly well taken. Maybe it would be a good idea for us to give some thought internally to being able to produce a national kind of brochure.

BRIAN MOORE:

I just have a comment on your first statement about doing financial analysis as well as economic evaluation. I think we're coming to that, not just for nonstructural measures but for structural plans too. But the problem with that is that you may develop your plan geared to meet what locals can pay for instead of developing your plans to solve the problem in the most efficient and effective manner. So we have a real problem, in that our previous guidance is all geared toward staying away from the financial end of things, not worrying about that because it's a local problem. Our job has been to come up with the best plan, no matter what it is. But the way things are today, I think that's unrealistic. And I think we'll be moving more and more in the financial analysis direction, looking at the ability of local entities to pay. And I think a lot of our plans may be formulated -- I hate to say it, but it might be true -- on the basis of locals' ability to pay, to some degree.

Your other comment on "self help". After landslides in the Baldwin Hills area of Los Angeles, prepared a self-help manual which outlined all the things that each homeowner could do to help prevent landslide and erosion problems on his/her particular site. It was pretty well received.

DAN MAULDIN:

I agree with Brian's first comment on financial aspects. I think there's a lot more than just the financial aspects that we're going to get into in our study process as we get into the new cost sharing. And that is the amount of input or "say so" that locals are going to have as they are expected to pick up more and more of the cost, not only of the study but of the project itself.

On the matter of self-help Corps publications, I've seen several. We had one on floodproofing of homes. Perhaps there hasn't been an all-inclusive one on nonstructural measures, but there have been some on individual measures.

GEORGE PHIPPEN:

On the matter of self-help manuals, perhaps better ones could be done sometimes. But there are an awful lot of these things around. The Water Resources Council has done manuals. The OWRT in Interior has done a community assistance manual. SAD did a special one. And there are others. So, I'm not sure that more are needed. Maybe what we need is systematic information on what is already available so that all who need help find ready access. That kind of information and the available publications could be kept current in Corps libraries by the FPMS units.

DONOVAN:

I'll say this, if I can continue to have GI funds allocated to that function for FPMS units, we can certainly compile and keep that kind of information in district libraries.

TONY LANIER:

I have a question on cost sharing. If a project is considered structural but still requires substantial land costs, would 65-35 federal and nonfederal cost sharing include land costs, or would the structural cost of 65-35 be with local interests providing lands, easements, and rights of way?

MAULDIN:

Do you want impressions or do you want an answer? My understanding was that 65-35 was an overall, blanket sort of thing. The locals were going to pay 35 percent of the total costs. Lands, easements, the whole works. Is that not correct?

DONALD DUNCAN:

Lands, easements, and rights of way or 35 percent, whichever is greater. If the lands, easements and rights of way were 60 percent, then the locals would still pay for them. If they were 25 percent, they would buy those plus pay 10% percent more of total costs.

FRANK INCAPRERA:

Dan Mauldin, in his panel statement, mentioned the problems they had with Peach Creek and the participation of the local sponsors. We had the same problem with Baytown. I only wish that about a half million dollars earlier we had hired two sociologists -- and spent something like \$60,000 or \$80,000 a year -- who could have gone out and done a social analysis of how the plan was really affecting the community.

We found out that social effects are perhaps more important in nonstructural plans. We found in Baytown that the people we were trying to move out were the ones going to the voters and saying, "We don't want to move; don't bother us." It was unfortunate that we were only looking for the best NED plan. In fact, we didn't recommend the NED plan, but our division thought we should. We wanted to go 90 years and they said to go 50.

Then people who had never been flooded beat us. And they beat us a second time after we had gone back and reduced the floodplain.

Since then we've had two studies that have had nonstructural measures in them. Curiously, they are almost identical in nature -- social status distribution, income levels. But big differences in length of residence. Our sociologists have analyzed these cases, by exceptionally proficient use of questionnaires, to determine who are movers and who are stayers. In Clear Creek those living in the floodplain didn't want the nonstructural alternative. Those in Cypress Creek were movers. Only careful analysis of many factors were we able to reach these conclusions with confidence. A structural project at Clear Creek will start next summer.

MAULDIN:

An excellent comment. I think that is the point of many experiences we've had with nonstructural plans.

MOORE:

That kind of supports what I was saying earlier, about our questionnaire that indicated difficulty with a nonstructural plan because of lack of support. I think it is very important to look at that lack of support and analyze what really is behind that. It may not just be a lack of support but maybe a lot of other contributing things. That seems to be what you're saying, too.

INCAPRERA:

It's the expertise I'm driving at.

MOORE:

That's what I'm talking about. You've got to have the people that understand what's happening with locals in nonstructural areas.

DONOVAN:

Thanks, Brian. Frank, that was quite an insightful comment. I, for one, couldn't be more pleased than to see the needed emphasis that you've given to the critical need for social assessment and evaluation in these situations. It's an expertise to which we've tried to give some emphasis in civil works planning, in general, as well.

FLOOD WARNING  
AND  
EMERGENCY PREPAREDNESS

## BASIC ASPECTS OF FLOOD WARNING SYSTEMS

H. James Owen  
Principal, Flood Loss Reduction Associates

### Introduction

Common sense suggests that people in the path of floods ought to be warned so that they can take action to protect their lives and property. Adequate warning is not available from the National Weather Service for many areas, particularly for smaller watersheds, because of a lack of data and information for developing accurate and specific flood predictions. One solution is the development of a local flood warning system in which the data needed for flood prediction is collected and furnished to the National Weather Service or is used locally to prepare the prediction, using a procedure furnished by the National Weather Service. Once some advance warning of flooding is arranged, it becomes worthwhile to develop a preparedness plan for using that information to improve safety and reduce economic losses.

Local flood warning and preparedness programs have received increasing attention in the last decade and especially in the last two or three years. There are several hundred systems of one type or another already in operation and additional systems are being implemented at a rate of perhaps several dozen each year.

The institutional setting and the concepts and practices relating to local flood warning and preparedness programs have changed considerably over the last 10 years. At first, non-federal involvement was largely limited to local civil defense or emergency services staff. There is increasing involvement now of local planning and engineering departments and of state emergency services and floodplain management agencies. Where emphasis a few years ago was placed almost entirely on generating a warning, there is increasing attention being given now to preparedness planning to take the maximum advantage of whatever warning can be made available. Technology has also changed dramatically. Some of the early systems used a float-operated stream level gage, wired to an alarm, that indicated when the the water level reached some preset elevation. Likewise, an early system was considered to be of fairly high quality if it made use of precipitation reports forwarded every hour or two from observers. Equipment is available now for continuously monitoring rainfall and stream levels with gages that self-report by radio every fraction of an inch of change in status and inputting the data directly into a computer that prepares the flood prediction and displays the areas that will be affected.

Research about local flood warning and preparedness programs has also increased substantially in the last few years. At least some exploration has been made of sociological, legal, institutional, engineering and economic issues. While the research effort is still far

from complete, what has been done provides a rapidly growing body of guidance for those interested in designing or evaluating such local programs.

These changes in institutional setting, comprehensiveness, technology and research interest are typical of a measure that is growing in acceptance and moving toward the mainstream of practice. One of the key questions in the future of flood warning and preparedness programs is the extent to which the Corps of Engineers will become involved in their planning, evaluation and implementation. Much of what is needed to answer remaining questions about flood warning and preparedness programs is the type thing that the Corps is well suited to provide and in which it typically has a strong interest, such as development of highly detailed prototypes illustrating techniques of analysis and planning and the development of information on costs and benefits.

Whether or not the Corps moves aggressively to experiment with flood warning and preparedness measures probably depends to a large degree on whether planners such as yourselves see the opportunity for such measures to be sufficiently concrete and reliable as to warrant their use. The questions I was asked to address relate directly to this and concern the accuracy and effectiveness of warning and preparedness programs, potential errors, and how satisfactory programs might be developed and implemented. Another impediment to consideration of local flood warning and preparedness programs by the Corps and other planners seems to have been the lack of an explicit planning procedure that would generate confidence in the comprehensiveness and correctness of a selected alternative. The literature is almost totally devoid of any technical treatment of a planning process. A portion of my comments deal with the planning process and show, I hope, that warning and preparedness programs are susceptible to explicit analysis and optimization.

#### Examples of Accuracy

The question of the accuracy of flood warning systems can be answered at least partially through a few examples. Table 1 lists several areas with flood warning systems and the accuracy claimed for those systems by officials responsible for their operation.

The systems listed in Table 1 range from a very simple one in which flood predictions are based largely on a crest-stage relationship to one using automated gages and a computerized model to keep track of rainfall and stream levels at several points as well as inflow and releases at four reservoirs. Figure 1 shows for one flood the hydrograph predicted by that more complicated system and the hydrograph of the flows actually experienced. Good accuracy can be achieved in flood warning systems as shown by these examples.

### Examples of Effectiveness

Since flood warning systems serve the the dual purpose of improving safety and reducing dollar losses, both aspects merit some consideration with regard to effectiveness.

Deaths and injuries due to flooding are of two types. One is the unfortunate case in which a person is surprized or trapped by flooding and suffers the consequences. These types of deaths are perhaps avoidable through the use of flood warning systems. The other type of death is due to a person deliberately choosing to expose themselves to risk, such as passing a barricade to cross a flooded bridge or canoeing on a flooded stream. There's a limit to how much warning systems or any other measures can do to save people from their own irrational behavior. However, so far as avoidable deaths are concerned, I am not aware of a single one that has occurred where a reasonably well-developed flood warning system was in operation. Perhaps there have been some but certainly not very many.

Perhaps the best example of the effectiveness of flood warning systems in reducing dollar losses is that of the Sprout-Waldron manufacturing plant in Muncy, Pennsylvania. That plant was severely flooded twice in a short period of years, once by Tropical Storm Agnes in 1972 and then by Tropical Storm Eloise in 1975. Between the two events, a flood warning system was installed in the area and the plant management developed a preparedness plan that included provisions for evacuating or protecting equipment, shutting off electric power and other actions.

As shown in Table 2 the plant's losses in the 1972 flooding were about \$3.4 million. In the 1975 flooding--after the warning and preparedness measures were in place--comparable flooding caused losses of only about \$230,000. Whereas the plant was shut down for six weeks after the 1972 flood, it was operating at 90-95 percent of capacity within three days after the 1975 flood. The more than 90 percent reduction of losses due largely to warning and preparedness certainly suggests that the combination of warning and preparedness used there was effective. In 1979, the same warning system was credited with enabling an additional \$700,000 reduction in losses through timely movement of contents from residences along one creek in the area.

There are other examples as well of a variety of types and amounts of savings through flood warning and preparedness. One action taken by the city of Coeburn, Virginia when a flood was predicted was that of disconnecting and hoisting a pump-motor set in their sewage lift station. The city manager estimates that the one action saved some \$25,000 in damages. It also avoided an estimated six month disruption of their waste treatment system while repairs and replacements for the special made equipment were obtained. Officials in New Braunfels, Texas, estimate that an hour or two of warning from their flood warning system is worth about \$1 million in savings just for moving city-owned equipment from their storage yard. In Big Stone Gap, Virginia, the

police chief claims one of the principal benefits of their flood warning system is the capability to avoid instances of overreaction at a cost of about \$25,000 each time a flood threatens but doesn't actually materialize. These people have obviously found their systems to be effective.

#### Potential Errors and Their Cost

These are the good examples. It's reasonable to ask if there are any examples where accuracy was poor or the program was ineffective. The answer, of course, is yes; and this gets to the matter of what kinds of errors and problems might occur in a flood warning system when its called on to operate.

I'd like to respond to this question first with an analogy between flood warning and preparedness programs and levees.

If we came across a levee and were curious about its potential effectiveness, we might ask first whether it was an engineered structure or whether some landowner simply scraped some earth into a berm along the river. If it turned out the levee was designed and constructed by the Corps of Engineers, we would be justified in assuming that a fair amount of consideration had been given to hydrology, hydraulics, soil conditions and other pertinent factors and that, as a result of this careful planning and design, there was a high probability that the levee would perform as intended.

On the other hand, if it turned out that the levee was not planned and designed by someone with the requisite skills and experience, we would probably be concerned about whether those basic hydraulic and soils investigations had been made or if the builder was even aware of their purpose and importance. There would be good reason to question whether the home-built levee included adequate provisions for erosion, seepage, internal drainage and the host of other things necessary for it to operate properly and safely. We might even conclude that the levee was worse than no protection at all because it encouraged an unwarranted sense of security and held the threat of suddenly failing when it was needed most.

Flood warning systems and flood preparedness plans offer the same possibilities as levees of being carefully designed and implemented, based on adequate investigation, or of just being put together with only a vague idea of what's to be accomplished and how it should be done. As in the case of a levee, doing the job right is considerably more time consuming and more costly but vastly more worthwhile.

A flood warning and preparedness program that is not properly designed and implemented is subject to enough possibilities of errors that its only worthwhile to summarize them by type.

One type of error is failing to identify an impending flood. This is the most serious type of error because it leads to giving no warning at all. A failure of this kind could result, for example, from a system in which detection of an impending flood was dependent on precipitation gages so widely spaced that a storm large enough to cause flooding might slip between them. This type of failure could also result from detecting the storm but not correctly identifying its intensity, again because of too sparse a data collection network. A total failure to warn could also result from such things as a breakdown in the system for transmitting data or disseminating warnings, or a blunder in analysis of the data.

Another type of error is issuance of a warning that is inadequate because it either underestimates the flooding, arrives late, or does not reach all of the affected parties. This type of failure could result from poor arrangements for data collection, indecision on the part of the system operator, absence of key officials in the chain of command, or partial breakdown in arrangements for warning dissemination. It may also be due to shortcomings in the degree of refinement of procedures for analyzing the collected data and interpreting the flood prediction in terms of the area that will be affected. This type of error may be susceptible to some correction as the flood episode unfolds. However it can also be as serious as a total failure of the system for some of the people that are affected.

A third type of error is that of overestimating the impending flood. This may result in either a totally false alarm or just some additional increment of evacuation or other response that turns out later to have been unnecessary. Whether or not this is a very serious error depends on the cost and risk associated with the unnecessary actions, the number of people affected and other circumstances.

Let me emphasize that these are the types of errors that might occur with an improperly designed system. Proper design can reduce the possibility of their occurrence to an acceptably low probability.

There are also a number of errors that can reduce the effectiveness of response to even an accurate and timely warning. These are primarily errors in planning assumptions and analysis. Some of these errors relate to matters of fact, such as the emergency resources that will be available for carrying out some action or the potential for early flooding of underpasses and low lying roads to cut off evacuation routes. Other errors may relate to matters that can only be assumed, such as whether telephone and electrical service will be disrupted or whether ambient noise levels will be high enough to affect the audibility of warnings. These types of errors may cause minor problems or may largely destroy the effectiveness of the warning and preparedness program, depending on their nature and extent. Again, these types of errors can be avoided through a conservative approach to design that includes adequately detailed investigations.

Several types of costs can be associated with these errors if they do occur. One is loss of life. Also, of course, there are the economic costs of property damage that could have been but wasn't prevented, the costs of overreaction, and the increased costs of recovering from a situation worse than was necessary. A third type of cost is the loss of credibility of the system and perhaps even its abandonment.

There is also the possibility of liability for errors. However, this is not very likely unless there has been gross negligence or intentional deceit in operation of the system or if the program was so poorly planned that it would have been unreasonable to expect that it would work.

#### Development and Implementation

The question I was asked to address concerning development and implementation brings together several considerations about accuracy, effectiveness and how potential errors might be avoided.

Design of a flood warning and preparedness program often begins with the decision of whether or not that part of the flood warning system dealing with detection and prediction of floods will be automated. This decision may be based on a number of factors including the amount of money expected to be available, whether observers are available in the upstream area, and the expected speed of onset of flooding. The next step is usually one of deciding the exact number, type and location of gages. This decision may be influenced by the size of the watershed, locations where observers are available, available funding, and the typical practice of having from five to a dozen precipitation gages, depending on the size of the watershed, and two or three stream level gages. Generally, there is an effort to make the system either all automatic or entirely manual. Once these basic decisions are made, the remaining problems are largely those of mechanics about how the system will be activated, how data will be processed and how the flood prediction can be disseminated and used. This approach is straightforward and results in systems that are reasonable in cost and fairly easy to understand and operate. It's largely a "one-pass" procedure and requires only a minimum of time and expense for planning.

Unfortunately, this straightforward and easy approach leaves a lot to be desired. There is good reason to question the accuracy and effectiveness of flood warning and preparedness programs that are designed in that way. One problem is that explicit consideration of the meteorologic and hydraulic factors that affect flooding is often omitted. Secondly, the approach puts the cart before the horse by first designing the warning system with whatever characteristics of accuracy and timeliness it may have and then seeing how the resulting warnings might be used by the community in a preparedness program. Since

consideration of the preparedness actions that provide the payoff for the program is deferred until well along in the planning process, little attention is given at the outset to institutional and other requirements for implementing the preparedness plan.

Investigations for design of a flood warning and preparedness program should begin with an analysis of the needs of the area to be warned. This investigation ought to give some attention to identifying the audiences who want or should receive warnings, the accuracy these several audiences require in warnings, the minimum size flood the system should be able to detect, and the purposes for which whatever warnings are issued will be used.

For an audience of campers in a desert wash where any flow at all amounts to a dangerous flood, it may be enough to know whether or not its raining in the upstream area. For an audience of homeowners on the lowest floodplains along a river, it may be necessary to know not only that its raining upstream, but also whether its raining enough that some overbank flooding will occur. The audience of people at higher elevations will be interested in an even more detailed prediction that will tell them if flood waters will reach to their property.

Similarly, it may be sufficient for the purpose of putting emergency services staff on standby if the warning is only accurate to the point of knowing that some flooding will occur. However, for the purpose of deciding to risk lives in a hospital evacuation, enough accuracy is needed to know with some certainty that flood waters will be so high as to require taking that risk.

Those to be warned also require differing amounts of time to respond to warnings. It may take far longer, for example, to evacuate a jail population than to evacuate the same number of people from a motel. Damage reducing actions, if they are to be taken, may require considerably more or less time than evacuation, depending on their nature and the amount of resources available for their accomplishment.

The needs of the community could be represented graphically as shown in Figure 2 with each point representing a particular response task and the estimate of its needs for accuracy and timeliness.

Another of the matters that should be addressed early on in the investigation is the thorough identification of what sources of information are already available. This may include synoptic data and radar coverage from the National Weather Service, reports from upstream communities, and gages that are already in place. The local program only has to fill in the missing pieces, usually with some combination of precipitation and stream level gages. The characteristics of accuracy and timeliness of the existing system could also be represented graphically to show which of the local needs it met or failed to meet (Figure 3).

Once these types of considerations are in hand, attention can be given to roughing out the system for collecting the data on which the

flood prediction will be based and to the procedures for processing the data and making the flood prediction. In general, the objective of design ought to be to meet the varying requirements for warning as inexpensively as possible, consistent with the need for reliability and the possibility of obtaining additional benefits by incremental improvements.

The design of a network of precipitation gages for a flood warning system should begin with an idea of the minimum flow that the warning system is expected to detect and predict. Then, with some idea of the maximum probable rainfall intensity in the area, a spacing of gages can be selected that will ensure the smallest storm capable of producing the critical flow cannot slip through the net undetected. However, this design only ensures that the network will provide at least one sampling of a storm's precipitation. That one sample will not tell much about the areal extent of the storm or the distribution across the storm of precipitation intensities. Adding additional gages will provide that kind of information and improve the accuracy of the flood prediction. The quality and quantity of data that can be provided and the resulting accuracy becomes a matter of how many collection points can be arranged or afforded.

If the portion of the upstream drainage being monitored is sufficiently far away, it might be decided to forego the expense of a precipitation network altogether for that area and instead use a single measurement of streamflow at a point below the area. This has the possibility of enabling even more accuracy than a precipitation network since it eliminates meteorologic considerations about storm size, rainfall intensity, and distribution of rainfall as well as those relating to infiltration, detention storage and other factors involved in the rainfall-runoff relationship. However, the warning time that can be provided is less because the measurement is delayed by an amount of time approximately equal to the time of concentration to the gage site. That shortening of warning time may or may not be acceptable.

Streamflow measurements offer a direct trade-off between accuracy and timeliness. Moving them further upstream to increase the length of warning time leaves a larger area unmonitored below the gage site that may contribute a significant flow. Again, some examination of possible rainfall intensities could help decide the maximum size of intervening area that could be allowed or the number of precipitation gages that should be used to supplement the stream level gage.

The option exists for breaking the drainage area into sub-watersheds and making these same kinds of analyses for each, perhaps handling some with precipitation gages and some with stream level measurements, according to what meets the needs for accuracy, timeliness and the threshold for detection at the most reasonable cost.

With a general idea of what is desired in the kinds and amounts and locations of data collection points, some consideration can be given to whether the system ought to use observers or automated gages. This decision depends in part on whether observers are available in the appropriate locations. If not, the choice in favor of automated gages is relatively easy. If observers are available, the choice becomes more difficult. Each approach has advantages and disadvantages.

Automated gages are available on a 24 hour basis without time off for vacations. They can also send data in a form suitable for input directly into a computer. Unfortunately, at least some of them can also send a false report if there's a nearby lightning strike. Automated gages also require a continuing program of servicing and maintenance and they're vulnerable to vandalism.

In some cases, there may not be much difference in cost between using automated gages and volunteer observers. Use of volunteers requires a continuing training program and they must be provided with a reliable means of communications. That usually means furnishing radios to back up telephone service.

Another difference to be considered between networks of observers and networks of automated gages is their frequency and speed of reporting. An automated network can provide a minute-by-minute update of the situation. Volunteer observers are usually instructed to report each hour or two and as much as an hour might be required for one round of polling all of the observers.

This flexibility in network design can also be represented graphically. Figure 4 illustrates the different characteristics of timeliness and accuracy that might be designed into a volunteer network by varying the density of reporting points and the frequency at which observers are polled to update the flood prediction. Figure 5 illustrates somewhat the same sort of thing for automated networks except the steps in accuracy become a smooth curve because of the continuous reporting and updating of the flood predictions.

The different shapes of the curves in Figure 5 also illustrate one additional point. The shape of the curve describing the system's performance could be modified by stressing, for example, the collection of precipitation data or streamflow data to improve the accuracy in some particular range of lead time.

If all of these options are put together with their costs and the needs of the community (Figure 6), the degree to which each alternative meets those needs begins to become apparent. If none of the alternatives are satisfactory, it might be decided to design another alternative of one type or another or even one that combines manual and automatic techniques.

The decision of whether the network should be manual or automatic also depends to some extent on how and by whom the data will be analyzed. For all situations except those with very short warning times, the locally collected data should probably be furnished to the National Weather Service for analysis with local prediction capability serving as a back-up. Automated systems enable simultaneous transmission of the data to the NWS and to the local forecasting center, avoiding the need and the time for organizing and transmitting observer reports. For cases in which flood predictions are to be made locally, the choice of a manual or automated approach may also depend on the accuracy and speed of analysis that is required and the complexity of the watershed.

Manual forecasting procedures that simply average rainfall amounts from a few gages obviously aren't very precise unless the drainage areas represented by the data are roughly comparable in size and other characteristics affecting runoff. Weighting the data to improve the precision of the analysis increases its complexity. Manual systems may also pose some problems in dealing with the timing of flows from sub-watersheds and with the effects of diversions and dams and other water control structures in the basin that may vary in their operation depending on time of year, pool level and other considerations. On the other hand, sophistication is no indicator of accuracy. Putting data through a computer will not correct problems stemming from basic deficiencies in the data collection network or breakdowns in data transmission.

A well designed system for collecting, transmitting and analyzing the appropriate types of data and information will usually provide flood predictions that vary in accuracy over time. Before rainfall begins, synoptic and radar data may enable a fairly reliable forecast of heavy rains and potential flooding. As actual rainfall and streamflow data become available, predictions of flood magnitude and timing can become commensurately more accurate. When data show the end of the storm, information on the crest and duration of flooding can be added to the prediction. Given this progressive improvement of accuracy over time, the accuracy of warnings becomes a matter of when they are released. If the design achieved its original objective, then it ought to be possible within this trade-off between accuracy and timeliness to arrange warnings according to each audience's particular needs for accuracy and length of warning time.

The task of arriving at an efficient and optimal system for flood predictions provides a substantial challenge. In addition, at this point, the design has yet to consider the options for warning dissemination and their effects on cost, time requirements and effectiveness of the system. We might examine, for example, installation of a radio-triggered, electronic siren system, use of mobile public address systems, disaster alert modules, or combinations of these and other techniques for reaching each of the audiences to be warned. Each alternative will have its own cost and characteristics such as

reliability, time required to carry out the warning dissemination process, whether the warning is only an alert or can convey specific information, and the kind of impact the warning is likely to have.

This whole design of the warning system should be paralleled by design of the preparedness plan, also based on the initial analysis of the community's needs and resources. Some trade-offs between the two may be possible that can ease problems of design. For example as indicated in Figure 7, there might be some flexibility in the time required to carry out some actions, according to how many resources are put into the task. If some reason is found that prevents or makes it unduly expensive to provide a warning with the desired timeliness and accuracy, perhaps the length of warning time needed for some purpose can be reduced by putting more resources into whatever task is to be accomplished. It might be decided, for example, to drop plans for moving equipment in the city's parks and use those resources for completing evacuation of the community's library on more timely basis. That kind of decision might be a good one if the cost of obtaining a higher level of performance from the warning system was greater than the potential damages at the city park.

A problem of not having enough warning time for a task might also be approached by making some permanent adjustment that reduces the amount of time required for emergency work. We might opt, for example, to floodproof the library, to replace existing shelving with something more movable, or to use the first floor only as a reading room. Alternatively, it may be found that the timeliness and accuracy of the warning system is such that surplus warning time will be available for some response actions. This may enable including additional tasks in the originally conceived plan without any additional resources.

There's no reason to expect that the optimum design of a comprehensive warning and preparedness program can be developed in one pass through the planning procedure. Several iterations may be necessary to find the optimum or at least to determine what departures from the optimum may mean in terms of benefits and costs.

If we can identify the costs of the several alternative systems we've designed and the benefits and costs of carrying out the various response actions, then we're able to make an evaluation of our options through the customary procedure of comparing their costs and benefits (Figure 8). If we suspect there's a better option possible, we might even generate another alternative or two to add to the comparison. We may or may not choose to select the system offering the highest benefits or best ratio of benefits to cost; but at least we'll have some idea of what we're gaining or giving away in the selection that we do make. In choosing the preferred alternative, we might also want to look at some non-economic tradeoffs between the systems such as vulnerability to failure, flexibility for future expansion or refinement, and the time distribution and apportionment of costs.

My comments so far have dealt mainly with design of the flood warning system up to the point of making the flood prediction. The same kind of points could be made concerning the need for explicit and detailed analyses in developing the response plan.

Implementation of whatever program is decided on raises an additional set of issues and needs for analysis. One of the main decisions to be made concerns who should be responsible for various actions. Making that decision may require analyses of organizational capability, legal authority, and how assignments of responsibility might be fixed. Implementing these kinds of decisions may involve standing orders, intergovernmental memoranda of understanding and contracts with private parties, all of which need to be prepared as part of the implementation planning. There is also a question about what parts of the program ought to be fixed through adoption by a local legislative body or in some other way and what parts ought to be left flexible. Since somebody has to pay for the warning and preparedness program, there is also the matter of obtaining agreement on an apportionment of costs and obtaining commitments to pay.

In addition to all of these legal, institutional and financial considerations, the program must be physically implemented through acquisition and installation of gages and other equipment, development of the forecasting procedures, and training of the system participants. Enough is involved in properly implementing a comprehensive warning and preparedness program to warrant some advance planning of whose participation will be necessary and how it will be done.

That planning for implementation should begin early on and proceed somewhat concurrently with design of the warning system and the preparedness plan. If it turns out, for example, that the state will fund the gaging network if it is of a particular type, that ought to be known when decisions about the network are made.

#### Need for Detailed Planning

The type of planning approach I've suggested is considerably more detailed, time consuming and costly than what has been used in most instances. Many communities have warning systems that were not designed in anything like this detail and in some cases, they lack any formal arrangements at all for response. Nevertheless, these systems seem to perform well as indicated by the examples I cited earlier. There seems to be a consensus that damages can be reduced by approximately 10 percent even with these more casually designed systems. Considering their relatively low cost, that can produce a healthy benefit-cost ratio. What makes the more detailed planning worthwhile?

One reason for more detailed planning is reliability. Just as we have a minimum level of protection and minimum design criteria for levees, there is some minimum degree of reliability and accuracy that is acceptable for a warning system. Like the poorly designed levee, an

inadequately designed warning system may perform well through several floods and then fail when tested too severely. What's required to provide the needed degree of reliability may range from meteorological and hydrologic analyses to evaluating the probability of simultaneous failures in primary and back-up systems for communications and power or the effect of simultaneous flooding in nearby communities from which mutual aid assistance was expected.

A second reason for detailed planning is that not all parts of a warning system and preparedness plan can be tested in advance under the conditions that may prevail when they're called on to actually perform. Detailed analysis is the only means of ensuring the program will be able to cope with the full range of conditions that might exist.

A third reason for detailed planning is the additional benefits that can be obtained by minimizing errors and improving performance. Many of these opportunities may go uncollected unless they are searched out and planned for. As an example, consider a community that might use early warnings and their available resources to either help evacuate movable property to a safe location or to mount a flood fighting effort. A successful flood fighting effort might protect both structures and movable property, resulting in prevention of almost 100 percent of the damages that would otherwise occur. On the other hand, if the flood fighting effort fails, the resources would have been better used to evacuate movable property and achieve perhaps a 20 or 30 percent reduction in losses. A local official may have a hard time in sorting out the options and recognizing the point at which to shift from one response strategy to the other, unless there has been some detailed analysis performed beforehand.

#### Needed Research

We were invited to include in our comments any suggestions for research. I would like to mention a few for consideration.

As I mentioned earlier, concepts, procedures, technology and experience with local flood warning systems has moved ahead rapidly. Ten years ago, the information and knowledge that existed was largely concentrated in the NWS and readily available to those most concerned. Now, however, the information available from research and practice is scattered throughout a variety of reports, planning studies, professional papers and other items. In some cases, valuable insights and information probably exist that have not even been put into written form. This dispersal of the information that we already know makes it difficult for planners to take full advantage of what's been done and avoid re-inventing the wheel. It also makes it difficult for those administering research to identify what remains to be done and its importance in the overall scheme of things.

I believe we've come to a point that it would be worthwhile to review what's been learned so far, collect and organize our existing knowledge about flood warning and preparedness programs, and thus consolidate the advances of the last 10 years.

Summarizing the present state of the art would support a second need, that of developing explicit procedures for planning and evaluating local flood warning and preparedness programs. In addition to the types of design considerations that I pointed out earlier, there are numerous other aspects to be addressed such as the integration of warning and preparedness alternatives with other measures in a comprehensive floodplain management program.

Both of these types of research effort could make good use of information from a number of case studies. In addition, a set of well chosen case studies would help enormously in explaining the operation, requirements and benefits of local flood warning and preparedness programs. The few vignettes like those I cited regarding accuracy and effectiveness are not enough. A wide variety of examples is needed so that planners can explain alternatives in terms pertinent to a community's specific problems.

A summary of the present state-of-the-art would also enable research administrators to identify current gaps in knowledge and program the work needed to move ahead with a well balanced approach. One example of need is that relating to ensuring the prompt response to warnings. While sociologists have worked this question over pretty thoroughly, I believe some investigation will show that legal approaches have hardly been considered at all. Some consideration should probably be given, for instance, to how regulatory measures requiring movement of vehicles and making evacuation mandatory might improve safety and reduce losses.

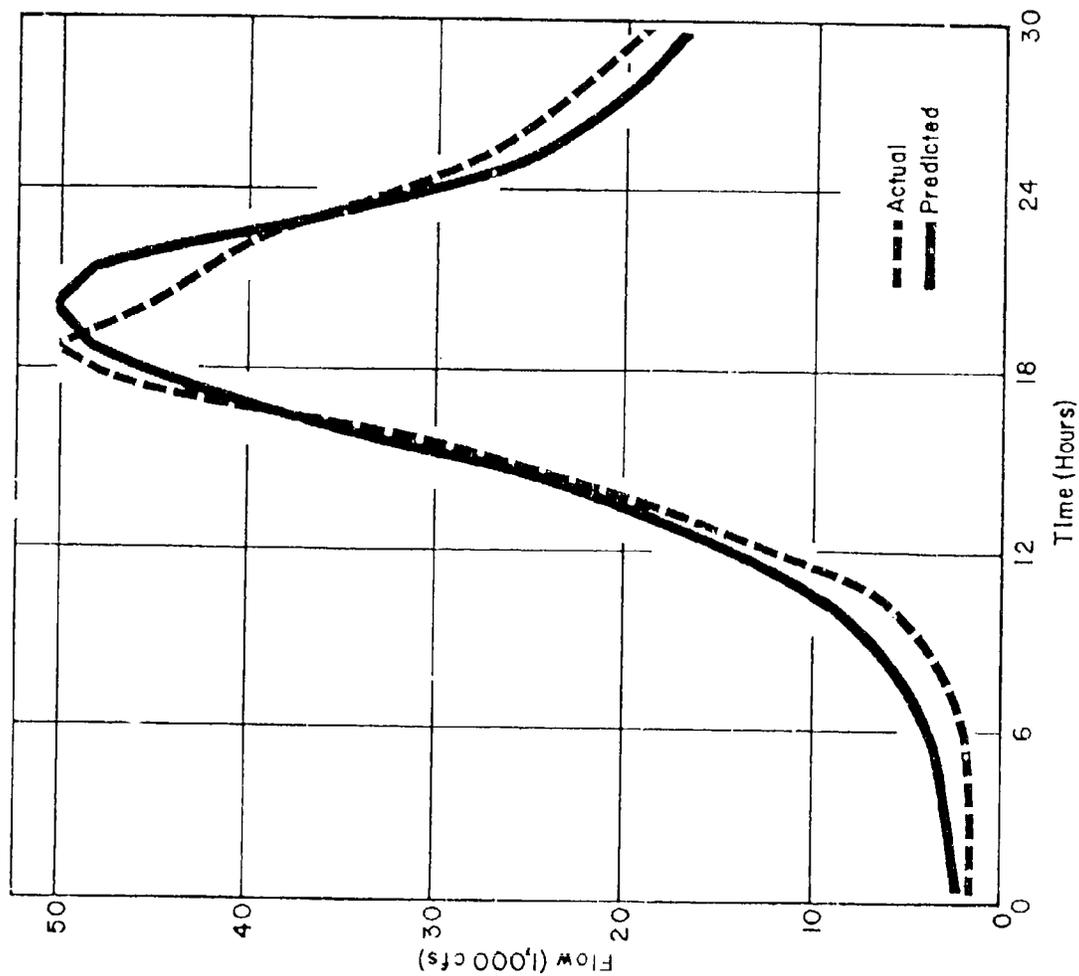
There is also a major need for research into the costs and benefits of flood warning and preparedness programs and their distribution among the public and private payees and beneficiaries. Work is needed to develop procedures for economic analysis as well as to collect the information to be used in the analysis.

With all of the foregoing in hand, a next logical step would be development of a package of technical guidance regarding the use, design and evaluation of flood warning and preparedness programs and the preparation of one or more prototype programs to illustrate application of the guidance.

A coordinated research effort of this type could probably be completed in three to four years at a total cost of between \$400-\$500,000. While that may seem like a lot, it's considerably less than what might be saved during one flood by one community with a competent warning and preparedness program.

TABLE 1  
WARNING SYSTEM ACCURACY

<u>SYSTEM</u>	<u>REPORTED ACCURACY</u>
WISE COUNTY, VIRGINIA	"WITHIN INCHES"
SWATARA CREEK, PENNSYLVANIA	± 2 FEET
HOWARD COUNTY, MARYLAND	± 6 INCHES
NEW BRAUNFELS, TEXAS	± 2 FEET
SANTA YNEZ BASIN, CA	"EXCELLENT"



**FIGURE 1. PREDICTED VS. ACTUAL INFLOW  
LAKE CACHUMA**

TABLE 2  
 COMPARISON OF FLOOD LOSSES  
 AT  
 SPROUT-WALDRON

	1972 <u>"AGNES"</u> 42 DAYS	1975 <u>"ELOISE"</u> 3 DAYS
LENGTH OF SHUTDOWN		
LOSSES		
DAMAGES	\$744,280	\$11,963
EMERGENCY COSTS	\$491,843	82,431
BUSINESS INTERRUPTION	<u>\$2,147,566</u>	<u>\$136,708</u>
TOTAL LOSSES	\$3,383,689	\$231,102

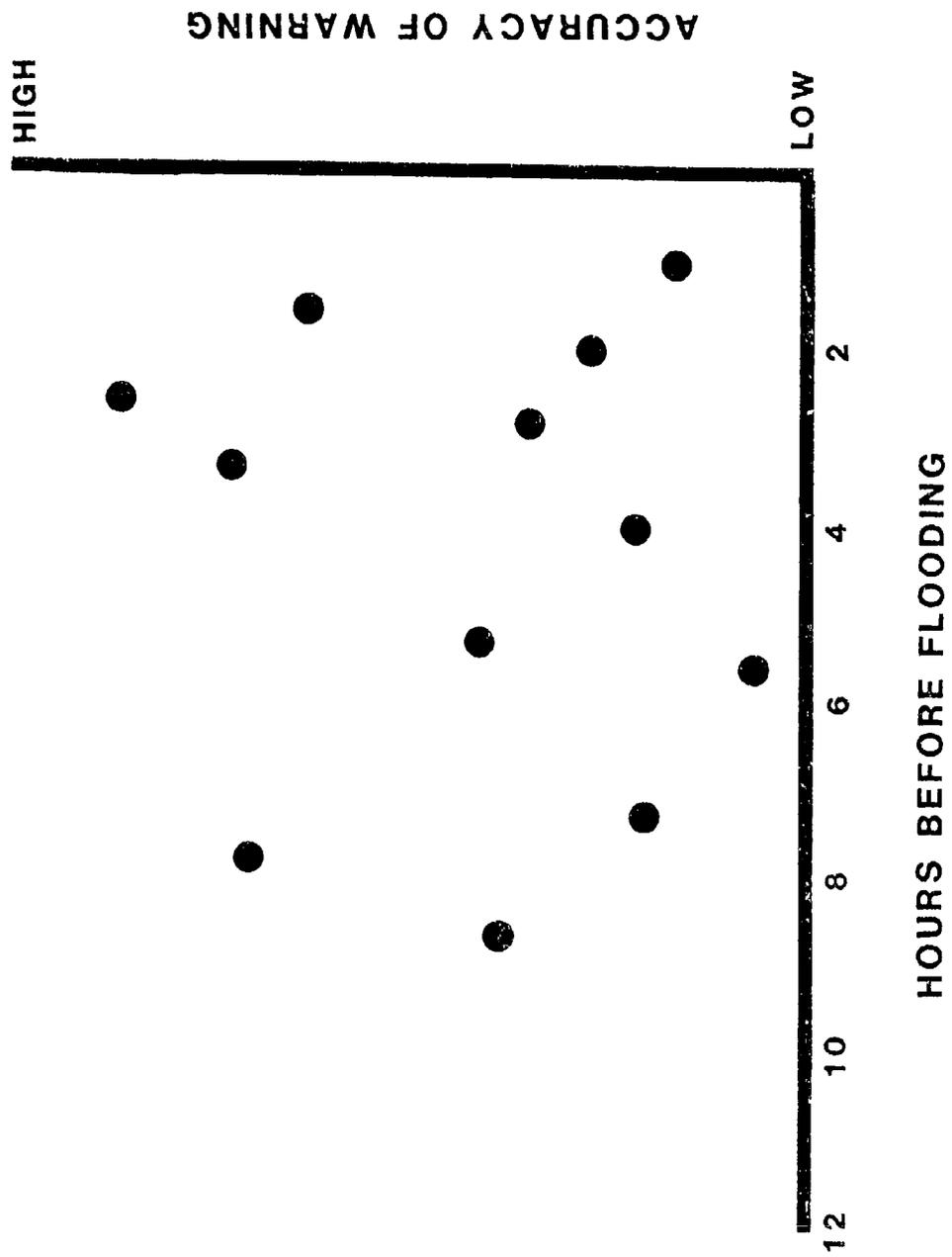


FIGURE 2. LOCAL NEEDS

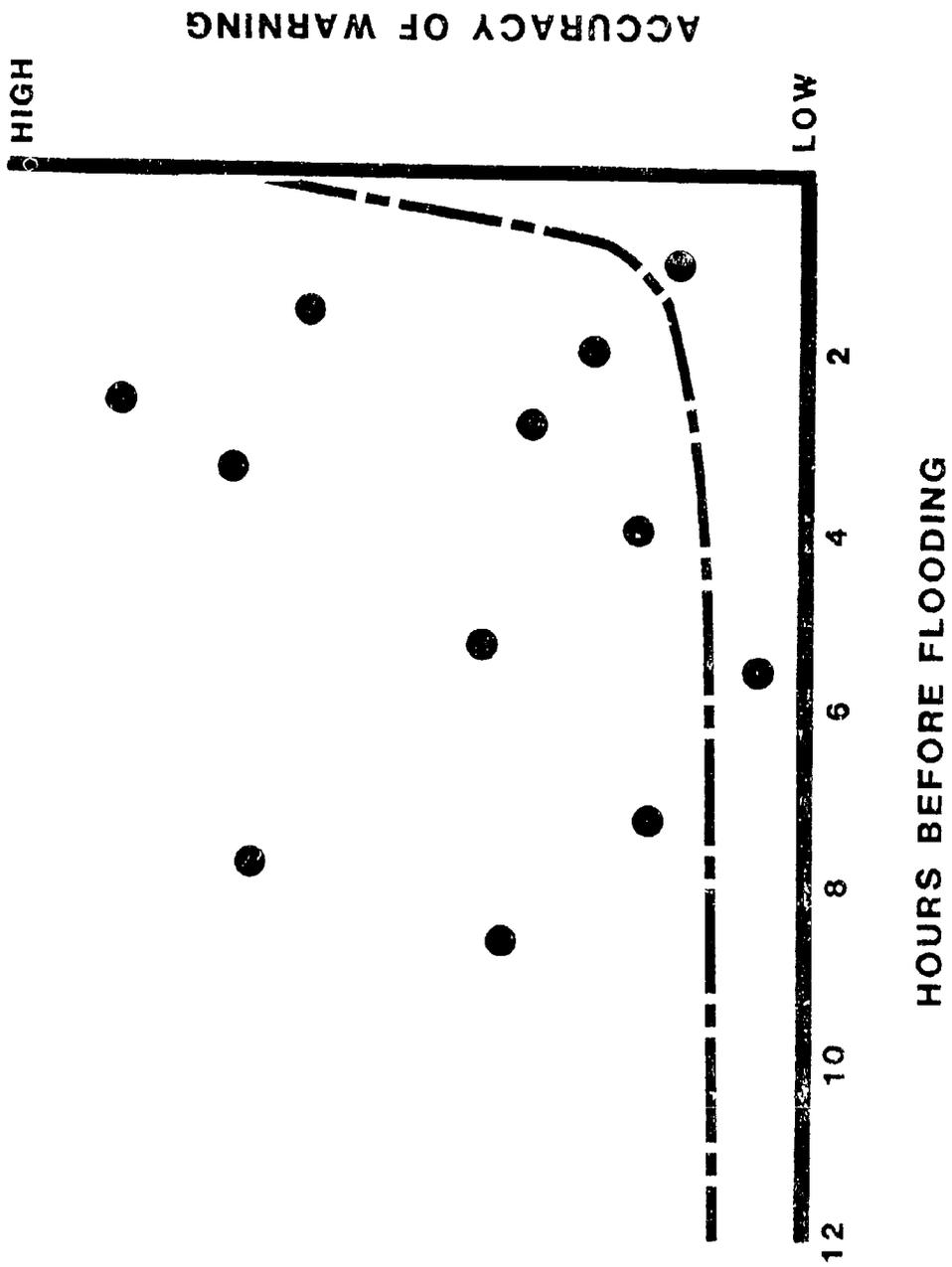


FIGURE 3. EXISTING WARNING ARRANGEMENTS

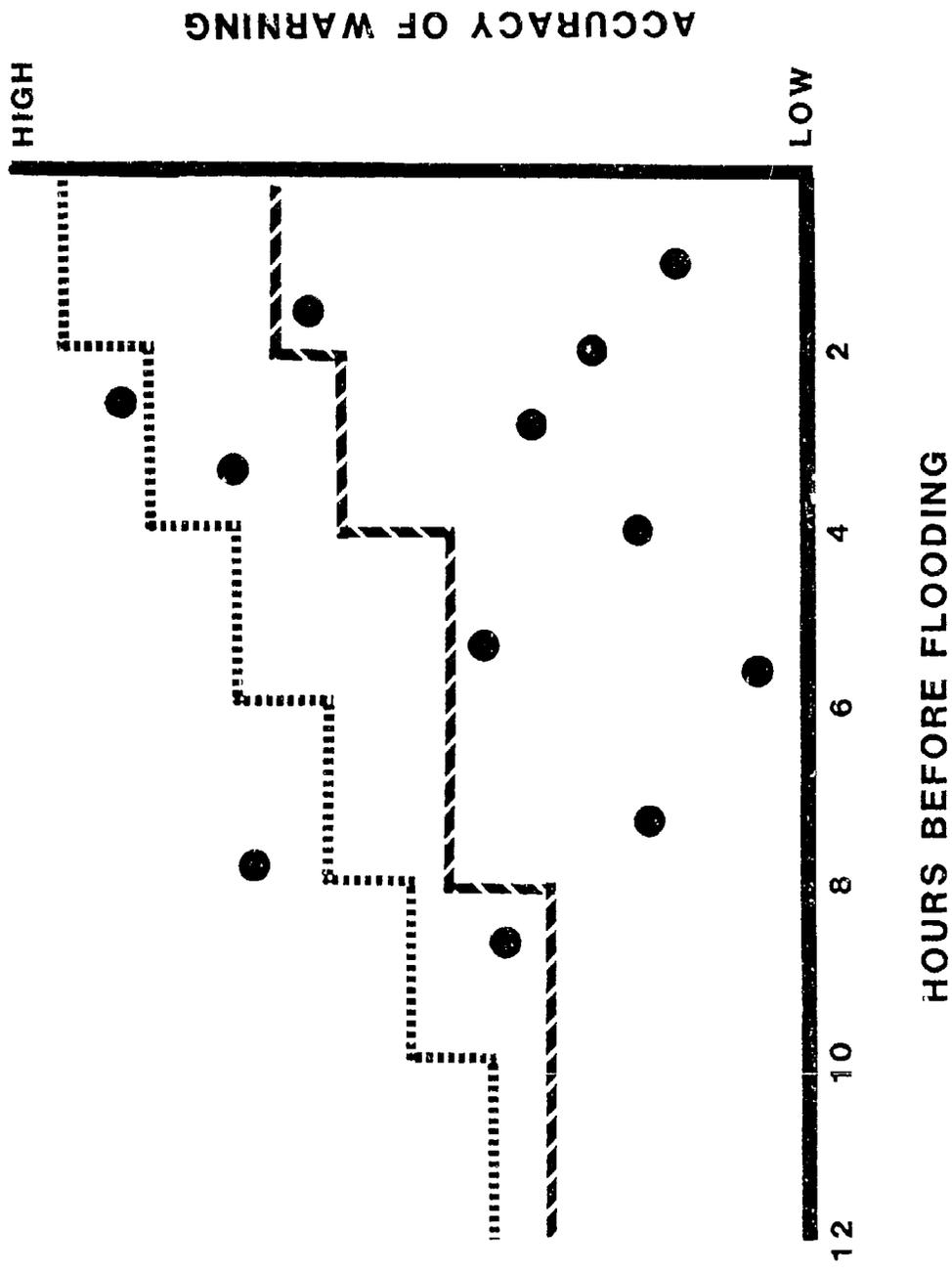
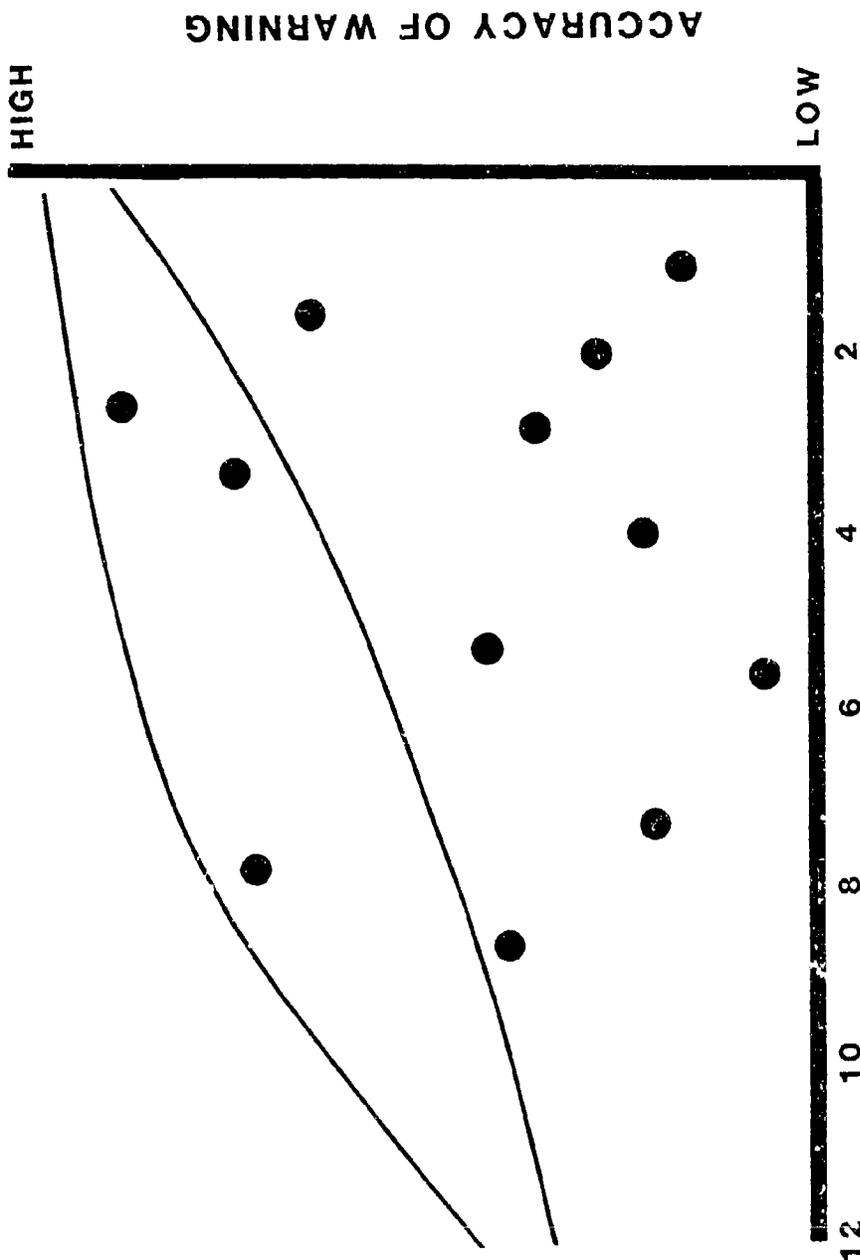
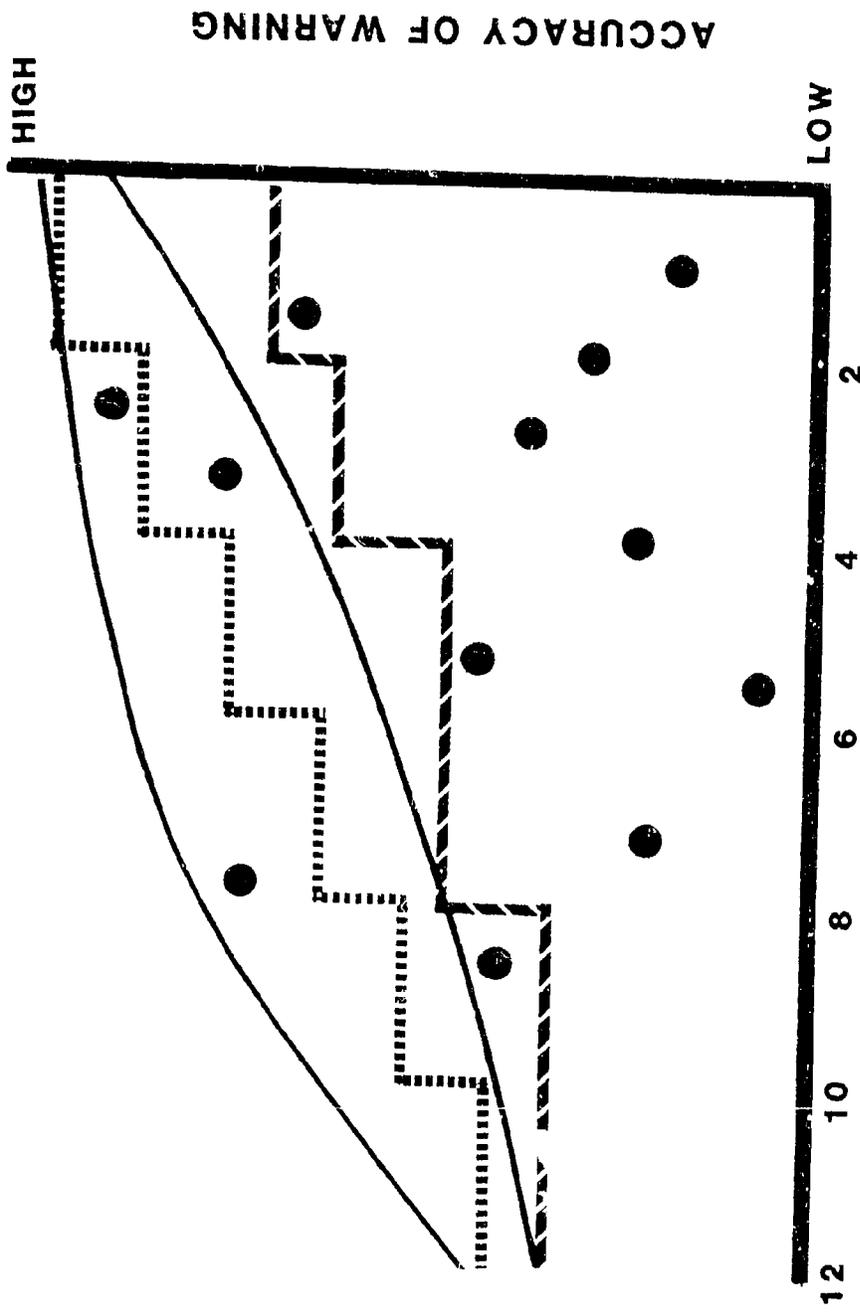


FIGURE 4. MANUAL SYSTEMS



HOURS BEFORE FLOODING

FIGURE 5. AUTOMATED SYSTEMS



HOURS BEFORE FLOODING

FIGURE 6. COMPARISON OF ALTERNATIVES

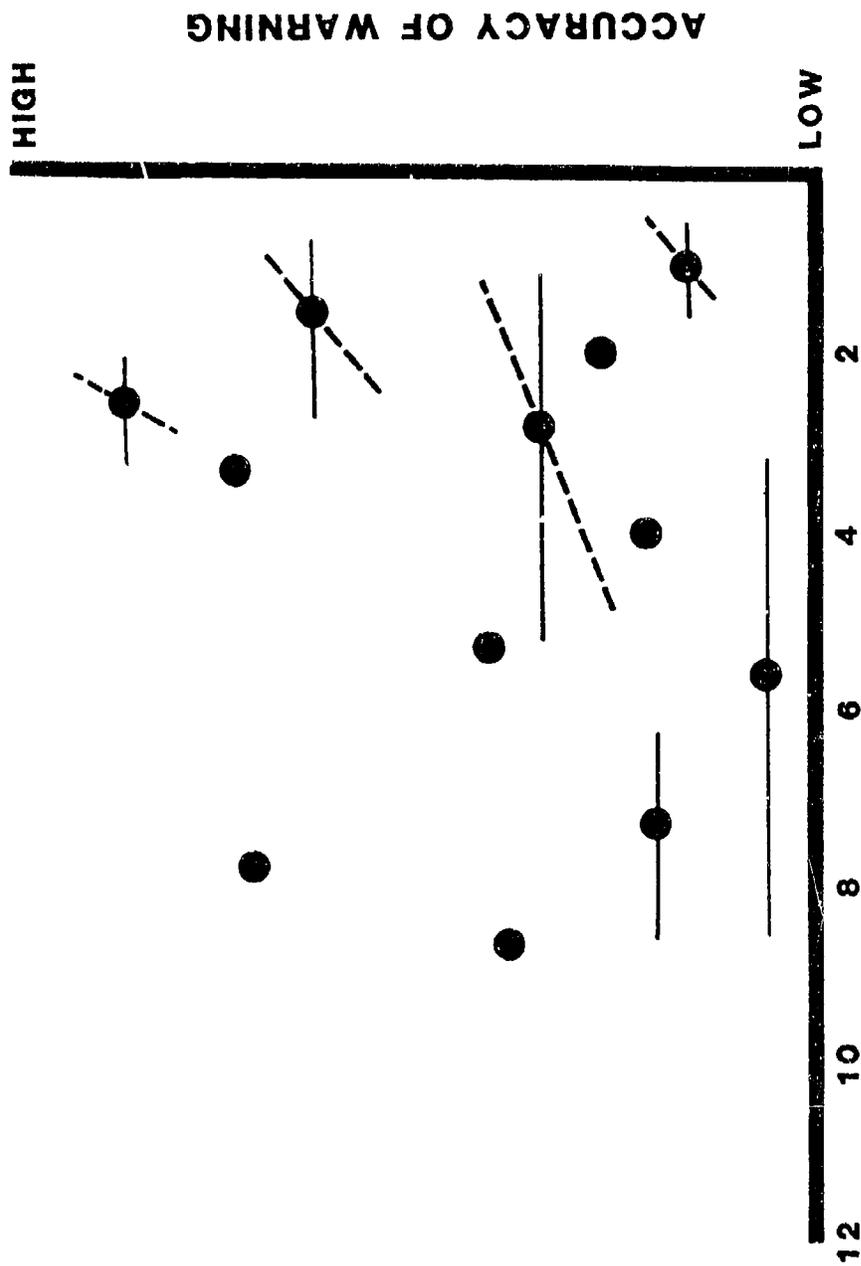


FIGURE 7. FLEXIBILITY IN NEEDS

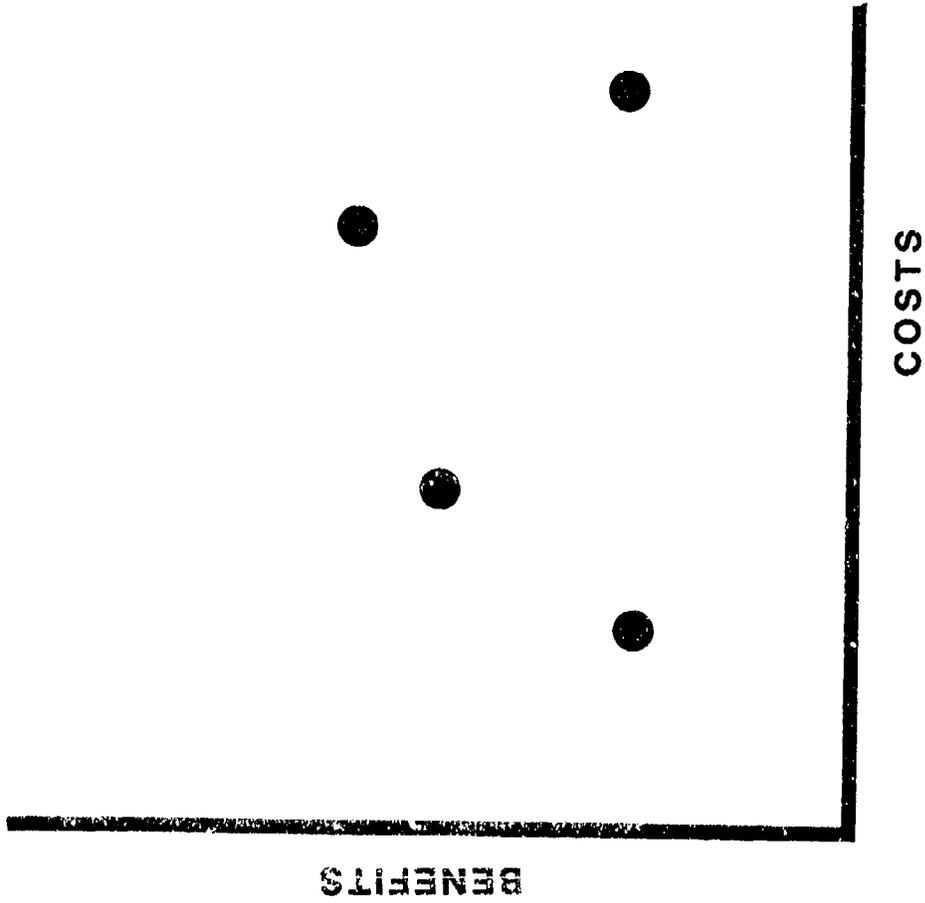


FIGURE 8. BENEFITS AND COSTS

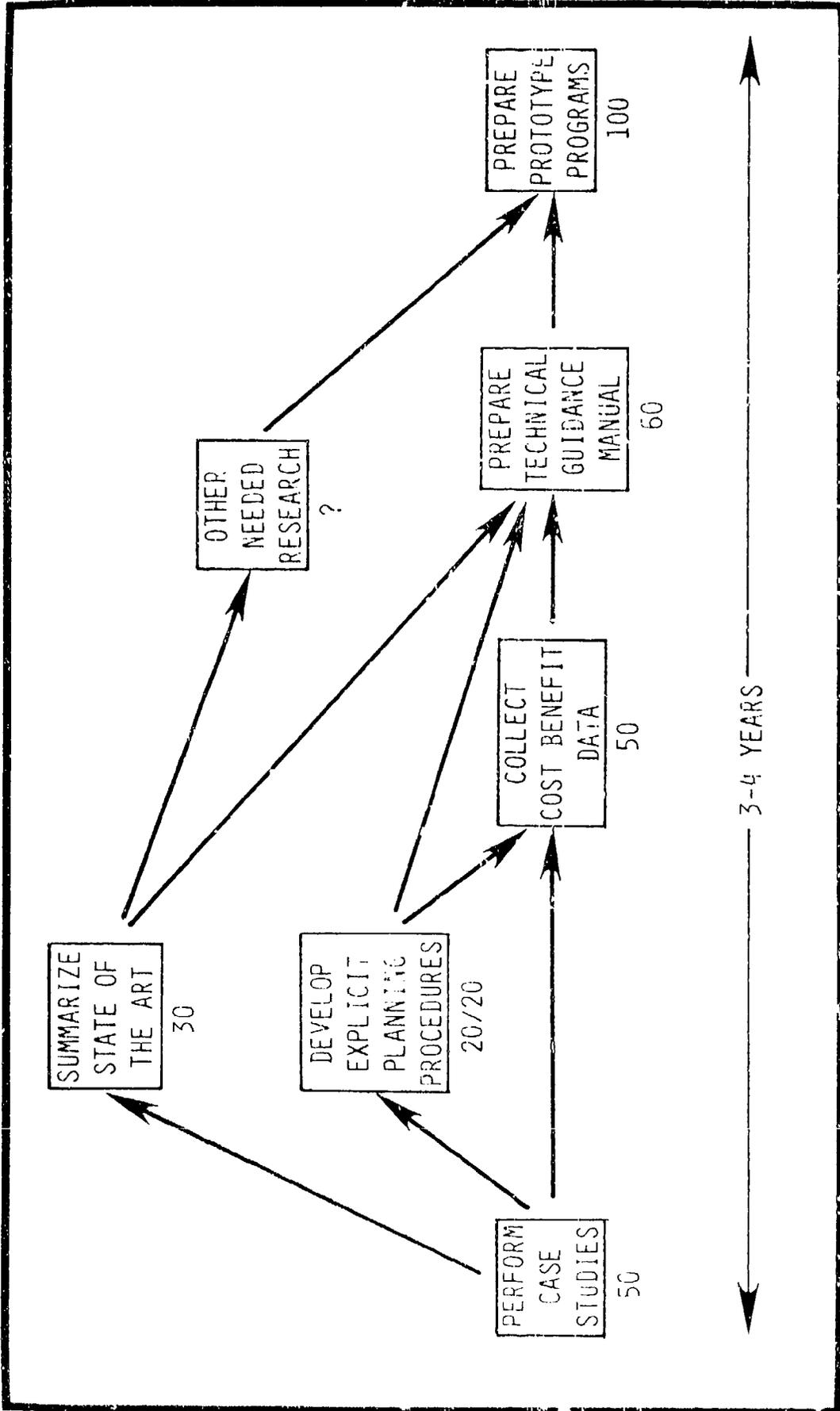


FIGURE 9. RESEARCH NEEDS

PANEL II, FOLLOWING OWEN ADDRESS

RON HILTON:

I've been involved in the flood emergency planning since the later 1970s when I was chief of the floodplain management services branch and, using FTMS funds, we developed hurricane evacuation plans. I am going to talk about the hurricane evacuation plans this afternoon, but one question--before I forget it--that I want Bill and Jim to be thinking about is, "Is a flood warning system needed, and if so, what type of flood warning system would be applicable in Florida, where there is no rapid rise in the flood waters?"

In the Jacksonville District we also include the island of Puerto Rico, which is an island 35 miles wide and 100 miles long. The rainfall averages from 20 inches a year to over 200 inches a year, and we have been told that the flood warning system on that island should include a system that is directly related to annual rainfall rather than stages because of the rapid rise that the floods occurred in.

But also I tried to initiate the flood emergency evacuation plan for a community in Puerto Rico using FTMS funds, and the funds were limited, so we're going to give the commonwealth of Puerto Rico guidance and ask them to do the technical studies. That never got off the ground, they never got funded locally, so we are still hopefully going to get that study underway.

But that is one of the problems--that the locals don't have funds and they don't make it a high priority to develop comprehensive flood evacuation plans. Like Jim mentioned, I believe that most communities have what they call plans or warning systems, but they generally operate in a crisis mode; they really don't know what's happening until they have the flood occurring, and then they take what action they deem necessary.

In Jacksonville we have found that we have three phases of comprehensive plans. We go into a technical data report, and one phase of the technical data report is a behavioral survey where we go out and survey residents in the flooded area to see how they would respond to a flood, to see how many would stay in their homes and how many would be on the road. We found that these data are very necessary if we go on into the transportation study to determine the flow of traffic out of the evacuated area. Then you have to go into your hazard analysis, your H&H work.

The three points of our evacuation studies have been the transportation study where you have to determine the evacuation routes and also the time required to evacuate, and then you have to identify the shelters; we have also found that many of the the local communities' shelters are located in the floodplain lands and are floodable, so they have to find new shelters when that occurs. Then the manpower planning: getting the police officers or fire department to man the major intersections when you have an evacuation is critical.

After we develop all the technical data, then we get with the local civil defense directors and prepare what are called "implementation reports." These reports are prepared by the civil defense director with our guidance, and

that's the key to the whole program--getting a document that the locals will use. If they help prepare it, then they will use it. Then another very important point is the public information program to get the local TV media meteorologists involved. We have been putting out brochures and pamphlets on those aspects.

I would just like to say that I've worked with Jim on several studies and in fact we've had many discussions late into the evenings several times in preparedness planning. I have some trouble with his viewgraphs and his estimates of the reliability of some of those estimates as a hydraulic engineer. I do share very much his enthusiasm and his feeling the need for the Corps and others to be involved in the area of flood preparedness planning.

MICHAEL BURNHAM:

I don't know how many of you have experienced firsthand an actual flooding. My personal experience was when I was six years old in 1951, during the floods on the Missouri River when many of the communities around my hometown were inundated. I still picture the impact that it had on the people, the damage that occurred to those communities during that flood. I've seen it repeated during my youth on several occasions probably to a lesser extent.

After I went to work in the St. Louis District I became responsible for an area on the Illinois River which was flooded in 1973 and 1974, and my area of responsibility included a small town less than 2000 people and the surrounding areas. I know the need for technical data, technical information. It was difficult to make decisions on how high to make the temporary barrier that protected the town of 2000 people without active forecasts, which we did not have. It was difficult to know whether or not we should evacuate the community without accurate information. I stood on a levee that was flooding, and the water was about halfway up to my knees, and I called that in to the St. Louis District, and some person 150 miles away told me I was wrong--the levee wasn't failing, because it said on their chart it didn't fail for another three-foot stage. The need for accurate information is important.

Since I've been at HEC I've been involved in formulating and in assisting local communities in two or three different projects dealing with flood emergency and preparedness plans. The reason why I share just a second or two of my experiences with you is because as an observer, as a participant in flood preparedness activities, and as an analyst it has become very obvious to me that we at the Corps have not always emphasized to the degree that we should the importance of flood emergency plans.

We have generated in our studies a wealth of information, technical information that no other organization really can provide--hydrology, hydrologic flood damage information; it all is imperative to performing, assessing, and developing flood emergency plans. Too often we close up our report and say we can't find a feasible project. We close up that information which can be valuable to local communities. Preparedness plans, at least in my way of thinking from an implementation and reliability viewpoint, are different with each location and the way people respond, and the way they're

implemented is different with each flooding depth. It makes it very difficult for me to stand up here and talk about the reliability of preparedness plans, because that is dependent upon numerous factors: the time of day, how long has it been since the previous flood, where are the people, and lots of other considerations. It's difficult to forecast the reliability of these alternatives and plans on an emergency basis. I do think that reliability can be greatly increased.

I'd like to also mention and to focus where I believe preparedness plans enter the planning phase. They are different than other measures. They are designed to manage the impact of flooding, the loss of life, to mitigate to some extent the damage that occurs. They are temporary and they are implemented on an individual flood-by-flood basis. They are not, in my opinion, the same as, nor are they comparable to, other permanent structural or nonstructural measures. My feeling as to where the implementation of preparedness plans belongs, is as an interim measure until other permanent measures are implemented or--and we often overlook this capability of emergency plans--as enhancement to those measures.

For instance, if, through my planning process, I determined that a levee was feasible, it may be 10 years before that levee is constructed. Preparedness plans have a great deal of desirability to be an interim measure until the levee comes on line. They also can be used to enhance that levee's operations, such as closures in the levee, or to enhance the evacuation of people should that particular levee fail.

I think that we are becoming more aware of preparedness plans as time progresses. The LA District, Jacksonville District, Baltimore District, and several other districts are pretty actively in flood emergency planning. So I think that we in the Corps are making progress in that regard, but we do have still a long way to go.

ROY HUFFMAN:

I would just like to make three points here. Number one, I feel that flood warning is a subject whose time has come. I think one indication of this is that the interagency hydrology committee has identified this as a high priority item for their activities. This is the same committee that has put up Bulletin 17. Number two, I think that flood warning is a subject that needs to be given considerably more attention in the planning process, because the amount of time available or flood warning time can have a major impact on not just the details and the design of the solution we pick, but it may determine which solution you would want to pick over another. And one other point--it seems to me that the warning time has a major impact on the level of protection you would select, because the higher the level of protection you provide, the greater the warning time. To me this is one of the major justifications for providing higher protection.

The accuracy has been mentioned several times here. I think this is very important in the sociological considerations and all that, because you are not going to rouse people out of their beds and move them out of their homes in the middle of the night unless they have a great deal of confidence in that

flood warning system; then they know that you are not going to have a false alarm. My last point is that when we are implementing flood damage reduction measures we can buy the equipment at federal expense with appropriate caution as a part of that system and we are doing that at one project that I know of.

BRIAN MOORE:

What Roy was saying is a perfect lead-in to what I was going to say. I too want to talk about the flood warning aspect. I think flood warning is a very important item and something that is effective, something that works, but it's something that you can't participate in unless you are doing some other planning at the same time. In other words, unless you have a project that's in the development stages, you can include flood warning as part of that. Other than that, you can't. I mean cost sharing, participating in the financial aspects of the flood warning measures.

In the coastal area of southern California most all the counties are implementing flood warning systems, and they are doing it on their own. They are spending hundreds of thousands of dollars to put in these rain gauges that are self-reporting, and they feed into a model that the National Weather Service has in Sacramento; then with that information, the runoff is computed through that model and is fed back to a computer in the local county's flood office, and with that they have an indication of what the peak discharge is going to be in the stream and when it is going to happen. Then they can put into effect their emergency plan.

I'll just give you one example of how effective that's been: in Ventura County. One creek in 1978 had a tremendous flood that overtopped the banks of the natural channel and flooded a number of homes, in the hundreds, and cost about \$6 million damage in the little town called Fillmore. We got involved in a small project program right at the same time, and we started our planning; this was in 1978. The county wanted something done in the interim. They felt flood warning was the way to go here to prevent this from happening in the future. They turned to us to see if we could participate with them. We had to tell them that we would make that part of our planning process for the study that we're doing right now, and at the end of that study you'll know if we can participate in that solution or not. Well, that wasn't good enough for them; they felt they needed something right away and they went ahead and spent their own money and put in five gauges and bought a minicomputer, and got together with the National Weather Service and developed a flood warning system for the area.

In 1980 we were still in the finishing stages of our planning and design process for a project that would prevent all the flooding, but it wasn't ready to construct. In 1980 they had another flood, and this time they got a warning, and they used that warning to send some equipment out to the area, to station it right on the side where the stream had failed previously. Sure enough the stream started to overtop, and they put the equipment into effect, plugged up the potential problems, and directed the overflow off. So it was an entirely different condition from what happened in 1978, but the point that I'm making is that was a pretty darn good solution for that level of flooding at any rate, and it was something that could be implemented before we got

involved with our project. Our project is under construction right now. Actually, that was a pretty fast planning time for us. We started in 1978, in 1981 we started construction, and it is being completed now. There was that period of three to four years that they really had no protection at all, and we really couldn't do anything and they did it themselves.

So to summarize here, I think it's a shame that we really can't get more involved in flood warning systems and a separate solution for these areas. And I wish something could be done with our policy and authorities to change that situation.

DISCUSSION FOLLOWING OWEN ADDRESS

LEONARD RATUSHEWITZ:

I'm wondering if there is any case in which floodplain warning has been incorporated into plan formulation in a way that it would be used as a means by which the cost of structural protection may be reduced because of the benefits derived from the warnings.

BRIAN MOORE:

I don't know of a pure case, but perhaps an approximate one -- Sespe Creek. But the preparedness part was something the county had planned. At Sespe Creek our solution involved a floodgate that's in the single levee that we intend to build with a railroad that goes across the stream. It's too expensive to raise the railroad. If we put a floodgate in, the lowered cost makes the project feasible.

The floodgate will be a lot more effective because there will be a flood warning system. On Sespe Creek we would have recommended that a warning system be implemented with the floodgate. It just happened that the warning system was already provided by the county. I think the combination of the less expensive floodgate measures and the advance warning time will constitute a project that is as substantial and effective as anything we could have built.

H. JAMES OWEN:

Some of this is being done by the National Park Service on some of their recreational areas also, in the west. They're able to provide protection of campgrounds and other areas to a limited extent with dikes and channels and then rely on warning for catastrophic levels of flooding.

RATUSHEWITZ:

The reason I put the question is, if we're talking about implementation of warning -- and we are -- then the best opportunity we have for that is where we already have other endeavors going on more structurally oriented projects. There you can perhaps show a tangible benefit for incorporating warning, by reducing the cost of the project. I think this is worth some study.

ROBERT POST:

A few years ago there was an emphasis placed, as Mike has pointed out, on developing flood emergency preparedness plans for communities where we have an ongoing GI study. That emphasis seems to be waning or gone now. Does OCE currently approve of using GI funds to develop flood emergency preparedness plans for communities where we are coming up with a feasible structural solution?

My experience is that there are situations in the country -- the Passaic Basin in New York, the several cases in Los Angeles District -- where there are GI funds being used to investigate flood warning preparedness plans and alternatives in conjunction with other structural and nonstructural measures. My experience is "yes."

ROBERT D. WOLFF:

I think there is really no problem with that from the perspective of OCE planning. Obviously the purpose and objective of a feasibility report when doing a GI study is to produce a report to recommend a solution for implementation. Throughout the last 10 years we've had sundry areas of emphasis as we're doing a study both in the environmental area and in floodplain management. I don't think there is really a definitive answer. I think it depends on each situation as to how much the study can accommodate in providing assistance to local interests as a part of the study. It can't be the predominant objective of the study when using GI funds, but it certainly can complement the study. And as was indicated before, if a study comes out with no recommendation for federal action, we do very much espouse the view that that report is, in fact, a living document for assistance to local communities and it shouldn't just be wrapped up and put on the shelf. Whenever emphasis goes into flood warning systems, it can be handed over to local communities for further development and implementation.

PAUL GAUDINI:

When a report is basically a negative letter report, it's different than having the information in the district in the drawers, for putting out as much technical information as you have -- basically hydrologic, economic, and so forth.

WOLFF:

Your question is, "Are you encouraged to do that?"

GAUDINI:

Yes. Are you allowed to spend the funds to do it? There is a matter of interpretation. You see some negative reports which are full of information and then there are others which have nothing except the usual letter report. I'm not saying that the technical data have to go through the formal review. But can it be put out, with the GI funds, as a finished product, at the end of the study?

WOLFF:

Yes, I think there's a lot that the district can do to informally transmit information to local sponsors or local people under the auspices of a GI study where that effort has been generated through the GI study. I don't think there is any proscription against putting out any kind of publication from the District where the work effort has produced information, and you take a small additional effort to get that information transmitted to other people.

Obviously, in the study that was referenced this morning -- that shoreline erosion study, where the Congress actually directed the Corps to not only do a study but to disseminate information, there was a mandate. Bill Donovan's group actually had seminars across the country to provide information. It's not as explicit, in our studies, to do that, but I think there is a general

encouragement to get usefulness out of our studies. And obviously it's a matter of management decisions as to whether or how much extra money you want to use to do that. And that only the management apparatus in district and division can answer. But OCE does not prohibit it, and we encourage it to the extent that it makes good management sense in terms of what other studies you have going and how to get use out of what you've already done.

DONALD DUNCAN:

I might add that we do have a short study in progress to examine our response to the nonfederal sector when there is no Corps of Engineers flood control project to be recommended. We're taking a look at the policies and the procedures. It's a can of worms.

GAUDINI:

I just have a general question. I've been with the Corps a long time and it seems like our planning philosophy took a little bit of a turn. In about 10 years or so it seemed like we were getting from "project" planning to "solution" planning. With the emphasis on Corps implementation, but even in absence of Corps implementation, we were into solution planning. And it seems like now we're swinging back to project planning again. And a strong indication of this is the Corps' philosophy on implementing flood warning systems. They're not spending or going further beyond the survey into actual further studies and implementation. It is a solution.

DUNCAN:

I hope we're not turning in that direction.

WIENER CADET:

Then, can we consider a flood warning system as an alternative solution to the problems of flooding, or is that an untenable solution?

OWEN:

I think there's nothing wrong with having a warning and preparedness program as a major alternative in a project -- contrary to Mike Burnham's comments. I thought I wouldn't get to get into this give and take. I understood Mike to say that if he couldn't make the preparedness plan just a supplement to another measure, then he wouldn't give them a preparedness plan at all. He would simply leave the people unprotected. I'm sure you don't mean that, Mike. But that's what I thought I heard you say.

I don't see any reason why a preparedness plan and a warning system cannot stand alone as a major alternative. They can also be merged with other structural and nonstructural measures. In some cases, for example, their combination is almost essential. If one's going to elevate structures, residential structures, then you'd better have a warning system and an evacuation plan to get the people out of there during floods.

This is one of the problems that comes up in the economic side, too. Where do the benefits from warning merge with the benefits for floodproofing and other contingency actions? It becomes difficult to sort it out.

MOORE:

I think you can do both, but you must realize that if you have flood warning as an alternative solution -- and it certainly is a solution -- you can't participate in it. But if it's a part of another solution then you can financially participate in it. I think that's a big difference.

DUNCAN:

I think this is a very good subject to bring out in the general forum session tomorrow. Something we could be thinking about is that the Corps has had a very difficult time deciding what our role is in this area. Some time ago that was a nonfederal responsibility, by and large. We've moved into it rather hesitantly. Maybe we ought to have some discussion on that. And Jim, I think you've probably serviced the nonfederal section. You may not be here tomorrow. Would you be willing to share your views as to what you think the Corps role should be in flood warning assistance?

OWEN:

The development of local flood warning systems has not been so exclusively limited to the nonfederal interests -- particularly local communities -- as one might first believe. The National Weather Service, for example, has had a program underway since 1974 and is currently spending quite a few million dollars promoting and developing local flood warning systems. So they're in very deeply. Also, of course, FEMA has a mission in the area of preparedness which includes floods. In addition, there are 14 states that have some activities to encourage the development of local flood warning and preparedness programs. So, local interests aren't really "on their own."

On the other hand, they tend to be better equipped to take on the operational role of carrying out a warning system, once it's established -- and perhaps even the financing of it -- than they are to do the planning and design. Unless they are a large community or populous county, in many cases they lack the technical staff to engage in the planning. This is one of the key roles to be filled in. It's a role that ought to be filled by a combination of the National Weather Service and the Corps of Engineers and other agencies. I think this would be a most valuable thing to have occur.

So far as working on specific projects, I don't want to suggest what kind of a role the Corps ought to have in that. I don't see, though, why one couldn't treat preparedness like any other measure. If we believe it works, it ought to be made available on the same basis as other measures.

MOORE:

It is true the Corps has had a difficult time finding out what its role is in flood warning systems. We always have thought this was the responsibility of local interests. But I think it's important to note that, particularly in our area, local interests have turned to another federal agency to get the necessary expertise to help them in developing flood warning systems. And they get a significant cost sharing from this other organization in that the other organization will do all the modeling; they'll plan out where the rain gauges ought to be, give all sorts of advice and assistance and all the computer software needed to achieve a flood warning system. All locals have to do is buy the hardware and operate it.

And I think because we have somewhat "pulled back" from that solution as something we shouldn't get involved in, some other agency has stepped into the vacuum and taken on a de facto federal role. It kind of hurts, because the other agency is oriented to a single purpose, whereas we're looking toward an overall solution. Our planning scale is perhaps much larger, then, than that of the Weather Service.

## COOPERATIVE ROLES IN FLOOD WARNING SYSTEMS DEVELOPMENT

Robert L. Carnahan and Curtis B. Barrett  
National Weather Service  
Silver Spring, Maryland

Cooperation in weather forecasting is not just a desirable end, it is an absolute necessity. Ever since Benjamin Franklin in the 1700's began asking friends to make regular observations of the weather at stated times and to report their observations to him, weather forecasters have depended upon others to provide information with which weather patterns can be determined and predicted. This need is so basic that cooperation among the Nations of the World is more extensive in meteorology than in any other field of human endeavour. The National Weather Service (NWS) today receives regular reports of weather conditions on at least a daily basis from almost all civilized areas of the globe.

In a similar way the NWS has for years depended upon other agencies of the government and volunteer observers in farms and towns across the Nation to provide information from which the NWS develops its forecasts and warnings. In recent years the Weather Service has received increasing cooperation from private industrial firms in sharing their proprietary weather information with the Federal Government as a matter of enlightened self-interest. It is clear that cooperative efforts are a way of life for those of us in the NWS and for the thousands of people worldwide who observe and report the weather.

We are delighted to be able to participate with you in this seminar on the implementation of nonstructural flood plain management measures. It is particularly satisfying to us to see emergency preparedness and warning systems given such prominence in your seminar program. We recognize that warning and preparedness can represent only one element in a program of nonstructural measures. We recognize that flood plain regulation, relocation of structures and flood proofing may all have longer-term benefits, but we also recognize that warning systems are an inexpensive and effective first step in the development of a nonstructural flood protection program. Such systems are not to be regarded as a replacement for other nonstructural measures, but rather as an element in the total program. We look forward to the day when every flood-prone community can boast of its own warning system, developed with the cooperation and involvement of the local citizenry. Participation in the creation of a local warning system can and often does lead to increased public awareness of the threat and community willingness to support other, more strenuous measures.

I want to talk to you today about cooperative roles in flood warning systems development: what such systems are, where we are today in the development of systems, why we need to do more and who needs to do what in this general area.

## The Value of Flood Warning Systems

Flood warning systems range in complexity from a vast network of observation and gaging stations on a large river system down to the simplicity of a flash flood alarm in a rapidly flowing mountain stream, draining an area of only a few tens of square miles. In each of these cases the key to adequate warning is availability of information and the timeliness of gathering and processing of information and dissemination of warnings.

Because the time of concentration of runoff is primarily a function of the size of the basin, time is generally not critical in cases of large river basin flooding. As basins become smaller and we move into headwater areas, warning time becomes highly critical and this is the main focus of attention of the current NWS flood warning program. In general, the NWS thrust is toward increasing the availability of information from smaller drainage areas and in reducing the elapsed time between observations and warnings of impending threats.

In order to provide maximum lead time when floods occur in very short time intervals (from a few hours to a few minutes) the NWS provides 1) flash flood watches and warnings at the county level, and 2) help to communities in establishing local flood warning systems. Local flood warning systems vary from simple manual self-help systems to more sophisticated automated data collection and warning systems utilizing state-of-the-art technology. The manual local system consists of volunteer rainfall observers, a flash flood coordinator, simplified flood forecast procedures and a flood disaster response plan.

An automated flood warning system known as ALERT (Automated Local Evaluation in Real-time) is a system of remote radio reporting river and rain gages, automated data collection and processing equipment, computerized hydrologic and meteorologic analysis techniques and a warning distribution system.<sup>1</sup> The ALERT system is being implemented in a number of local areas across the country and is recognized as having great potential for the future.

In Appalachia, the NWS is implementing a regional approach to flash flood forecasting by cooperating with various federal, state and local governments in implementing IFLOWS (Integrated Flood Observing and Warning System). IFLOWS is an automated data collection and forecasting system which incorporates much of the ALERT technology and will provide flash flood forecast and warning capabilities for an 80 county region in Kentucky, Virginia, West Virginia and Pennsylvania.<sup>2</sup> We'll discuss these systems more extensively later.

The costs of local flood warning systems vary, as might be expected, depending upon the complexity of the installation.<sup>3</sup> Local flash flood warning systems, utilizing volunteers and manual observations made with plastic raingages and staff streamflow gages can be implemented for only

a few hundreds of dollars. ALERT systems for individual communities are being implemented with capital costs ranging between 20 and 50 thousand dollars. In metropolitan areas costs range up to 300 hundred thousand dollars. The IFLAWS system being implemented in the Central Appalachians costs approximately \$50,000 per county. Alarm systems can be installed for two to five thousand dollars each, depending upon the complexity of the communications system needed to transmit the alarm to a fully manned location, a part of the local public protection system.

In an effort to improve its flood warning capabilities, the NWS has recently completed considerable work assessing the potential benefits available from improved flood forecasting.<sup>4</sup>

National Weather Service verification studies indicate that greater than 70 percent of flash flood warnings have less than 1 hour lead time. Greater than 50 percent of flash flood warnings have no lead time, that is, they were issued after flooding had already occurred in some portion of the area. On the average, only a 4-hour lead time can be provided for a flood occurring within 18 hours of the precipitation and a one-half hour lead time can be given for flooding occurring within 6 hours after the rainfall. It is clear that improvements in flood forecast warning lead time are seriously needed, particularly in headwaters areas. It is the NWS conclusion that if warning lead time can be increased from 4 to 14 hours for an 18 hr-flood event and from one-half hour to 2 hours for a 6-hr flood event, potential damage reductions of approximately 100 million dollars per year can be realized.<sup>5</sup>

The NWS approach to establishing this potential benefit encompassed essentially seven steps as shown in Figure 1:

1. Establish the number of rain gages required in a given headwater basin as a function of the area of the basin,
2. Determine the number of headwater forecast points needed and the catchment area for each,
3. For each basin determine the number of gages required and determine the total number required as the sum of the requirements for each individual basin,
4. Establish a general relationship for flood warning benefits in terms of the percentage reduction in flood damages, as a function of the lead time available for response to the warning,
5. Determine for each forecast point the potential lead time that could be offered, the required data sampling interval to achieve this lead time, and the actual lead time now offered,
6. Determine for each forecast point the mean annual flood damage,

FLOOD LOSS. REDUCTION BENEFITS

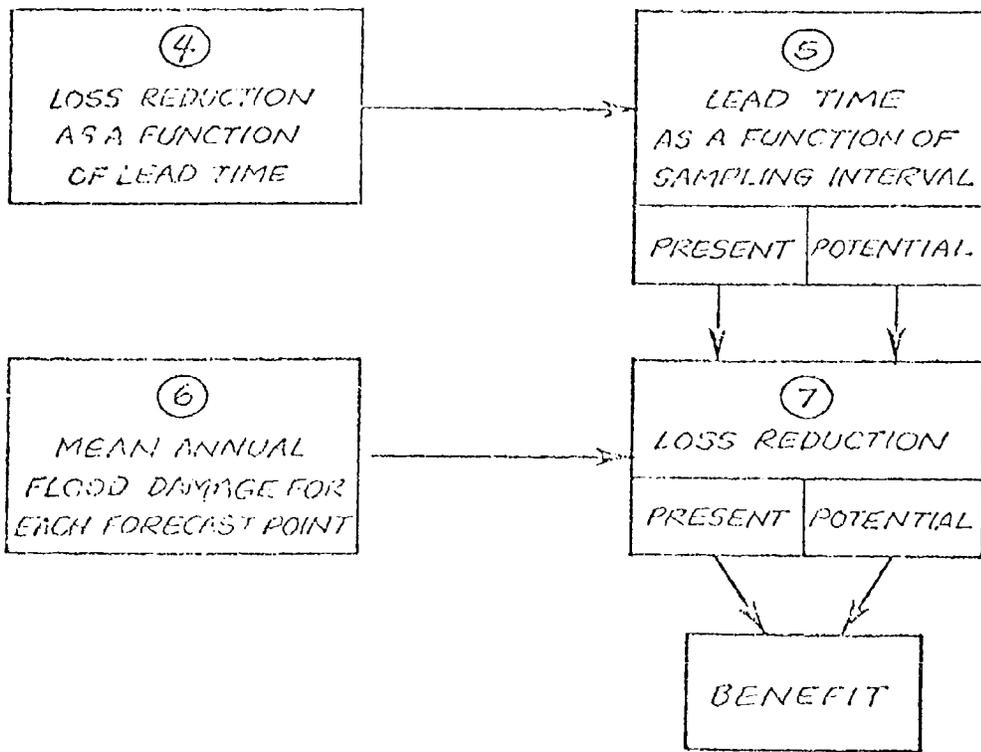
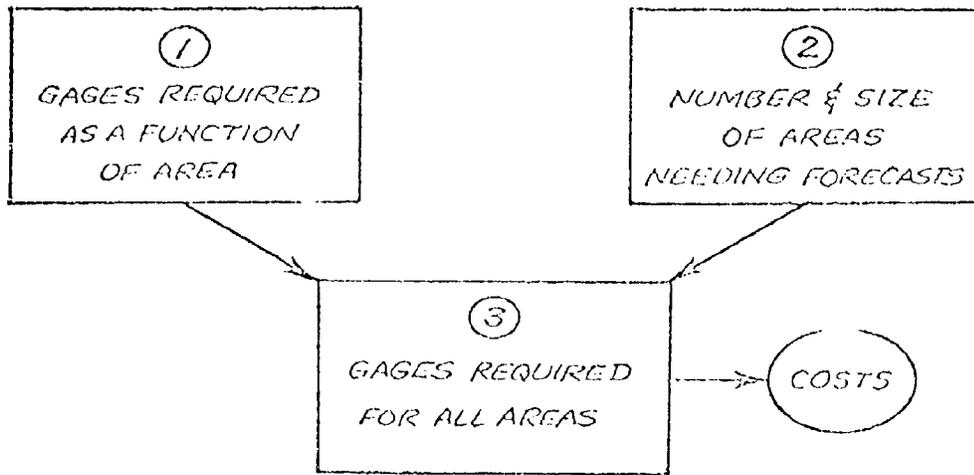


FIGURE 1

7. Estimate for each forecast point the potential flood warning benefits of the existing services and from future services that could result if the potential forecast lead times were achieved.

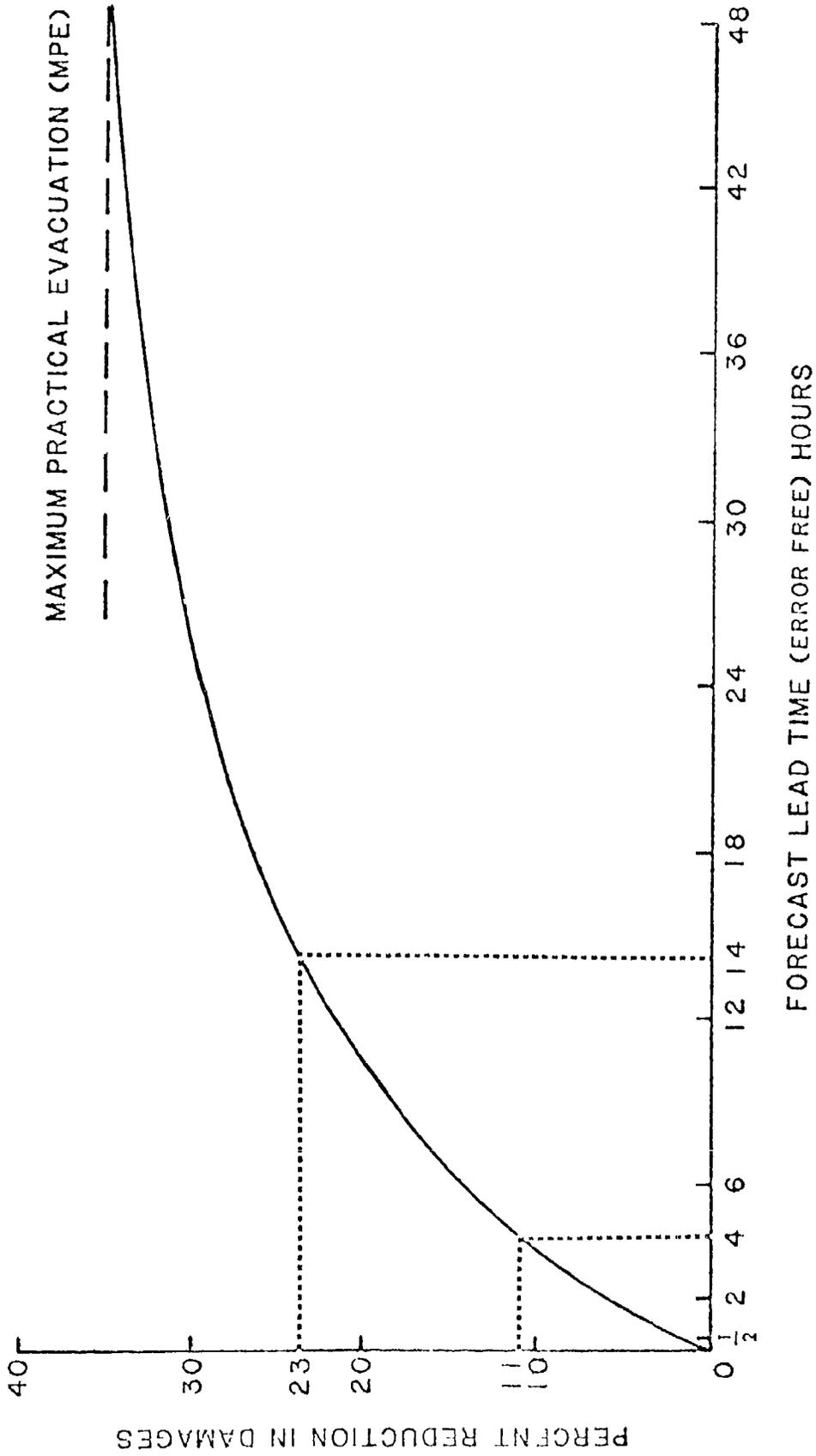
The number of gages required is dependent primarily upon the size of the river basin and ranges from about four to a one hundred square mile basin to eight for a one thousand square mile basin. The next two steps are relatively straightforward and lead to a conclusion that about 5,000 gages are required.

The most critical part of this analysis lies in step 4, which depends upon the relationship represented in Figure 2. It shows percent reduction in damages as a function of lead time. Note that according to this curve lead time of as little as 4 hours still permits a percent reduction in damage of approximately 10 percent. This reduction is possible because many valuable items such as cars, televisions and furniture can be moved readily. The curve was originally developed by the Environmental Science Services Administration<sup>6</sup> but reconfirmed to be valid by more recent studies.<sup>7</sup> Reduction in damages is limited to saving movable property and does not include losses which can be avoided by flood fighting measures such as sandbagging. To this degree it underestimates savings.

Potential lead time for a given basin is the time between the occurrence of the most intense rainfall over the basin and the occurrence of the flood peak at the forecast point. A study of lead times for representative basins produced a conditional distribution of lead times for given areas. Combining these lead times with mean annual flood damages from existing headwater forecast points produced an estimate of flood warning benefits for both actual lead times and potential lead times. The resulting mean annual flood warning benefit for achieving potential lead times in headwater areas was found to be about 170 million dollars. Part of these benefits are already being achieved because some lead time is now being provided to headwater areas. The National Weather Service has come to the conclusion that incremental potential benefits of improving the lead time for headwater area flood forecasts is of the order of 100 million dollars per year.

#### Difficulties in Assessing Benefits

It is readily apparent that much of this analysis depends upon the credibility associated with Figure 2, Percent Reduction in Damages as a function of Forecast Lead Time. Admittedly, there is no truly reliable way of developing this curve. It is dependent not only upon receipt of warnings but the willingness of the public to respond to them. Anderson-Nichols in Boston has been doing some work on this issue and personal conversations with Redmonds Clark of that organization indicate that their results would lead one to expect proper response from approximately 75



DAMAGE REDUCTION = F ( LEAD TIME )

FIGURE 2

percent of the population with sufficient lead time. Eighty percent response is possible with sirens or police warnings. In any case it is interesting that Anderson-Nichols has apparently found no reason to revise the relationship as proposed by the Weather Service many years ago.

One aspect of public response which should be recognized at this point is that people respond most readily when they know they are at risk. This requires stage-height relationships, inundation maps, and a specificity of forecast which the National Weather Service has been frequently unable to provide. Prevention of damage requires not only adequate warning but appropriate response from the threatened population -- an outcome to which we can all contribute.

#### The National Weather Service Approach to Flood Forecasting

The primary mission of the NWS is to protect life and property from losses due to hazardous weather and flooding. The issuance of flood forecasts and warnings provides the critical time for people to evacuate flood areas and to move valuable possessions to higher ground.

The Federal Emergency Management Administration (FEMA) has identified 20,000 communities in the U.S. as flood-prone. The NWS flood warning program is directed toward serving these 20,000 locations.

The National Weather Service provides various levels of flood warning services to these 20,000 places. Specifically, the NWS provides flood warning service for 3,000 designated forecast points. Generally, hydrologic data are available at these points. Crest forecasts and lead time are forecast for the occurrence of floods at designated river gages. The relationship between the forecast point or river gage and the area of floodwater inundation is usually not known at these locations except where the NWS, the Corps of Engineers, local authorities, or others have studied the area and defined where the flood waters may reach.

Of the 3,000 forecast points, approximately 1,000 are for headwater areas, for which headwater flood forecasts are provided. The remaining 2,000 points are along the mainstems of larger rivers. For the 1,000 headwater forecast points, most of these rivers crest from 6 to 18 hours. The rivers in the 2,000 communities can crest from 18 hours to weeks.

In order to provide river and flood forecast service to the 3,000 forecast points, forecasts are provided by NWS River Forecast Centers (RFC). Thirteen RFC's are staffed with professional hydrologists responsible for collecting and analyzing hydrologic data, development and implementation of hydrologic models, and generation of specific flood forecasts. These forecasts are relayed to state Weather Service Forecast Offices (WSFO's) for dissemination to the public. Generally the RFC can provide flood forecasts for streams that crest 12 hours or more. However, because many floods occur in 12 hours or less, another level of service must exist to provide maximum lead time for the short fused flood.

Simplified hydrologic techniques derived by the RFC are used by the WSFO to forecast many headwater river basins. Remembering that headwater forecast points lie along river basins that crest between 6 to 18 hours, time is usually not available for the routine process of collecting data, forwarding the data to the RFC, processing the data, exercising computerized hydrologic models; analyzing hydrograph output from various hydrologic models and disseminating forecasts to the WSFO. Because of the critical time factor, simplified hydrologic procedures are used at the WSFO to expedite warnings to areas threatened by rapidly rising streams and rivers.

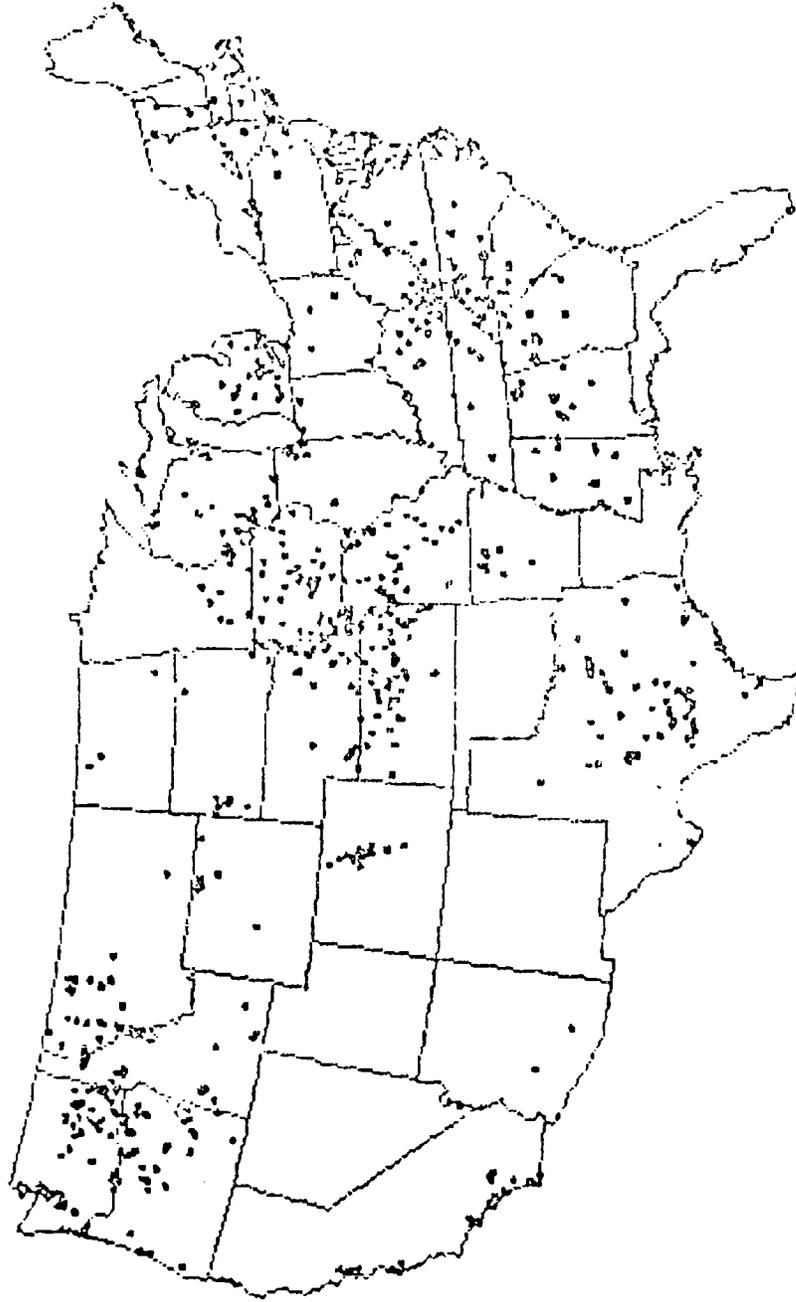
Generally speaking, floods which occur in 6 hours or less are known as flash floods. In many instances a flood which occurs in 12 hours would be considered a flash flood. Because of the extreme short lead time involved in flash floods and because of the scarcity of data, specific, numerical flood forecasts for communities threatened by flash floods are not feasible. The NWS provides a generalized flash flood watch/warning service for all counties in the Nation. A flash flood watch is issued if meteorologic conditions indicate that flash flooding is possible. If the occurrence of flash flooding is imminent, or is occurring, a flash flood warning is issued.

In addition to the river and flood forecasting service previously described, the NWS also provides assistance to communities in implementing local flood warning systems. There are currently over 1,000 Local Flood Warning Systems (LFWS) in operation. Figure 3 shows the location of these various LFWS throughout the country (note that the data are incomplete for Oklahoma and Pennsylvania). As mentioned earlier, such Systems vary in complexity and capabilities. They can be categorized into 1) manual self-help systems, and 2) automated flood warning systems.

Most of the LFWS in operation today are Manual Self Help Systems. These systems are inexpensive and simple to operate. Although surprisingly accurate, they are not as accurate as the more sophisticated automatic systems. They depend to a large measure on volunteer observers, and maintaining enthusiasm on the part of such observers over long periods of time is difficult, especially in areas where flooding is infrequent. Nevertheless, volunteer systems do afford communities with basic flood warning capabilities at low cost.

The last decade has demonstrated a substantial growth in the use of automated flood warning systems. The advancement of computer technology, development of computer processing and hydrologic models coupled with decreases in the costs of computers has resulted in the rapid development of cost effective flood warning systems. Although various types of automated flood warnings are now emerging, the following are basic categories of these systems:

NATIONAL WEATHER SERVICE  
LOCAL FLOOD WARNING SYSTEMS



NUMBER OF POINTS 766  
DATE 110382

FIGURE 3

## ALERT

The ALERT system consists of 1) automated event reporting river and rain gages, 2) automated data collection and processing equipment, 3) computerized hydrometeorologic analysis and modelling techniques and 4) a warning distribution process.<sup>1</sup> The precipitation gages report 1 mm precipitation events via a radio transmitter to a base station. The river gage is a simple event-reporting unit which transmits preselected incremental changes in river elevation. Both are powered by batteries. The base station consists of a radio receiver to receive the event-reported radio signals and a microcomputer system. The microcomputer system collects all hydrologic data, processes the data, executes the Sacramento catchment model every 12 minutes, and provides the local agency with the best estimate as to the severity of flooding. The Community Coordinator provides local warning distribution to disaster response officials in conjunction with flood and flash flood warning statements issued by NWS offices to appropriate media.

## IFLOWS

The IFLOWS system, being implemented in the Central Appalachians, consists of over 100 radio reporting rain gages that are polled by a State Emergency Automated Response System (STEARS). The STEARS is a minicomputer located at the state Emergency Operations Center (EOC). STEARS provides the functions of processing rainfall data, forecasts, warnings and other information transmitted on the Backbone Distribution System. The Emergency Automated Response System (EARS) is a county minicomputer located at the county EOC. The EARS receives information from STEARS, displays all information and products, provides audible and visual alarms of flood warnings and can be programmed to provide display of appropriate response actions. A voice coordination subsystem provides voice communications between all IFLOWS participants. The IFLOWS system links all appropriate NWS field offices and state and county disaster preparedness offices into a single integrated flood warnings system. IFLOWS not only provides state-of-the-art technology in automated flood warning systems operation but also provides a test bed for new hydrologic procedures and developed technology.

## FLASH FLOOD ALARM SYSTEMS

Another type of automated flood warning system is the flash flood alarm. Flash flood alarm systems consist of water level sensor(s) connected to an alarm or light located at a community agency which operates on a 24-hour operation. Water levels exceeding one or two preset amounts trigger the alarm. The distance the alarm is located upstream of the community determines the amount of warning time provided. Currently over 65 flash flood alarm gages are in operation (figure 4). The NWS can provide communities with the necessary specifications to construct a cost effective flash flood alarm gage system.



In review, the NWS provides specific flood forecast and warning service to 3,000 communities in the U.S. Approximately 1,000 local flood warning systems are now in operation providing site specific flood forecasts to communities. In view of the 20,000 flood-prone communities as determined by FEMA, approximately 16,000 places in the Nation receive only generalized flash flood warnings which are issued on a countywide basis.

#### Historic Involvement of Other Government Entities

When the U.S. Weather Bureau was first established in 1870, it consisted of 25 stations and 233 staff members with a budget of \$50,000. It was part of the U.S. Army Signal Service. River level and flood data collection was started in 1873, and in 1890, when the Weather Bureau moved to the U.S. Department of Agriculture, the Weather Bureau Organic Act was passed by Congress and the Weather Bureau was charged with "The forecasting of weather, the issue of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce and navigation, the gaging and reporting of rivers...." and a host of other things. Note that even in these early days the relationship of weather to defense, agriculture and commerce was recognized. From the earliest of times, therefore, the Weather Service has cooperated with other agencies of the Government in performing its responsibilities.

Particularly in "the gaging and reporting of rivers" the Weather Service has had substantial assistance. The Corps of Engineers, for example, in its role of operating flood control structures has maintained close contact with the National Weather Service relative to expected inflow into its reservoirs and anticipated releases by its reservoir operators. The U.S. Geological Survey in its historical role in monitoring ground water and streamflow has been a vital source of information to the Weather Service and, equally, the recipient of Weather Service data from NWS gaging stations.

Other agencies of the Government have also been important. For example, the Bureau of Reclamation, the Soil Conservation Service, the Federal Emergency Management Agency (and its predecessors), the Department of Agriculture, and the Federal Aviation Agency have all had an intense interest in weather and have been helpful to the Weather Service in the performance of its statutory responsibilities.

Increasingly in recent years state and local governments have also played a role. Particularly in the aspect of disaster preparedness planning and public awareness to hazards, state and local governments have been prime movers. Personnel of NWS have been eager to cooperate to the extent possible and much has been done. This past spring many state and local governments joined NWS in the observance of a national flash flood awareness week, specifically designed to increase public recognition of the threat of floods and flash floods nationwide. There were proclamations from the Governors of 14 States and local events from New York to California.

Within about the last 5 years, the Weather Service has begun to recognize the increasing role which private industry is playing in disaster preparedness and the development of flood warning systems. In

1981 the Corps of Engineers, the Federal Insurance Administration and the U.S. Water Resources Council joined NWS in preparing a film, a slide presentation and a technical manual on cooperative flood loss reduction based on the experiences of Lycoming County, Pennsylvania.<sup>9</sup> The remarkably successful local flash flood warning system in that County was stimulated by the activities of a private company, the Sprout-Waldron Company of Muncy.

Sprout-Waldron suffered damages of over \$700,000 to their facilities as a result of Hurricane Agnes in 1972 and additional emergency costs of nearly \$500,000 were encountered in returning the plant to operations. An additional \$2.1 million loss was incurred as a result of business interruption. In a 1975 flood resulting from Hurricane Eloise, after the development of its own local flood forecasting and warning system, Sprout-Waldron was able to reduce its losses by 93.2 percent. Physical damage was reduced by more than 98 percent and business interruption expenses were reduced by over 94 percent. The fact that the significant reductions in losses are attributable to the adjustments made between floods by Sprout-Waldron and not to differences in flood height can be illustrated in comparing the ratio of 1975 and 1972 losses for the Borough of Muncy with the ratio of losses at Sprout-Waldron. Dollar losses for the Borough in 1975 were nearly a third of those in 1972 while losses at Sprout-Waldron were only about 7 percent of those experienced in 1972.<sup>10</sup> It is clear that Sprout-Waldron had substantially reduced its losses as a consequence of preparation, threat recognition and appropriate action. The Sprout-Waldron story is only one case, although an outstanding one, of industrial loss reduction through preparedness planning and response to warnings.

#### Future Trends in Warning Systems

There is no need to cite statistics to this audience to demonstrate the seriousness of the flood threat in this Nation. Similarly, the rising trend of losses is well known. The latest average economic loss due to flooding is near \$5.0 billion a year and is projected by the U.S. Water Resources Council to reach \$11 billion annually (adjusted for inflation) by the year 2000. NWS statistics show a 5 percent per year increasing trend of flood losses over the past 30 years.

The increasing trend of flood losses is predominately due to increased occupation of the flood plain. However, part of this trend is due to increased urbanization of the upstream river basin. Increased urbanization results in an increase in the volume of runoff and an increase in runoff velocity from the same rainfall. The alarming increase in flood plain development in flood plains, combined with a rapid population growth has resulted in a greatly increased flood risk to the Nation's population.

The demand for flood forecast service is understandably increasing. However, present resources within the NWS are strained to meet the existing level of services. The prospects for additional funds at the Federal level are not bright. Thus the expansion of increased forecast points, increases in forecast accuracy and timeliness of forecast products can only improve

on a gradual basis. Highly cost effective solutions to flood problems can be expected to receive the greatest attention within the NWS in coming years. You may expect to see a lot of emphasis on Local Flood Warning Systems and cooperative efforts with other organizations and governments.

Local flood warning systems provide communities with maximum cost effectiveness in flood warning service. Communities are reaping substantial benefits by purchasing and maintaining the necessary equipment. Since all the data are collected and processed and forecasts are generated at the community level no valuable time is lost in warning residents of impending floods.

The process of establishing a local flood warning system in a community increases the community residents' awareness of flood problems. Part of this process is the assessment of the community's flood disaster preparedness program. An integral part of LFWS is the establishment of a viable flood disaster preparedness plan which links advanced flood warnings to predescribed actions designed to save life and property. Another benefit of LFWS is the distribution of specific flood inundation information to threatened residents. Sociological studies conducted after recent flood disasters indicate that people require specific information to respond appropriately to flood warnings. A person must feel personally at risk before appropriate action will be taken. Because flash floods are often confined within small areas (0-20 square miles) well within a county, generalized county flash flood warnings do not localize the event enough for people to feel at risk.

When possible, flood warnings for particular roads, subdivisions should be issued to define the area of inundation. This type of information can be conveyed by the operation of Local Flood Warning Service. Also, LFWS can improve the distribution of flood warning information to the people who need to receive it.

Many local systems now in operation are a result of the NWS efforts to develop cooperative agreements with the many local communities. The costs of real-time data collection and flood warning systems are low enough to put the cost of automated LFWS within the economic reach of many communities. The cost of implementing manual self-help LFWS is negligible; the benefits to communities are enormous.

The benefits to NWS and its mission are also great. As Local Warning Systems increase in number, the NWS must have access to data collected by these systems so that downstream residents can be warned. Exchange of data and forecasts between local coordinators and the NWS is absolutely necessary to assure high quality forecasts for the community operating the system and to provide effective warnings to downstream residents.

#### Possible Future Roles for Cooperators

The future in flood warning system development can be exciting indeed. In spite of the fact that many problems remain, progress is

being made in the understanding of the atmospheric and hydrologic phenomena and the development of workable forecast solutions. Probably one of the most difficult problems remaining in this period of austere budgets and heavy competition for available dollars is that the solutions do cost money and require support from state and local government entities. As has been pointed out earlier the benefits are substantial, and in terms of the numbers of dollars that have often been expended for flood protection, flood warning systems are almost ridiculously inexpensive. Bringing about appropriate and adequate expansion of flood warning systems will require further cooperation between the various levels of government and the private sector.

The Corps of Engineers can make substantial contributions by turning their vast experience in cost/benefit studies to the development of improved methodology for computing flood warning system benefits. This matter is much more appropriate for engineers and economists than it is for meteorologists. Certainly the Corps can make significant contributions in this area.

Secondly, the Corps can contribute importantly in the design and installation of automated flood warning systems. It may be that such systems should be regarded as an essential first step in flood protection for a community, capable of being designed and implemented in a relatively brief period of time, and for minimal cost.

Finally, the Corps can contribute in the sorely needed area of protection from dam breaks. We all need better systems for monitoring dams and detecting leakage or incipient breaks.

The National Weather Service can continue to contribute by utilization of data from local flood warning systems and by the development of the hydrologic models which will turn observations into forecasts. The Weather Service fully intends to work toward expansion of flood warning systems through its own resources and through cooperative efforts with state and local governments, but it is not to be expected that all of the systems that are needed can be created without further Federal Government assistance.

The Federal Emergency Management Agency has a strong role to play in the encouragement of state and local governments to do disaster planning and to create and maintain local warning and response plans. In particular, the FEMA National Warning System has been crucial to the success of natural hazard warning dissemination in the past and can be expected to play a critical role in this area in the future.

The Federal Insurance Administration can encourage local flood warning systems through a program of incentives. How such a system might be developed is still unclear, but the objective is highly desirable and should serve, in the long run, to reduce flood loss claims.

With the Corps of Engineers, FEMA and the National Weather Service cooperating, it appears highly likely that state and local governments and the private sector will respond with rising enthusiasm to make their own contributions toward the protection of their own lives and property. Cooperation in the weather business may have been important for many years, but it seems to be destined to play an even more important role in the coming decade of emphasis on nonstructural measures for flood protection.

## Notes

1. ALERT - a Cooperative Flood Warning System for your Community. National Weather Service, Western Region, February 1981.
2. IFLOWS System Description, National Weather Service, Flash Flood Program Office, July 1980.
3. Flood Warning System - Does Your Community Need One? National Weather Service, Disaster Preparedness Office, March 1980.
4. Benefit Model, NWS Gauging Network, GKY & Associates, Inc. March 1981, pp 39-41.
5. Program Development Plan for Improving Hydrologic Services. National Weather Service, Office of Hydrology, Unpublished Manuscript September 1982.
6. Day, Harold J., Flood Warning Benefit Evaluation - Susquehanna River Basin ESSA Technical Memorandum WBTM Hydro 10, March 1970.
7. Benefit Model, NWS Gauging Network Op. Cit., p. 33.
8. The Future of the National Weather Service, National Advisory Committee on the Oceans and the Atmosphere, July 1982.
9. Owen, H. James, Cooperative Flood-Loss Reduction - A Technical Manual for Communities and Industry. June 1981 pp. 1-5.
10. Owen H. James, OP. Cit. pp. 91-93.

PANEL III, FOLLOWING CARNAHAN ADDRESS

RON HILTON:

I want to talk to you now about hurricane evacuation planning in the Jacksonville District. In January 1978, I met with the Florida Bureau of Disaster Preparedness at their request to see if the Corps of Engineers could assist them in preparing hurricane evacuation plans. We got a letter of request from the Florida Bureau of Disaster Preparedness, sent through channels, that they did get funding. And in April 1978 we started the Lee County study. That study cost \$120,000 and was completed in May of 1979. It was just for one county and hurricanes affect more than one county, so it was decided by the state they would like to see us go into a regional concept. So the next request was for the Tampa Bay region. It's a four-county area on the gulf coast. That study cost \$300,000 and was started in January 1979 and completed in June 1981. The population of the Tampa Bay area is a little over two million people. Then we got another request from the state. They liked what we were doing, so they wanted us to study the lower southeast coast of Florida from Palm Beach to Key West, another four-county region. That study cost \$850,000, of which \$300,000 was Corps of Engineers' money, and then we got \$50,000 from FEMA. That study was started in April of 1981 and we will complete in June of 1983.

One thing that has stood out in regard to our studies is the time required to evacuate coastal areas. The National Hurricane Center generally can give people a 12-hour daylight warning time. In our studies, because of a high-density population in the coastal areas, we were getting evacuation times ranging from 10 to 20 hours. So there was a problem there, but we're giving the local civil defense directors the technical data on how we came up with our 20 hour evacuation time.

We don't know how these studies are going to work. But the local officials are talking with each other; in Tampa Bay, for instance, the civil defense directors of the adjoining counties didn't even really know each other till we started our study. They got to talking with each other, and that was one big help in our study.

We had quite a bit of involvement in our hurricane evacuation studies. Of course the National Hurricane Center has been doing all our computer runs using their SPLASH and SLUSH models to determine the coastal service for category 1 through 5 hurricanes, and also the times involved. The regional planning councils in Florida have been helping us out. The councils in the Tampa Bay study formed a disaster preparedness committee. They called this committee meeting monthly, and they would get 40 to 60 people to attend these monthly meetings. We would go down and get updates monthly on how the study was progressing, and we would get their input on what was going into the studies--from the disaster preparedness committees, the county planners, the chiefs of police, chiefs of fire departments, the Red Cross and other interested public officials. The state of Florida now has got some funding from FEMA and other federal agencies, and they incorporated into other areas of the state. We don't have any requests or funds to do any other studies in

Florida, but we would highly recommend that funds be provided for additional hurricane evacuation studies. Money's tight, but it's needed throughout the country.

ROY HUFFMAN:

I was excited to hear Bob say that he felt there was cooperation needed, because I've felt that way for a long time. It seems to me the job of developing flood warning and evacuation plans that are effective for all of these 20,000 communities is really a big enough job for all of us. It's going to take all the resources of the federal government, and I think we can contribute significantly toward this. And I think the technical expertise that we have in our districts and divisions could make a significant contribution.

MIKE BURNHAM:

Jim, this morning, said he understood that I said in my first panel discussion that if I couldn't implement a structural measure then I would also not implement a preparedness action. And that's not what I meant to say.

I think there's one issue that keeps coming up that makes some of us kind of afraid to even look at flood preparedness actions. That primarily is that if I implement a preparedness plan, won't that take away the benefits from another major structural or nonstructural measure and make it more difficult to justify those. Again, my opinion is that I consider these things to be an interim measure; and you justify those in an interim project light until the structural or nonstructural measures are implemented for those components of emergency preparedness action that are used to enhance the structural or nonstructural permanent measures. Then of course you could justify those onward.

But I think it's an important topic that maybe needs to be addressed because many districts have shied away from looking at and recommending preparedness planning actions for that reason. They felt it attracted benefits away from other permanent measures. I view them as different types of animals. Emergency preparedness plans are temporary. They are implemented on an event-by-event basis as opposed to a permanent measure.

I think we have the tools to fairly well know how to assess the damage computation aspects of damage reductions associated with the measures. But we don't know what percent of the people will raise the structures, what percent are in contents, what percent of the people will perform temporary floodproofing actions, what percent will remove the contents. I think we'll probably only get those types of insights--and they vary with each particular study--by doing quite a bit of field reconnaissance and interviews of people on how they responded to local agencies and the people in the field.

One other thing which I would like to stress and which was talked about by Bob and by Jim, I think, is that too often we concentrate on the flood warning system. The payoff is the response--how do the people respond? That's what we're really after. If the warning enables us to respond in a way that we desire, that's good.

And I think when we do that--if you use that as your focal point, you're going to be right involved with the local agencies of the area. The response is primarily a function of how the local agencies deal with that problem to get people to react.

I think that primary person that you'll deal with is probably the emergency operation person or the emergency operation center, and usually that's a county basis. So it's going to take a lot of coordination and cooperation and involvement with not only state agencies, National Weather Service, and other agencies, but it's going to take a lot of coordination with the local agencies.

Comment: I think it's an important aspect of this business that the way the Weather Service sees these things, and the way that you all find them if you get involved in local systems, is that you really can't do this without the involvement of the people. And often we find that if you get people involved in the development of a warning system, they become much more aware of the flood hazard, and therefore they are much more motivated to do something in the way of the protection of their own property, the implementation of other kinds of nonstructural measures. On the matter of public support, it's awareness that generates public support, and I think it may well benefit for even structural measures down the road.

JAMES OWEN:

I'd like to direct my comments to the state role in warning and preparedness because it is one that is not very well defined yet. I mentioned during my presentation that there were some 15 or 16 states that had activities underway. These range from very slight activities to some rather substantial ones. Some, like Arizona and California, have programs that emphasize state participation in actually collecting the data and making flood forecasts. And I understand that Connecticut may be going this route. Some other states are participating and they are involving local government, but the emphasis, again, is on the collection of the data, the formulation of the forecasts, and there doesn't seem to be as much effort in the development of a comprehensive preparedness plan to take advantage of those learnings. The third category, of course, is those states--and there are always some--that encourage it because they say it'll be nice to have this, but they're really not providing any money or technical assistance to help it go. They're interested, they're encouraging it, but not much is happening.

In all but a few states, the development and operation of the local flood warning systems that now exist has tended very much to be a federal-local program with almost no state participation. I think this is very unfortunate. The state role has simply not been thought through very clearly as to what the alternatives might be. FEMA, when it was organized, split away from the National Weather Service the federal responsibility of the flood preparedness plan. The Weather Service is left with the expensive part of making the investment. The states could help bridge this gap at the federal level, and they could help see that the local programs when they're developed have the proper amounts of attention both FEMA, the NWS, and other agencies.

Secondly, along the same line, the content and quality of warning and preparedness plans vary a great deal according to the skills, the interest, the participants, the money available, and other factors. We lack, so far as I know, any explicit criteria on what ought to be included in a comprehensive warning and preparedness plan, the level of detail with which it ought to be prepared. There is no uniform level of practice. Here's an area which is wide open for states to provide some leadership to the federal agencies and say what they want and what they think ought to be included in the plan and what they expect in terms of quality when the work is done.

Third, not much attention has been given to the interrelationship between individual local flood warning and preparedness programs, and that is a lot like building levees without looking at the upstream or downstream effect. States are in a perfect position to do some framework-level planning as to how these individual systems will eventually grow into some kind of coordinated whole. At least one state, Maryland, is planning to explore this broader state role based on the availability of money. But I'm not aware of any other states which have done or are planning to do it.

I'd like to suggest this one other item. The St. Paul District recently undertook an effort to ask states in their area what it was the states wanted in the way of products and services related to flood warning and preparedness the Corps might provide. I think this is an excellent thing to do. I've never been involved with districts giving consideration to doing this. In the St. Paul District, I think it's basically a matter of asking the question. States may not be very well prepared to respond just off the cuff to that kind of question. It seems like it would be appropriate for IWR, or HEC, to perhaps sit down and give some thought to appropriate state roles and develop some alternatives and have something to suggest to states and then go to them and ask how the Corps might be of service. I think this could be a real step forward.

DISCUSSION FOLLOWING CARNAHAN ADDRESS

WILLIAM HOLLIDAY:

I'd like to know if we could be a little bit more specific about what the National Weather Service's authority is. For example, if the Corps of Engineers completes a study and determines that a warning system is an essential component, should we then recommend to Congress that Congress authorize the Corps of Engineers to install it? Or should we recommend that Congress authorize the weather Service to install it? I understand you don't have money, but it's not clear what your authority is.

ROBERT CARNAHAN:

The Weather Service's role is observations and forecasts. The Weather Service has no desire to get into the design or installation of systems. As a matter of fact, in almost all of the cases where we have local systems, those systems have been designed, often, with some Weather Service oversight or some technical guidance, but very often with the local community, or the state, or the county, or whatever, doing primarily the design.

In the case of the system in the central Appalachians, that design has been done in some cases by the Communications Division of the National Weather Service and in about as many cases by contracts. That's a peculiar circumstance in which money was specifically appropriated for that purpose. The Weather Service does not have money appropriated for that purpose anywhere else. So, in any other circumstance, it would be up to the local community to decide what they wanted to do. The truth of the matter is, the Weather Service doesn't have the engineers on the communications capability to do all of this sort of work. The Weather Service has no desire to covet the role at all. What we really like to do is see those systems come into existence, because what we need is the data.

JAMES E. GODDARD:

To further Bob Carnahan's comment, for the last 10 years I've been among those who have encouraged the Corps. I think the Corps or any others planning projects should actually take advantage of all other agencies insofar as the consideration of whether or not there is a viable warning system. I think that the Weather Service is supposed to cooperate with a Corps office or any other federal office in giving advice. I'm sure they have some funding for that. I'm sure if you asked them for consultation you would get it.

I would like to comment on another matter as well. This morning Brian Moore commented on the nonstructural measures. Maybe the actions that are going to be required are not Corps actions but local actions. Therefore you have to reach those people. Both Jim Owen's and Bob Carnahan's presentations have brought that out. How do we reach those people and get them to act? We need to devote some thought to that. To come up with a plan is one thing; for it to end up on the shelf, unused, is another. What we want to do is get warning systems implemented, and the means is successful working with nonfederal people.

CARNAHAN:

Jim, That's important. Bill Donovan mentioned earlier that at least half my career was in the private sector, and I was involved in a lot of planning and a lot of contact with communities. Believe me that's not always a pleasure. You never quite know how people in a community are going to react. It's a drag to get out to night meetings. Larry Larson knows about this, I'll bet. But nevertheless it pays off because you gain, therefore, local people who have had some role in the development of these plans and feel as though they own it a little bit more. You're much more likely to get implementation when you have the people involved in the planning process. Involvement of the public is an important issue.

FRANK INCAPRERA:

I just want to mention the issue that came up with Hurricane Allen along the Texas coast. If we do come up with a preparedness plan and put our name on it, it had better be in such detail that is operational. I hope we won't make a mistake in that respect. We should be aware that it takes a great deal of money to achieve such sound detail.

State and local civil defense people evacuated the Texas coast from Port Arthur to Corpus Christi. They got everyone out of their houses and on the highways but nothing worked very well beyond that step. The residents of the coast have said they won't leave their homes at the next warning. Lesson: If we do these plans, we must really know what we're doing and plan thoroughly.

RONALD HILTON:

That's a real problem we're faced with in Jacksonville, too. Much of Miami Beach was evacuated for Hurricane David, a couple of years ago. A real hurricane didn't develop, but many think they've been through one and say they won't leave next time. So the county is going into a public information campaign, with the meteorologists of local TV stations trying to impress upon the people that they need to do what their civil defense director tells them to do. It is a real problem. We've developed these plans but don't really know how they're going to work until we have a real hurricane.

CARNAHAN:

I'd like to add something. Ron knows Neil Frank of the National Hurricane Center, and he mentioned the problem of the amount of warning that Neil feels he can give to a community and how long it takes to evacuate.

It's clear from what Ron said that, in the many communities where it takes longer to evacuate, Neil feels he can give an adequate warning. So what kind of a dilemma does this put someone in who has the responsibility of calling that warning? Either he puts out a warning prematurely and runs the risk of unnecessary evacuation and subsequent disbelief, or he waits until he's pretty sure and these people aren't left with enough time to get out. This is faced all the time. In the case of Hurricane Allen, Frank, that was such a severe storm that I don't believe there are really any regrets.

INCAPRERA:

I think if you can give them the information, and get the public aware of what's going on, give them the whole package, let them know in advance what's going on -- that they are going to have these problems, it is helpful.

DENNIS PARKER:

I'm very interested in what Jim Goddard had to say about implementation difficulties, because in London we have a particular tidal surge flood problem, which now should be alleviated considerably because of the barrier barrier scheme -- the tidal exclusion scheme -- which has just been installed last week, in fact. But prior to that there had been a flood warning dissemination system. There was a publicity campaign associated with this flood warning system. This consisted of TV advertisements before flood season, extensive education of residents, commercial properties, and so on. Officers went out explaining what to do in the case of an emergency.

Evaluation was done of the effectiveness of that information and public education campaign. What resulted was that 95 percent of the people who were interviewed would, in fact, have taken the wrong actions. Only five percent would have taken the right actions on receiving the flood warning. That sort of negative finding is very worrying. I wonder from that experience to what extent we really recognize the difficulties of implementation, the difficulties of getting these messages and instructions across to people in these public education campaigns.

I'd be interested to hear of any instances in America where it has been shown that certain types of publicity are very effective and certain other types not effective.

CARNAHAN:

I can say something from the Weather Service point of view. There have been a lot of studies done within the last few years relative to sociologically observed human behavior as to what happens when the public is warned. One of the things that has been discovered is that people do require reinforcements of a warning in order to take action. They need to know they are personally at risk. They need to be kept constantly updated on what is happening. They will react as a family very often; they'll reach a family decision which even includes relatives beyond the nucleus group. There has been a fair amount done as for the effectiveness of publications, too. It has been found that leaflets and brochures and things like that are not very effective. Radio and TV spots are more effective. Personal communication is more effective than the "spots."

HILTON:

In the Tampa Bay region study prior to this hurricane season, they created a mock exercise using the plan that was developed. The National Hurricane Center actually tracked a hurricane and the forecasters of the region were getting readings on this mock hurricane. The public television station made its time available for that day to give information to the people.

They had a mass casualty drill where they let some students in the local schools off for the day if they would volunteer to go act as if injured. They were transported from Tampa Stadium to local hospitals to see how that worked. They evacuated nursing homes in the St. Petersburg area. They actually brought the county commissioners together and had them make a decision after actually conferring with the governor of Florida. They learned from their mistakes in all these efforts on the exercise.

H. JAMES OWEN:

(Supplemental comment to General Gay after Seminar)

As noted by Mr. Carnahan, the cost for a flood warning system can be as small as a few hundred dollars. However, it can also be several tens of thousands of dollars for an automated system employing state-of-the-art technology. The cost of preparedness plans can likewise vary widely, from practically nothing in the case of a simple evacuation provisions for floodfighting, emergency management of utilities, temporary relocation of property, and other damage-reducing actions. This flexibility makes it possible to design warning and preparedness plans that fall into the feasible area at all points along the curve shown in Mr. Johnson's first figure, supporting his suggestion that warning and preparedness should be included in every plan.

The information presented during the seminar concerning benefits of flood warning and preparedness warrants some clarification. The chart shown by Mr. Carnahan suggested that damage reduction in the range of 10 percent was possible with warning lead times of several hours. Yet, each specific case discussed indicated a far higher percent-age of damage reduction, as much as 90 percent in the case of the Sprout-Waldron manufacturing plant. One reason for the difference is that the chart shown by Mr. Carnahan reflects damage reduction due simply to the availability of a warning. The specific cases cited reflect the additional effect of preparedness planning, illustrating the importance of incorporating such planning in all alternatives that involve warning. Also, even higher benefits can be expected as the public in an area becomes familiar with the existence of a flood warning system and gains confidence in its accuracy and reliability. Case studies of a few communities suggest that the response to warnings almost doubled the second time their system was used.

Several points about warning and preparedness alternatives did not receive any explicit attention during discussions. One that is important concerns the fact that warning systems are designed to detect the smallest flood of interest and provide protection against all larger floods at no additional cost. This feature makes warning and preparedness one of the few measures able to cope at a reasonable cost with the possibility of catastrophic levels of flooding.

Warning and preparedness measures are compatible with most other measures and are an essential supplement to some, such as floodproofing. It might also be noted in this respect that a commitment has already been made to prepare emergency plans for dams, which is a special application of warning and preparedness concepts. Warnings and preparedness could be used as well for

levees, elevation in place, floodproofing, and other measures subject to failure or limited by economics or other factors in the level of protection that they provide.

Warning and preparedness measures also have other advantages that commend their use. In addition to their low financial cost, they cause few or not adverse social or environmental impacts, take no land from the tax rolls, and require no relocation of people or activities. While improperly designed warning and preparedness programs may prove inadequate, their failure does not cause the catastrophic losses associated with failure of a dam or levee.

FLOODPLAIN REGULATION

LAW AND VALUES IN FLOODPLAIN REGULATION

By  
Jon Kusler  
Attorney and Water Resources Management Consultant

I have three topics on which I would like to share perceptions with you. I am not going to do it in the same order that is in your agenda, but I hope to get to the ones in the agenda by the end.

Over the last year I have been working with some other attorneys. We have been doing workshops around the country for local government officials and for attorneys, and we've been with probably about 1100 or 1200 attorneys and local government officials in just about every area of the country. It has been a very interesting experience for me because it is always a learning experience when you have people coming in asking you questions and saying what concerns them and saying where they think things should be going.

I think the "bottom line," as they say, on this workshop is where the Corps is going. So as I go through these three questions, I would like you to keep that bottom line in mind, and I would like to feed back to you some of what we found around the country and what we found attorneys and courts were concerned about.

The three points concern why communities and states are interested in nonstructural approaches right now, and always a question is what will happen two years from now or five years from now. The second is what are the courts saying, what are the issues, what kind of litigation do we have in the last decade. Third, how does that relate to the Corps' programs?

In terms of doing our workshops around the country, there are half a dozen reasons why there is a very strong interest in nonstructural approaches. It is very interesting to do workshops now and, having done workshops ten years ago, see the differences. I think many of the reasons they are interested in nonstructural have to do with money. All of you are very familiar with that problem. If you don't have new starts on dams, if you have a federal policy of cost sharing, if you have a federal policy of full cost recovery, I wonder how many of you working out there with communities feel that you would still have a job if the full cost recovery idea were continued for flood control works over a period of years. I wonder how many new structures would really be constructed with a 25 percent cost share if it were some kind of hard, up-front money.

I think the point, though, is--and I am not attacking the cost sharing policies; we have an administration that is very cost conscious--if it is not just reflecting a broader concern with the federal government, with where our dollars have been going. I am wondering to what extent that is going to get turned around. It may get fine-tuned; it may get adjusted over the next three or four years.

I think this is pretty important to the Corps, if the Corps has a service to offer to the public and if the Corps wants a role. Is it going to be doing projects? What kind of projects is it going to be doing? Something other than projects? But the big concern around the country is reduced federal dollars. The states don't have any money and a lot of the communities don't have any money. What is the other side of having no money? You have got costs if you occupy the floodplain. Here is the second of the issues that I was supposed to address and that is the off-site cost, the externalities. A few years ago, let's say 30 years ago, the off-site costs of floodplain occupants were not, I think, nearly as well appreciated as they are today. Now we have flood maps. In law, many years ago, the concept of the act of God was something that you couldn't foresee or that you couldn't predict. Well, now we have got all kinds of people predicting these things, with flood warning systems, flood maps, and so forth.

With the increased predictive capability, we have all sorts of liability issues. Probably the number one issue that comes up now if you talk with attorneys and local government officials is liability. We did a workshop with about 85 community people down in Knoxville two weeks ago; we went around the room just to see what questions people would have. For 42 questions, 24 of those had to do with liability. Is local government liable if they put in a flood control structure that doesn't work, doesn't provide enough protection? Are they liable if they mark an area in the flood height--if they put a marker up saying floods are going to come this high and somebody gets flooded by a larger event? Then there is liability for storm drainage, liability for issuing a permit, liability for not issuing a permit, liability for flood insurance, liability for not getting flood insurance, and endlessly onward.

This has to do with what has happened in the last 20 years or so in the courts. You suddenly have the ability, if you are a private landowner, to sue the local government for a lot of things you couldn't sue them for some years ago. So you have not only the fact that there are no bucks to deal with the kind of costs that are incurred with floodplain occupants and the fact that these costs are to some extent predictable now, and they weren't, but you have local government officials, landowners, and so forth concerned about the liability that may result from occupation of the floodplain.

There is a lot of talk about the environment, that it is not such a high priority. What turns out is that environment is not such a high priority in bad times; but in bad times, nobody has any dollars to do structural works. In bad times there is no development. And if times get better, I can absolutely guarantee you that the concern for environmental values will also return to a greater extent. You start seeing that right away as soon as construction starts. The difference between now and 20 years ago is that a lot of people are interested in and aware of floodplain natural values.

For example, one of the things that we have been getting fed back to us: The administration has been cutting back bucks for sewage treatment facilities. You are all familiar with what is happening with tertiary treatment requirements. Well, there is a lot of evidence in recent years that wetlands played a very important role in terms of water quality protection. People are looking to the next 15 to 20 years to how they are going to have

water supply and how they are going to have clean water. So then they say, "If we destroy the wetlands, and they are important, how are we going to get water supply? I think the question for you is which of these things are they going to turn around with another administration, with this administration. Which of these things are going to be here for the next decade in terms of basic problems with liability and problems with scarce dollars and concern about environmental values.

There are certainly now a lot more incentives. In terms of the incentives of the flood insurance program with 17,000 communities that says you are supposed to do something, look at cost. Some years ago, there were no maps, there were no ordinances, there was no literature, there was no 1362 Program. You had not had Prairie du Chien. You had not had examples that have come to the public attention--Soldiers Grove, etc.--which act as sort of models and raise awareness. And then, of course, there is a whole series of state requirements which Larry Larson will talk about. You have 31 states that have said to communities, "You had better regulate the floodplain or we will." So you have a whole series of forces at work right now that are moving toward looking at the full range of techniques for managing floodplain areas.

Everywhere you go, it used to be people were concerned about the flooding of the Mississippi River, or the big flooding. Now there is a great awareness of the fact that you are getting serious flood damages for very small streams, and that becomes of great interest to the community because they are liable for a lot of the stuff and they weren't liable 20 years ago. What have the courts been saying? Most people think of the courts in terms of regulations. I will get to regulations in a moment. But there are 10 lawsuits between private landowners right now, or between a buyer and seller, or between a landowner and a local government, or between a landowner and the federal government. There are probably 10 of those based on some liability issue for every one there is concerning regulation. It is a startling fact that the big issue is cost, off-site costs and who is going to bear those costs.

I was out in Marin County right after we did a seminar in San Francisco this spring. I was in Marin County right after the mud slides and the flooding that occurred in January. We had their attorney come and speak, and at that time they had \$300 million worth of suits against Marin County. I think it is up to about \$450 million now. He made a very interesting remark. He said that the reason that we have got \$300 million worth of suits is because there is no flood insurance for mud slides. If people can't gain a remedy for the kinds of damages that they incur, they sue someone. If they can't get a flood control work, they sue someone, if they can't get flood insurance. The whole idea is that if you can collect from somebody, you go ahead and you don't take legal action; if you can't collect, you take legal action.

Now, why this whole liability thing becomes so important in understanding what role the Corps may play in the future is that it used to be that a community couldn't be sued under the idea of sovereign immunity. It could not be sued for very many actions; the state could not be sued for very many actions; the federal government couldn't and still can't be sued for many actions. The immunities have been much more severely limited for local

governments. If a landowner went ahead and sold his floodplain to somebody else, he could not be sued, ordinarily, unless he made misrepresentations at common law. At common law, if you had a floodplain and you put up a dike on that floodplain and it backed up water on somebody else, in many jurisdictions, at least with the common enemy doctrine and so forth, you were not liable, even if you increased flood damages.

There are some exceptions, but there are some major directions. The first thing is that we are moving both in terms of the surface water and flood flows clearly towards some kind of reasonable use concept in terms of the common law. In other words, if you substantially increase damage on other individuals, you are probably going to be held liable. That is the modification to the common law concept.

So landowners are at risk now, and in some states, like in California, they are being held absolutely liable. It doesn't matter whether you are negligent in some certain instances. In the supreme court of California, a recent suit said if you modify the flow of water and that results in damage to somebody else, it doesn't matter how careful you were. You are liable. You could imagine: You have got a hillside like this, and this guy has obviously prepared his site, and there is this one, and this one, and so forth down the hill. You get a nice flow of water down there, and you can imagine what a field day it is for lawyers suing one another all the way up the hill. The point is that we are dealing with a rapidly evolving area of liability between landowners.

How about local governments? It used to be local governments could not be sued over storm water problems, within some limits, because this was a sovereign capacity when they were doing flood control and so forth. It is no longer true. You find around the country that attorneys are advising their communities: not to get into flood control works because if they get into flood control works and if they are not done correctly (I am talking about community flood control works; federal government is still pretty immune), the communities are being socked with damage suits. They are being socked with suits for inadequate storm water drainage; they are being sued for issuing permits.

For example, a community goes ahead a permits and subdivision, and that subdivision results in flooding downstream. There are 15,000 suits alone under something called Section 1983 of the Civil Rights Act, people suing because they claim, for example, that the community permitted a subdivision to come in, the subdivision increased the runoff, and the runoff damaged their land, so they sue the community for taking their property.

So we have this whole evolving area of municipal liability. We have liability on the part of the banks. We've had six district court cases, two of which have held banks not liable for failing to disclose flood hazards. These were communities where the flood insurance program held that the banks were liable for failing to disclose to sellers that the area was in a designated floodplain. That looks like it will go to the U.S. Supreme Court because we have conflicting court appeal decisions. The point is the externalities, the risk of building, of using, of doing flood control work and

so forth in the floodplain. People who occupy are being held increasingly responsible for the costs that incur to other people.

The second area is what has been happening with regulations. Should you have an interest in finding out about floodplain regulations very up to date, this just came out: Regulation of Flood Hazard Areas, Volume 3. I worked with other people in doing Volumes 1 and 2 back in the late 1960s early 1970s. This is the update. This is just available from the University of Colorado Hazards Center; it is going to be published by GPO. It has a chapter which summarizes what the courts have been saying from 1970 through 1981. It was really quite a fascinating task for me to go back after a decade and look at--fortunately, with the support of the Water Resources Council, now defunct, and its member agencies--what had happened in a decade, what kind of progress we made, what kind of problems we had, what happened in the courts.

There have been a lot of cases. We are talking about 60 either state supreme courts or appellate cases--more cases in the last decade, as you would figure with all the regulations, by a factor of two than there had been up to 1970.

What have the courts been saying? You can generalize, and you can get a lot more detail than anything I have to say by looking at this report. They have been absolutely supportive of floodplain regulations. There is not a single case where the court has disagreed with the basic concept of floodplain regulations and need for floodplain regulations. There have been a couple of decisions where they have now found a sufficient factual base for denial of a permit or they found an action of a community to be unreasonable, but the support has been overwhelming in terms of the general validity of the regulations.

I would like to briefly review the law on a couple of subjects that I thought might be of interest particularly to you people. What have the courts said about maps? In terms of the tests that courts apply, they look first to see if regulations are valid in the general sense. In other words, is the ordinance that a community adopts valid? As I just said, the courts have not struck down any floodplain ordinance in the last decade. We are talking about 60 decisions. It may have occurred at the lowest level, but not in any of the appellate decisions. So the second level of looking at the validity of regulations has to do with are the regulations valid as applied to particular property. You can have regulations, as you know, valid in general but not valid as applied to a particular piece of land. That is the way the courts look at floodplain regulations. In looking at the validity of regulations, they apply a series of tests. They look to see if the regulations are adopted for valid objectives. They look to see if they are reasonable, whether they have an adequate factual base. They look to see if the regulations are discriminatory, whether they have been adopted in compliance with proper procedures. They look to see if the regulations take property.

In terms of some of the issues that pertain to you, what have they been saying about maps? This is a terrifically controversial subject at the local level. Everybody always comes in and says that the maps are no good, that we have got to have maps at the scale of one inch equals 200 feet or something

like this, and that they have got to be super accurate. Regulations have fared very well with regard to maps. There is one court case--and there are 17,000 communities with regulations--in which regulations were struck down for inadequate maps. Now I don't necessarily agree with that conclusion, but the courts, in a 1972 Michigan decision, found that there was not evidence of flooding.

FEMA has been doing very well. They have had about 10 or 11 cases of district court decisions on their maps, and they have been winning them, probably because of the unique features of the FEMA statutes, which give everybody in the field procedure and a time limit. They have been winning them basically on the landowners not having followed the proper procedures to contest the maps. But they have been winning them all. It does not mean that one could get by with very inaccurate maps, particularly looking at the future.

What courts have also been saying, and it is interesting, is that they become less concerned about the taking issue in the general validity of regulations. They tend to become more sophisticated in looking at the impact of regulations on particular property owners and whether they are justified, whether they are fair. Here is where the data base becomes increasingly important, and we have had a number of decisions where courts have warned. Take the Maryland decision, where the court actually struck down a flood determination at a particular point because there had been a flood event after the determination; in other words, the floodplain elevation had been set. This flood event indicated that there really should have been a re-evaluation of the 100-year elevation or the 50-year elevation at that point. So the courts said, go back and recompute the thing because of the fact that you have some new data that should be included.

That doesn't mean that every map has to be redone every time there is some new flood information. But you can say that the courts on one hand have been upholding the general validity of maps; on the other hand, they are becoming increasingly sensitive to the factual base and they are, of course, aware of the fact that techniques have improved in terms of doing prediction, of modeling flooding. It relates to a future role for the Corps, I think.

They also, by the way, sustained the kind of procedure that is usually followed by communities, and that is that there is a map, but then there is a refinement procedure built in the ordinance that says if you think you have been wronged, if you come in with data to show that these maps are inaccurate, we will send somebody to help you find out. Courts have agreed with that kind of refinement procedure even though the maps themselves initially had inaccuracies.

In terms of the 100 year standard, it has been contested in a number of cases. Every time it has come up, it has been sustained and, significantly, there have been about 35 cases in addition to these that I have just mentioned on the flood insurance program. Most of the cases on the flood insurance program have dealt with relatively specific issues like whether the federal government should pay for a particular kind of damage in a particular circumstance. In one really important case for the flood insurance program,

about 30 landowners and 40 communities attacked the basic constitutionality of the program. The district court here in Columbia said it was valid, and they described it as a benefit program and therefore you couldn't complain if you didn't get the benefit. But the overall standard of the flood insurance program, the 100 year standard, has been sustained in a number of community ordinances as well as state. There has been no real problem with that in the courts.

In terms of discrimination, do you have to map all areas at once? Do you have to regulate everything to the same standard? There have been no regulations struck down in the last decade as being discriminatory because of the fact that you have regulated some areas and not regulated others. The courts have said you can strike the evil where it is most firmly felt. So in terms of the broad discrimination, similarly, there have been no cases that have struck down regulations for applying more strenuous standards for new uses and not regulating existing uses stringently.

In terms of the objectives for regulation, courts have overwhelmingly endorsed the protection of public safety. In getting back to that second question for me, which was externalities, whenever the Corps finds any kind of real externalities, what you are trying to do is prevent one landowner from beating up on another landowner; in other words, putting in a dike or a levee so that it will force water over onto another land. The courts say that a man can't make a nuisance of himself when it's an eminently proper exercise of police power. They have very strongly sustained the prevention of nuisances. They have sustained the prevention of increases in flood heights. All of the floodway regulations that have been litigated, the court has not had any problem with. They have had a little more of a problem in doing very restrictive regulations in flood fringe areas, but no problem with floodway regulations because they are linked to this prevention of one landowner damaging another in a cooperative sense.

There have been some problems with trying to zone lands for open space to reduce future condemnation costs. If a community or the Corps of Engineers or anybody is going to acquire land later for a flood control structure or for recreation, it can probably regulate and even keep all structures out if there is an independent factual basis for that regulation. In other words, if this is a floodway, and it really is a severe flood hazard area, you can regulate on that basis. You want to be very careful not to say the reason you want to regulate is because you want to reduce future condemnation costs. The courts have gotten very sensitive on this point, including the U.S. Supreme Court in a case I will not go into in depth, but that is one objective that courts have been reluctant to sustain.

Turn to the taking issue. Everybody wants to know if the regulations take property. About 35 of those cases had to do with the issue of whether the regulations took property. In only two cases was there a taking found; they were lower court decisions early on in the decade. The regulations have fared extremely well against taking challenges. I won't get into the theories of why the regulations have been sustained so well, except to say that the diminution of value has not been applied. A series of tests in court apply. The diminution of value test does not apply with any kind of rigor. Courts have sustained very substantial reductions in values.

The ultimate test applied by the courts these days is does a man have any reasonable practical use left for his land. That is really the bottom line. In general, courts say that a regulation is a taking if there is no reasonable or practical use left. They say that it is not a taking if there are reasonable or practical uses. What kinds of uses are practical in a floodplain? Back in 1972 and in 1971 when I worked on Volume 2, looking at those cases I would have said that open space zoning to the flood fringe would not have been considered to be held valid. But we have a bunch of cases in which our flood fringe areas were zoned for open space and the courts have said that agriculture, forestry, and recreation uses were practical. What they look at in a highly specific sense is what did the guy pay for taxes; what did he pay for the land. Has he actually had some use of the land? Has there been a rent on the land? They tend not to be looking so much at speculative value.

That gets into this whole first question, and that is, "Do floodplain regulations reduce values?" In some instances, particularly where you permit development, do you allow it to be elevated? A lot of studies have been done. You people have done studies that indicate that the cost does increase somewhat and maybe the value of the land does decrease somewhat. When you are talking about prohibiting all development, I don't think there is any question that the regulations reduce the value of the property and reduce it substantially. But courts tend to get, these days, quite analytical with regard to where the value comes from. Is the value there because of the fact that there are public rights in navigable waters, and does the landowner have a right to those rights? Does the value come from the fact that the federal government is subsidizing the floodplain development?

The courts have gotten, should I say, very cynical about speculative value. (I won't say that in every case.) They tend to look at some factors that I think are very important in maybe looking at long-term roles for the Corps. They tend to look at what is the impact of regulations on an entire piece of property, not just on the floodplain aspect. In the whole series of decisions--and some of you have been working with 404 as well as maybe with floodplain--the courts have been almost universally supportive of the 404 program, and you wouldn't have predicted that 10 years ago.

In Florida, we have these big chunks of land. A developer tries to develop that; he's got 5000 acres, and maybe 1000 or 500 acres are upland and the rest of it is mangrove. The courts are saying, "Okay. Cluster some development on the upland. We are not going to look at just that area that you want us to look at; we are going to look at whether you have some practical use for the whole property."

Courts have gone beyond that and said you have to have practical use, and if the use is really dangerous, it is not really practical. If a guy wants to put up a use in an area and it is going to get knocked down next year by flooding, some court cases say there is a reasonable use. They say that any use that is going to damage anybody else is not a reasonable use, that no man has the right to make a nuisance of himself.

I will turn to some concluding remarks about what I see as meaningful to the Corps. I don't mean this as a smart remark, but I think that you people in the Corps feel that it is an agency that should play a useful function in the future and should keep in existence because it is going to keep funded. If anybody takes seriously cost-sharing requirements and so forth, I think, in a very practical sense, the Corps is going to have to work with a whole range of alternatives, nonstructural stuff, maybe even 404 and so forth. Because if we really take seriously cost-sharing requirements, there aren't going to be an awful lot of flood control structures. That is a personal opinion. You wander around the country; maybe you have a different perception than I do.

I don't see this route getting quickly reversed. Whether you are Carter or Reagan or anybody else we are talking about federal bucks and federal expenditures and how much it costs for concrete and for staff. So it seems to me that the Corps (and I have worked with George Phippen and others), as an agency, has terrific technical expertise as well as history.

The one issue is that you keep yourself alive; the other is that you really serve a useful function in the world. I think there is a very useful function, including structural works in some instances. This seminar is not antistructural. Looking at these 17,000 community programs around the country as well as the state programs. If the Corps wants to better serve state, local, and other agencies, I would pitch special study maps. We reach a certain point in the whole flood insurance program where, in the kinds of gross mapping for certain kinds of special areas like alluvial fans, mud flows, coastal erosion areas, and so forth, we just have to get into more sophisticated maps. I would hope the Corps might play a large role in that. I don't have great confidence in some of the contract work. The second function I would pitch is technical services, much of what you have been doing but perhaps a little bit different. But the final thing, and something that you were working with some years ago and have been working with, is helping communities with floodplain management plans. I would hope that that might be revitalized again because I see there a lot of the action in the next four or five years. Cost sharing is going to have to be tailored to community and state needs; they are not going to cost share unless it is tailored to needs. It means you have got to work with them. That is the bottom line.

PANEL IV, FOLLOWING KUSLER ADDRESS

BILL SINOVICH:

Some of the questions--since, John you're an attorney--some discussion I'd like to get into a little later is on the liabilities that may be attached to federally authorized projects. For instance, in Huntington, West Virginia, there is an authorized project in the famous Tug Fork valley. A lot of people have heard about that, I'm sure. And one of the major components of the total plan for development is nonstructural. It's either floodproofing, moving, relocating--the whole bit; and the business of liability associated with that particular project is, if we move people out and say you're in a flood-free area now and they get flooded, who's liable?

And also it seems the floodplain regulations in some instances are regulations of convenience. By that I mean there's some evidence that people will adopt regulations in order to take advantage of some federal programs but then once they get the program they would like to have, they don't really enforce the regulations very well. And of course that ties in with the other section here on land values. Obviously in an area of very tough, rugged topography, you have no flood-free lands, you have no flat land so to speak. You hate to regulate yourself out of business. I think in lots of cases that's what people are afraid of--that it will affect their land values and so forth, so they are very hesitant. Of course this effect is long range in their view, and, as I say, in some cases they seem to adopt and then quickly forget about it.

Larry, do you have some thoughts?

LARRY LARSON:

Yes, I'd like to key in briefly on one that is about the adequacy of regulation. I think that we all tend to take a look at the federal regulations that are mostly brought up through the NFIP, the insurance program, as being the base regulations. And in fact what we tend to apply to all this--and I think even that is not adequate--is that we ought to be looking toward perhaps either changing national standards to make them more effective or being aware that there are more stringent regulations at some of the state and local levels. Surely I don't think the national standards are preventing all future development. Furthermore, I don't think they're acting as a "disincentive," so people understand the need to act on mitigation.

John mentioned 31 of the states are regulating. I think a number of those are more stringent; for example, a number of the states have a zero rise floodway. Whenever you're working in one of those states, you ought to be well aware of that because you'll be at cross purposes if you don't. Some states have a free board for first-floor elevation that the federal standard does not have, two feet for example. Some states have regulations where they might require real estate agents, for example, to notify property owners of the flood hazard when they purchase property, or else they are subject to having the property turned back to them along with a fine.

I think the key to many of those going beyond the basic federal regulations is a good information and education program which helps locals understand the advantages to them of doing that versus just complying with some of the basic minimum federal regulations.

LEONARD RATUSHEWITZ:

I'd like to address the matter of floodplain regulations from the point of view of the Plan Formulation Branch in the North Atlantic Division, which of course covers a highly urbanized area. Naturally we could say we consider floodplain regulations along with the other nonstructural alternatives as a full-fledged alternative. The fact of the matter is that it appears to play a very limited role in the plan formulation process, ordinarily being one of the alternatives that gets dropped out early in the report. Then we wind up incorporating floodplain regulation only as a halfhearted item with local cooperation which is worded something like, "Publicize floodplain information to provide leadership," and so forth and so on.

Perhaps we deal on a limited basis with floodplain regulation because we are in a very developed area in NAD, and it may just be too late in most areas for floodplain regulation to have as much of an effect as it would in more undeveloped areas. However, in most cases where areas are undeveloped, the problem may be seen in regulation of land--government interference with local land-use planning and decision making, or difficulty in demonstrating that we have an economical floodplain regulation alternative.

From a conceptual understanding point of view, there still seems to be a problem of breaking away from the artificial separation that seems to exist between regulation as an alternative and the conventional structural floodplain measures. Floodplain regulation is not as glamorous. It's a rather passive means of flood protection, and in the view of many people it seems to hold up process. And also it might mean that if we could only define the NED aspects of floodplain regulation in more definitive terms, we might be able to show that it would be a viable undertaking in many floodplain areas. Because we never seem to have it identified in NED terms which are our guiding rules at the present time, it's very difficult to generate any attention to it. And as soon as we show that there's any possibility of a feasible structural floodplain alternative, we lose any kind of local interest we may have had in floodplain regulation or any other nonstructural measure.

So therefore we need to be able to define floodplain regulation more in terms of any deterrent, in terms of benefits and costs, and possibly identify optimum plans which may exist in a certain damage area. If we could somehow refine the analysis process so that we might be able to say to a community, "Here's a project with a levee exactly n-feet high and a channel 50 feet wide; however, there's a certain area here that's not being developed, and the optimum floodway for that would accommodate the 75 or 100-year flood." Something like that, so we have a specific point of communication with local people. Of course it would be very difficult to identify the benefits of floodplain regulation, but this is one of the areas which should be subjected to some consideration.

I would like to point out that although we seem to be getting into many of the technical areas of nonstructural alternative (We've gone very deeply into regulation and legal aspects thereof; we've gone into a lot of material on floodplain warning systems, I think the key to the implementation of nonstructural alternatives is formulation. We don't seem to be hearing enough of that. It's the formulation process that leads to the recommendations of the Corps to implement something. I think that's a significant point, since the subject title of this conference does stress the word "implementation." And implementation comes out of a report that recommends congressional action.

Some of the things we need to reiterate again and again are ways to measure benefits and costs in NED terms. It might be good to have some case studies to show the viability of floodplain regulation as a truly effective device. Maybe one option might be--if a local community does accept floodplain regulation as an alternative--to possibly reduce local cost sharing requirements as sort of an R&D effort to see how some of them really function in the field. We also might want, on a Corps wide basis, to identify several highly favorable potential situations which could actually result in a floodplain regulation alternative and maybe throw some funds in that direction, again sort of like an R&D effort.

There ought to be some specific guidance to enable the divisions and districts to be able to effectively deal with floodplain regulation. I think the better the tools given to us by higher authority, the better able we are to actually translate these problems into effective nonstructural solutions. We recommend the use of field people especially in districts in developing any guidance that may be developed for nonstructural planning, because this would lend a certain degree of practicality to the planning development and guidance. So that's extremely important. Oftentimes, the perception on the part of the field is that we have a lot of people in Washington who seem to be doing a lot of academic studies which never really fit that well into the actual solution to the problem in the field. Somebody mentioned several instances where nonstructural alternatives have been pursued rather effectively. I think it might be a good idea to somehow see to it that, Corps-wide, people are informed of these success stories, allow those reports and other information relative to those reports to be adequately disseminated among the people who might have good use for them.

That's about all I have, but I just want to emphasize that we ought to be addressing nonstructural implementation as a result of plan formulation, not of structural but of flood control measures.

DISCUSSION FOLLOWING KUSLER ADDRESS

TONY LANIER:

Is there any precedent for taking property for the public good without compensation? This has come up several times in Florida, where they considered doing that.

JON KUSLER:

Could you give me a specific idea of what one would be trying to do to the property that would constitute taking?

LANIER:

A piece of property that's flooded every year for a good portion of the year, and someone had bought it for speculative purpose, sight unseen, and yet the owner doesn't want the government to take the land without compensation, although it has historically been flooded every year and will continue to be. The federal government or state could use it as part of a flood control project. The state's position is that if the owner bought a bad piece of land speculatively, the state isn't at fault or obligated by his action. So the state can condemn and take without paying the owner.

KUSLER:

Maybe I don't understand the facts well enough. The rule is, if someone has title to property, you can't take away the title without compensating them in some way. That's universal. The qualification on that is a lot of the low-lying area in the country (including that in Florida) is bought and used but not actually owned. It's like the bottoms of lakes in Wisconsin or marshes along the coast. They have an interest, in that they own the upland and have riparian rights. They may think they've owned it since the year 1750, but in many instances they haven't actually owned, especially below the mean high water. That latter is in public ownership.

There's a public trust concept in the states. You have a unique situation in Louisiana, for example, where the constitution says that communities and state can place flood control works on private property without compensation because the owner bought the land under that constitutional provision. I'm trying to answer but I suspect there are some other facts with regard to the Florida deeds. The general rule is, though, that you can't take property in the actual physical sense and use it for a flood storage reservoir, or whatever, if it is really in private ownership, without compensation.

JAMES E. GODDARD:

On the matter of liability, many of you working in FPMS units will recall that in the last 15 years I've maintained about their liability that you don't threaten the local jurisdiction if they don't take action after you've pointed out that they have a flood problem. But you can encourage them by pointing

out liabilities. Up until about eight years ago you could only find one case, near Chicago, which settled out of court. About seven years ago it came up again at Scottsdale and was settled out of court.

So it's encouraging to me to see, Jon, in your Volume III update for the Hazards Center, a source of liability documentation which you can point to in working with communities. It clearly shows them the legal trend toward greater liability for local governments. It seems that you'll be able to more effectively encourage community action in response to study-established flood risk than you could in the past.

KUSLER:

The chances of a community being held liable do decrease if it has some kind of rationally thought out, combined floodplain management and stormwater management plan. The fact that they can demonstrate in court that, even if there are increased damages on someone, that this is part of a reasonable overall scheme, they decrease their chances of being held liable. The reason for that is that, at common law, to establish liability, it isn't simply a matter of damage, but there has to also be negligence or some lack of proper forethought. A plan in some ways establishes a standard for "care."

GODDARD:

Then if they don't take action by providing a plan, after being advised of flood risks then they are liable?

KUSLER:

It increases the probability of their being held liable, yes.

BEATRICE HOLMES:

I was interested in the remarks of the gentlemen from NAD about the difficulties of economic justification when you have an undeveloped area. Often you can predict that in 20 years such an area will have been developed. I don't know if there's anyone here from the Jacksonville District. I've recently become aware of a very depressing project that's being pursued by the water management district there. That's the upper St. Johns project.

Originally there was a Corps flood control project there which was terminated in 1972 because of NEPA, but not before it has done a great deal of damage, from a wetlands point of view. What has concerned the Water Management District is non-point pollution and they have come up with a nicely integrated structural and nonstructural combination project--an off-plain reservoir that would release water very slowly, and acquisition of land to restore the marshes. And this plan was taken to the Jacksonville Corps District which said, "Whatever can be attributed to flood control we can probably do."

The question is, there aren't flood control benefits in that project suggestion, for the farmers, so they don't want the project. But they know the area is under pressure to be developed. And I'd just like to know if that cost of project occurs often under those circumstances.

LEONARD RATUSHEWITZ:

Well, as I said, economic feasibility is what we use to make a recommendation. If we don't have that, we don't recommend, usually.

GRANT KELLY:

Jon, for those states that Larry mentioned that had adopted the "zero rights" floodway as part of their participation in the national flood insurance program, have there been any cases decided as to whether that was considered unduly restrictive?

KUSLER:

There have been a number of cases dealing with floodways that were more restrictive than the FEMA one foot standard, and the regulations have all been upheld. There have been four or five state supreme court decisions that have upheld great restriction on "out fringe" uses as well as the floodway.

You keep getting these questions from municipal attorneys about how a community can avoid liability. My colleagues and I just advise them, "Don't do anything that's going to increase flood heights." Put in a "zero right" floodway. Don't issue a permit for anyone who won't provide compensatory storage and stormwater runoff. And so on. Put such provisions into your zoning, and hold to that principle of not increasing flood height. Don't let anybody increase any damage on anybody else, and don't do it yourself. Then your chances of liability are small and of having your regulations upheld are great".

CARL GAUM:

I'd like to raise a hypothetical case. We have a levee project which optimizes at 25 years. The community decides to go with the 25; it's well justified. What happens when the flood comes along and that levee is overtopped? Are they liable?

KUSLER:

They probably aren't. You get really hairy situations where the federal government is also doing the construction. As you know, in general, the federal government cannot be held liable partly because Congress says it cannot be held liable. And when it's a federal project that has been authorized and cost shaved, you get into a mixture. The problems may arise from improper construction or maintenance, however. That can result in liability.

The courts have not been holding communities liable for failing to provide 100 or 500-year protection versus 25-year protection. They have for improper design, construction, maintenance.

I might just add that FEMA has a very aggressive policy of suing communities right now. You've probably all heard of the Jefferson Parish case. FEMA, as one of the first actions of the Reagan Administration Justice Department, decided to sue Jefferson Parish and for \$93 million.

The parish had adopted floodplain regulations and entered into the flood insurance program. It unfortunately did not enforce those regulations. There were some very suspicious things, like all the deviations came in exactly the same. Then they were flooding and there were drainage problems, and the federal government paid off. Then the administration in its effort to save money and prevent fraud decided to sue the community to recover those \$93 million of payments for flood insurance claims.

The senators and whole Louisiana delegation lobbied the administration to prevent the action. I called Justice the other day to see if they were going to proceed, and Cummings, in the general counsel's office, said they have 40 such legal actions around the country where floodplain regulations have not been enforced and there have been damages. They say it's pretty simple. You enter the flood insurance program, you get subsidized insurance on the one hand, and on the other you are in a contractual relationship with the federal government. If you don't carry out your contract as a community, you're liable.

They're also going in on a set of theories of subrogation. If one landowner get damaged and another landowner has done something that was not legal (like a variance not legally justified), FEMA will come in and sue on behalf of the damaged party. Just like an insurance company would if you had collision insurance and your car is damaged. Your insurance company will pay you but then they will sue the person who damaged your car. This is general official policy now.

ART HARNISCH:

On the matter of just compensation for the taking of property, what's the current thinking of the court when a local community comes in and downgrades "down zone" land, prohibits building, and develops a green belt? To what extent is the community liable to property owners for that?

KUSLER:

In the course of doing floodplain zoning?

HARNISCH:

Whenever you're doing floodplain regulations, you're going from a situation of either no regulations at all or there's residential zoning, and then you go to floodplain zoning. So you're almost always imposing some additional restriction if for open space, its highly restrictive, or if it's

just a flood fringe, evaluation requirements. Every case involves new regulations that weren't there before. I'm not trying to be overly simplistic, but we've got 60 cases and the courts have never bought the argument that new restrictions create community liability.

When there are highly restrictive regulations prohibiting all development, I've been surprised. All the regulations that have been contested to the appellate court or state supreme court so far have been sustained. I wouldn't have expected that. The courts tend to look at the impact to the landowner, how much he paid for the land, the taxes, etc., to decide whether there is a taking. And they've been deciding there is not taking.

WIENER CADET:

We are studying a project in the county of Oneida in New York. We have proposed a levee on the left side of the creek, which is more developed than the right side. We came up with the combined solution of structural on the left side and nonstructural on the right side. My question has three parts. With the levee on the left side, there are some project-induced damages on the right bank due to higher flood levels with the project. Assuming that the only engineering solution is relocation, would it be appropriate to propose some form of monetary remuneration in lieu of location if the property owner prefers to remain? And what form could the equitable legal and acceptable compensation take (that is, lump sum damages, or what other)? If no type of remuneration is appropriate, would the owner have the option of remaining in the floodplain, assuming the owner's building doesn't adversely affect the functioning of the project?

KUSLER:

I think I understand the first two questions okay, but I'm unsure about the third. Could you restate it?

CADET:

If no type of remuneration is appropriate, would the owner have the option of remaining in the floodplain, assuming that his structure, building, doesn't adversely affect the functioning of the project?

KUSLER:

I don't profess to have a good handle on the whole area of the law of federal liability of flooding. But in general the federal government has not been held liable for increasing flood heights on private land due to construction of levees. On the other hand, there is a whole series of cases that says that if the federal government--by a flood control structure--actually inundates lands or makes it wet, it can be liable.

The facts of the situation would really dictate the outcome. Is the landowner flooded every year, once every 500 years? How often, how severely, and so forth will tell whether compensation is due for project effects.

The second issue. I think the flowage easement of some kind is a very familiar technique to compensate a landowner.

Regarding the third question, it all depends on the regulations. If you're talking about floodplain zoning, the fact that someone is going to be more severely flooded than they were before--if so, they're usually in nonconforming use. If you're talking about the possible treatment of a person in terms of condemnation laws, I don't know if you can allow someone to remain on land you've condemned for a project. I'd need more specific situational facts to react well to your third question.

## FLOODPLAIN REGULATION: EFFECTIVE WEAPON OR PR SLOGAN?

By

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### INTRODUCTION

Much has been said, by those interested in the reduction of flood damages, about floodplain regulation. Advocates of nonstructural approaches to flood damage reduction believe that floodplain regulation should be a major weapon in the arsenal needed to carry on this battle against flood losses. Since floodplain regulation has been around, in one form or another, since the earliest days of nonstructural awareness if not flood control the question that logically follows is, "How effective is regulation in carrying out its segment of the flood damage reduction mission?" Is it an effective weapon in the battle or is it just public relations gimmick--a slogan to be used to placate those who want something done in a nonstructural mode. What is Corps' role in regulation?

This paper briefly reviews the development of regulations for the floodplain and discusses the purposes of such regulations as well as identifies those involved in the regulation process. It then provides an assessment of the effectiveness of regulations and a discussion of continuing use of the floodplains in the face of regulations and the role of the regulations with respect to protection of the environment. Based on these general discussions, the paper concludes with the presentation of a series of issues that must be faced in the continuing efforts to improve the effectiveness of floodplain regulation in the nonstructural approach to flood damage reduction.

#### Regulating the Floodplain--A Review

The Federal role in flood damage reduction dates back to the middle part of the 19th Century when the Mississippi River Commission, acting through the Corps of Engineers, assumed some limited responsibility for flood control in the Lower Mississippi Valley. This activity was expanded slightly in 1917 and 1923. Finally, in 1928, the Corps of Engineers (again, as a representative of the Mississippi River Commission) was assigned full responsibility for the Lower Valley. In 1933, we saw the addition of the Tennessee Valley as an area of Federal flood control interest. In 1936, with the Flood Control Act of that year, flood control in the entire nation became a Federal responsibility. In the fifties Gilbert F. White and others published analyses of activity in the nation's floodplains. It was then that attention began to turn to nonstructural approaches. (White, 1953, 1958; Hoyt and Langbein, 1955). For

at least 30 years, the primary focus of damage reduction was on "control" through dams, levees and other structural works. The University of Chicago's Geography Department spawned several papers on flood damage reduction that brought to the nation's attention, in the early 1960's, the need for a nonstructural approach to include a viable program of floodplain regulation. Passage in 1965 of the Water Resources Planning Act (PL 89-90) reflected concern for development of a comprehensive program of flood damage reduction that would be both structural and nonstructural in its approach. The 1968 National Flood Insurance Act (PL 90-448) offered insurance to persons living in the floodplains when the community in which they were living had approved floodplain ordinances. This rather weak approach--there was limited participation--was given teeth in 1973 with the passage of the Flood Disaster Protection Act (PL 93-234) which not only required the purchase of flood insurance for Federally supported projects but also, more significantly, required insurance purchase by anyone locating in the flood-prone area and seeking a Federal mortgage guarantee. In effect this made the National Flood Insurance Program (NFIP) mandatory rather than voluntary for most communities. Publication by the President in 1977 of Executive Order 11988 forced Federal agencies to commit themselves to avoidance of the floodplain in their projects and in Federal projects in the communities which they supported. This push was supplemented in the same year by Executive Order 11990 which established the Federal interest in the preservation and protection of wetlands and tied this to wise use of the floodplain. What is important is not the history itself but the recognition that in the 54 year history of major Federal flood control action, nonstructural activity has come on to the scene in force only within the last few (10 to 14) years. Regulation, once an afterthought has been given credibility by the strengthened National Flood Insurance Program--circa 1973. Flood insurance is available to individual property owners only if their local government participates in the NFIP and implements a program that includes floodplain regulation.

#### Components of Floodplain Regulation

Floodplain regulation consists of any number of tools used by the governing body (Federal, state or local) to control the use of the floodplain (Kusler, 1976:37). They include but are not limited to:

. Zoning--the division of an area into districts or sectors to which various standards of occupancy are applied.

. Subdivision regulations which control the division and sale of lands. The review of subdivision plans provide opportunities for the local community to contain activity in the floodplain.

. Building and housing codes which control building design and specify minimum flood elevations.

. Special regulations which include such items as riparian vegetation control and control of encroachment on the floodway to prevent activity within these key areas of the floodplain.

. Comprehensive planning which provides a holistic, systems approach to integration of the floodplain into the overall structure of a community.

. Permits which control specific actions within the floodplain. The requirement to obtain permits may not specifically relate to the reduction of flood damages (e.g., pollution control) but does affect the activity in the floodplain.

#### Purposes of Floodplain Regulation

Why regulate? According to the Water Resources Council's Floodplain Management Handbook (Flood Loss Reduction Associates, 1981b) floodplain regulations can serve to:

. Prevent, in flood-prone areas, new development that could result in loss of life and excessive damage to property.

. Reduce the potential for loss of life and property in areas already developed.

. Protect unwary buyers from purchase of property in flood-prone areas.

. Prevent encroachments that decrease the flood-carrying capacity of floodplains and that could, as a result, cause flooding in other areas.

. Reduce public costs for emergency operations by reducing the extent of floodplain occupancy and the resultant need for recovery and rescue operations.

. Reduce the need for future expenditures for construction of flood control facilities by limiting floodplain occupancy.

. Preserving natural floodplain values from ecologic and aesthetic viewpoints. These are not the goals of the regulation program but rather what regulations can do. Obviously, each and every community does not establish its regulations to meet all of these purposes. They represent "the breadth of possibility."

#### Who Regulates: Why and Why Not?

Many instrumentalities of government play roles in floodplain regulation activities. At times the Federal government through permit programs such as Section 404 (PL 92-500) becomes heavily involved in the actual regulation of activity in the floodplain. In a similar manner, many state governments,

either because they possess an effective state level system which protects multi-counties properties or because of a reluctance to delegate these responsibilities to the local level, may also exercise control over the floodplain. When properly delegated the responsibilities by the states, cities, counties, planning boards and other instrumentalities of local government can carry out effectively the mission to regulate the floodplain and it is these lower-level activities that in fact exercise the majority of floodplain regulation activity (Barker and Morgan, 1979).

Perhaps a critical question is why would a community want to regulate the floodplain. We know what can be done with regulation--the purposes--but do we know the why of regulation--the goals? Steve French and Ray Burby, in evaluating the state of the practice of the management of the floodplain (French and Burby, 1980) found that most communities had two basic goals in mind when they established regulations. The primary goal was to reduce property loss. A second goal was to protect public safety. Other goals in the minds of these communities included reduction of damage to public property, reducing erosion and sedimentation, preservation of natural areas, preservation of open space and maintenance of good water quality.

Californians emphasize that "each new structure constructed at an inadequate elevation or in the wrong location presents a future problem for local government to solve through use of its most scarce commodity--money. . . ." (California, 1980:69).

The above answers reflect the responses of officials responsible for the regulatory activity and might be somewhat PR oriented. Perhaps if the truth were to be known, I would guess that those communities and activities that do regulate are those that either have a demonstrated need to participate in the National Flood Insurance Program--the constituents pressed for this participation and have evidenced the need for it--or are those communities with a sincere interest in planning for the future--communities that have developed an "environmental" awareness.

Communities that do not participate in regulation of the floodplains are those that are capable of dealing with the economics of flood losses and that typically have a limited urban area affected by the flooding. In these communities, areas in the floodplain are either of little value in the overall fiscal structure of the community or are underdeveloped. Given these circumstances, they either cannot anticipate a need or do not wish to be burdened with the strictures and structure of regulations. Since it is generally accepted--by the uniformed--that floodplain regulations drive down land values and substantially increase the cost of development, many communities find great opposition to regulation from development interests. The California study (California, 1980) found that, 'basically there is no economic incentive to the landowners or real estate developers to encourage floodplain regulation. These special interests benefit from diffusion of the costs . . ." of protection. They note that local governments are sensitive to development interests. In addition, the acceptance of such a regulatory program by a local community brings with it responsibilities for carrying out the program with little fiscal support from the state or Federal level to aid with such new program costs.

## EFFECTIVENESS

### How Effective is Regulation?

What is effective? Ray Burby, Steve French and Ed Kaiser (1980) in developing a Conceptual Framework for Evaluating Program Effectiveness, indicate that an effective program is one that "produces the desired results." The only problem is, we cannot define what we want--what are the desired results? The goals and objectives of floodplain regulation are not clear or at least not universally accepted. They vary by locale, the "personality" of the governments involved, and the nature of the flooding problem.

Burby suggests that once we establish the "desired results" such effectiveness can be determined through cost benefit analyses of the various programs, a priori or post facto impact assessments and through program evaluations which provide retrospective looks at the programs. Few efforts, however, have been made to carry out such evaluations.

How extensive is the regulatory activity? Since participation in the NFIP brings with it mandatory responsibility to participate in the program either in an emergency or regular program phase, one can assume that the greater than 16,500 communities in the program are providing some form of regulation. Over 1,000 communities in the regular program provide a much stricter form of regulation than do the remaining 15,000 in the emergency phase, with the most significant difference being the need for communities in the regular phase to require residential buildings to have their lowest flood above the 100-year flood elevations and to have non-residential buildings be either flood proofed or above the 100-year flood elevation, and to restrict all development in a floodway.

How then do you measure effectiveness? One method would be to evaluate the performance in limiting invasion of the floodplain by new development. A second method would be to evaluate the ability of the regulations to limit future development. Quite obviously, some efforts can be made to quantify the former while the latter requires judgement on the part of the experts concerned--either those at the local level or those who possess national expertise. Burby and French conducted a detailed study of 1203 local jurisdictions to evaluate both cases--past performance and the expected future. A similar study was undertaken by Sheaffer and Roland, Inc. (1981), for the Flood Insurance Administration, with a focus on a detailed examination of 21 communities. Sheaffer and Roland sought to determine what would be the future development in the floodplains of these communities under three scenarios. In the first case, development would continue without regulation. In the second case, moderate regulations would apply and in the third, stringent regulations would be used.

### Effectiveness: When Does Regulation Work?

Not surprisingly, both Burby and French, and Sheaffer and Roland discovered that a regulatory program works the best where there is no one to regulate. That has also been my observation. When there is little activity

in a floodplain and plenty of non-floodplain alternative sites available, floodplain regulations are easy to install and serve well to keep out development. Where alternatives are limited, the regulations will be less successful. Burby and French attempted to review program effectiveness by examining invasion of the flood plain after institution of regulation and found little correlation, in the aggregate, between regulations and the rate of invasion. At the same time they found that 62 percent of the regular phase and 49 percent of the emergency phase participants rated their programs as effective. It would appear that, to the floodplain managers, effectiveness can be judged from success in ensuring "safe" development in the floodplain rather than by strict reliance on prevention of invasion.

They also found that a significant decrease in program effectiveness accompanied development. Sixty-two percent of communities with little existing floodplain use and many alternate sites were rated effective in their program. At the other end, only 49 percent of communities with moderate to heavy floodplain development were rated effective.

In examining which types of regulation proved to be the most effective, they found that in all cases, elevation and floodway regulation were considerably more effective (+20 percent) than zoning and efforts made to control subdivision activity.

In carrying out their projections of activity in the floodplain under the three scenarios, Sheaffer and Roland examined economic, social and environmental effects.

When there is no regulation of the floodplain, losses sharply rise (71 percent in 12 years), housing units in the floodplain increase (35 percent) and there is a sharp rise in conversion of open floodplain land to urban purposes. When moderate regulatory steps are taken--moderate being application of current NFIP requirements--the losses forecast for scenario I would be reduced by 85 percent, housing increases by 78 percent and land conversion by 36 percent. Under a stringent rule scenario--no development in the floodplain--flood losses, housing starts and conversion actually decline, albeit slightly.

### Failure

What are the characteristics of system failure? As can be seen from the previous paragraphs, floodplain regulations are the least effective when the floodplain is already developed and there are pressures for "more!" Speaking from the local viewpoint, the man in the trenches, Carl Nelson of Orange County, California (California, 1979:56) summarized his problems with floodplain regulation and in the process provided a good cookbook list of reasons for program ineffectiveness. His list includes:

. Uncertainty. In urbanized areas not recently flooded, unless there is demand or push from above--the state or Federal level--it is difficult to get local officials to assume the responsibility for tough regulations. They are uncertain of their support.

. Lack of data. Local officials are reluctant to press ahead with any floodplain regulations in the absence of good hydrologic data. Poorly prepared data are data that are taken to task and frequently represent a cause for setbacks to the overall program.

. Costs. Regulating requires inspectors, maps and controls, all of which cost small communities more than they are willing to put forth.

. Confusion. Differences in maps produced by Federal agencies, state officials and individual engineers make it difficult to explain the regulations to a court or an adjudicating body.

. Cowardice or lack of courage. No one wants to tell neighbors that they may or may not develop a given region. If there is some way to duck the issue, it is often easier to do so.

. Errors. Preliminary distribution of incorrect flood hazard information from FEMA causes a lot of wounds to the program.

. Resentment. Who is deciding what is the 100-year flood and where is it going to be. Why 100 years? Typically the Federal government is seen to be the driving force--Big Brother. When there is a lack of belief in the 100-year flood, this becomes a distinct problem. To most people this "distant" flood is the concoction of Washington and "why should they tell us what to do?"

. Property Value Loss. Most people believe, as was noted above, that when zoning takes place or new regulations are imposed, the cost of construction goes up and the value of the property goes down. (At a recent public hearing in Suffern, NY, a resident of the 50 year floodplain being offered Federal assistance got up to complain that all of this discussion by the Federal government about flooding was driving down the value of his property).

#### Is Floodplain Use Always a Failure?

Definitely, no! This, however, gets back to what is the desired result of floodplain regulation. Is it elimination of flood damages, or reduction of flood damages or wise use of the floodplain? White, et al (1958) and Krutilla (1960), as well as many others, have stated that economics may well drive an activity into the floodplain, where if it is not causing damages to other activities in the floodplain at that location or other locations, it may be realistic for the activity to develop within the floodplain. The story of the Sprout-Waldron Division of Koppers Company in Lycoming County, Pennsylvania,

told in Jim Owens' very fine study for the Water Resources Council (Flood Loss Reduction Associates, 1981a), indicates that through a program of flood warning, flood proofing and evacuation over 90 percent of the losses normally sustained in a major flood are capable of being avoided. The decision for Sprout-Waldron to remain in the floodplain rather than to move out of the floodplain made good economic sense. Those who are familiar with the development of inland ports recognize that one of the requirements frequently associated with such projects, is the requirement that activities located in industrial parks created at such ports by the Federal project must be navigation related. Frequently activities with navigation interests place some of their facilities within the floodplain with full knowledge that occasional losses will be sustained, recognizing that a combination of flood-free and floodplain land is the most economic approach to their needs.

In the rural case, things are different. Since there are normally no regulations, use of the floodplain for farming, might not be deemed a failure of regulation, because even if such regulations existed, farming would be considered a use compatible with the floodplain. The conclusion, however, that farming is a normal floodplain activity, is based on the assumption that the economics--getting two crops in a three-year period (one flood year)--make it profitable for the owner to locate in the floodplain and that the owners' actions in developing the floodplain do not in any way hinder those of his neighbors (Galloway, 1979). The assumption is also made that the flooded farmer bears his own losses. Actual practice would tell us that one of two things occurs. After making his two successful crops, the farmer may be hit by some sort of flooding and rapidly decide that it is not wise to continue to suffer these losses and that he should construct some structural protection on his own. This created problems in the use of the floodplain in that the flood storage lost means higher stages for someone else. In the second case, the farmer looks to have someone pick up his flood losses.

#### Do We Regulate to Protect the Environment or Eliminate Flood Damages?

This may be the \$64,000 question! Again it is very difficult to define, at least on a national basis, the specific purpose of the floodplain regulation program. Clearly, reduction of flood damages is a worthwhile objective--so also is preservation of natural values. In most cases the preservation of natural values provides a floodplain that is "structurally" efficient in terms of flood conveyance. Since the number of constrictions on the floodplain are limited, the natural approach is typically a reasonable one. Reduction of the number of human activities in the floodplain prevents further development, enhances the environment and becomes a benefit to the environment of the regulatory program.

The key, however, to evaluation of the relation between the environment and floodplain regulation is cost. Can the goals of flood damage reduction be accomplished while including protection of the environment as a secondary benefit. Burby and French found that floodplain regulations were about half

as successful in reducing encroachment in natural areas as they were in preventing future development in a floodplain area. They note that success in preventing encroachment on the natural areas was considerably greater when the objective and the program became a state one rather than a local one. Again, there is an apparent reluctance on the part of local managers to get tough when the goal is not mainline.

The above indicates that while local managers recognize that natural areas are subject to some form of limited encroachment, rather than sacrifice the "salability" of the entire floodplain management program by establishing very stringent rules to protect natural areas, they see that it would be better to have "looser" rules that might allow development that would go into natural areas. There is clearly a presumption that if too big a bite is taken in regulation, the entire program may fail.

The current disputes over Section 404--pollution control or wetland control?--legislation highlight the sensitivity of many people to the apparent use of flood damage prevention regulations to carry out environmental goals. Even such regulations as California uses to control damage to riparian vegetation are seen by many people as using floodplain management as an excuse to enhance the environment when the mission to enhance the environment had not been established.

#### THE PAST AND THE FUTURE

##### Summary

What does all this mean? It clearly is difficult to tell how effective is floodplain regulation. It is a useful weapon but certainly not the only weapon. It can be said with some degree of confidence that the longer you wait to impose regulations, the more difficult it is to get them accepted. Once the floodplain has been invaded, regulation is more difficult, even though the need for the regulations are more apparent.

The experiences of the last 15 years, as well as look at what is happening today say that the floodplain regulation responds best to incentives, albeit negative incentives. If the local communities understand that noncompliance will result in action being taken against them, they tend to comply. If regulation is PR, it is recognized as such. Here the Corps often can provide a much needed push. If the Corps is serious, it will argue for strong regulation in support of structural-nonstructural plans.

Extreme care must be taken in looking back over the effectiveness issue to define what is the real objective of the regulatory process. It is certainly not to prevent any use of the floodplain. There are logical uses of the floodplain that do not constitute a failure of regulation. Failure must not be automatically assigned to a program that does not control encroachment on natural areas. Nowhere is environmental enhancement or protection assigned as a primary mission of floodplain regulation.

Patience is a virtue and patience in the business of regulation is most virtuous. One must not lose sight of the fact that while flood control has been around for over 50 years, nonstructural approaches are new and their implementation takes time.

### Questions for the Future

There are many issues that need to be faced in developing an effective approach to floodplain regulation:

Good information is needed to provide good regulations. As was indicated above, one of the reasons for a failure in the effectiveness of regulation is lack of data. People who want to support good programs need to have the ability to support those programs with data that are sound. Can we pay the price? This will require close coordination with FEMA.

A question that must be asked when there is failure of floodplain regulations is, "Did the local people decide that by invading the floodplain, they would force structural solutions?" As was indicated in a recent study (Galloway, 1980) of the effectiveness of Federal nonstructural programs, steps must be taken to insure that when regulations are required of a community by a Federal-local agreement, there is a clear understanding that if the regulations are not implemented, there will not be a bail-out through some sort of structural program.

Similarly, systems economics must be brought into assessments of floodplain regulation effectiveness. Going back to the issue of the farmer who says it makes sense to farm in the floodplain if in two out of three years he gets a crop, we must insure that our analyses recognize and cost out the fact that when the farmer does not get a crop he may look for some sort of government aid. The cost of providing this aid must be included in the effectiveness equation.

A thread running throughout the entire literature on floodplain regulation is adherence to the concept of the 100-year flood as a "standard." Our lack of certainty about hydrology leads one to speculate that there may be problems ahead. The same regulations that control development to greater than 100 year flood elevation will be cited as the catalyst for bringing development into an area subject to the 500-year flood. Couple this with the current effort of the Reagan administration to reevaluate (and possibly reduce) the 100-year floodplain standard and the problem becomes worse. Letting people in the 100-year floodplain, regulated to the 50-year level, could be a disaster!

Most of the literature on effectiveness of floodplain regulation is focused on the urban situation because the urban situation is where the National Flood Insurance Program applies. The rural areas generally have been ignored. It is not too early to remember that tomorrow's urban problems are today's rural problems and that broader based regional approaches will provide some substance to this regulation. Burby and French see that a land use management paradox exists. Most attention is focused on regulating already highly developed floodplains, yet we know that success in those areas is hard to capture. Little attention is placed on underdeveloped areas where the chance of long-term success is high. Here the Corps can lead the way.

The problem of floodplain regulation cannot be overly generalized. Flooding is caused by a series of problems that are geographically oriented. Certain urban flooding, ice jam flooding, and flooding that comes out of the hills create requirements for unique regulations, regulations that may be parallel to those that have previously been discussed (California, 1979).

Several studies have pointed out that education is a major problem. For 25 years we have been trying to convince people not to live in the floodplain. While they do not perceive a problem of flooding, they do perceive that regulations are going to cost them something either through a reduction in land values or increased taxes to support such programs (even though there is much that would say that this is not the case--regulations do not overly impact on cost), (Muckleston, 1981:72). As with many professions, the problem may be that we are talking among ourselves and not talking to the public. A recent poster prepared by the State of Louisiana and the League of Women Voters notes that "Water Will Rise." Obvious to us, yes; to others, no. More needs to be done!

Additional attention needs to be paid to regional floodplain regulation. The emphasis now on community regulation through the NFIP leaves unanswered the problems of future development in rural areas and the ties among communities. The few states with regional regulatory programs provide a guide for others for action that must be taken in the future (Platt, 1982). Federal agencies can serve in this arena as facilitators.

The social impacts of regulation must also be considered. Annabelle Motz, in a well-thought-out (Motz, 1978) paper on zoning as a nonstructural alternative, points out many of the pitfalls connected with the entire issue of zoning and zoning in the floodplain in particular. In many cases of regulation we find the affluent deciding what is good for the not so affluent. Excessive commitment to some regulatory programs can be in fact a commitment to programs that we do not really understand or want from a social perspective. Full understanding of the social impacts of floodplain regulations is an imperative.

Lastly, we must seek to limit changes in direction from Administration to Administration and ensure that words and deeds go together. Major efforts by the Carter Administration to vocally support nonstructural activity were not accompanied by the fiscal support for these programs from highest levels (Galloway, 1980b). This quickly led people to believe that there was not much to the programs. The Carter Administration supported environmental protection as a subset of floodplain regulation. Now we see messages from the current Administration that would indicate that this support will not continue. We are back to the uncertainty problem.

#### Conclusion

I have offered problems and challenges. Do you have solutions?

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PANEL V, FOLLOWING GALLOWAY ADDRESS

WILLIAM HOLLIDAY:

Col. Galloway's discussion was outstanding. He covered the whole ground, made some excellent points. At one point, you said there's some question as to which flood we should use, whether it should be a 100-year flood or some other flood, and the thought occurred to me that maybe we should first find out which 100-year flood is the 100-year flood we should be using.

I think you had three basic messages in your presentation about the extent and effectiveness of regulatory controls: the question as to if we had continuing floodplain development, was that truly a failure of in regulations, and is the environmental protection the unspoken or underlying reason or justification for regulatory controls. Regarding the extent of effectiveness of regulatory measures, in the Corps of Engineers, in planning our projects, we have presumed that regulatory measures will be effective in controlling development in conjunction with structural plans. And we have seen no reports that have in them as one of the items of local cooperation that local interests must adopt and enforce floodplain regulatory controls, as appropriate.

You never really spelled that out. We don't specify exactly what we mean. We have presumed that they would adopt a full set of regulatory controls probably a two-district set of zoning ordinances with a floodway and a floodway fringe area. I think we also presumed that they would be participating in the FIA program. But I have concerns, and they are what regulations actually have been adopted? What kinds of agreements at the district level are you really requiring when you sit down and enter into a contractual agreement with the locals? Are you actually asking them, "Show me some evidence that you are participating in a national flood insurance program or regulatory program." Are you asking them, "Let us see a copy of your floodplain zoning regulation." Are you reviewing it? It is an adequate regulation? It is really what you had in mind? When you added that A, B, C item in there, you might ask yourself, "Why did I add that if I'm not ever going to think about it again?" And I think we have to look more closely at that.

In formulating projects we are assuming that the most probable future without any project includes adoption or presumes adoption of the floodplain regulatory controls. But I don't think we really have a good handle on what that really means either. As you indicated, there's all kinds of scenarios that an economic and a land-lease expert could think about in trying to project what that most probable future is.

With regard to the failure of regulatory controls, if we had continuing development in an area where we had planned the project, and it has been authorized and we constructed it, and we had an A, B, C requirement, and yet development continues in the floodplain area, who's responsible? Are the local people responsible? Do we ask them to assume responsibility? I think that we do have some responsibility. I don't think as an agency, we're giving it serious consideration at all.

Regarding the environmental aspects, I think that environmental objectives are good, valid considerations. There are often locational environmental advantages for locating on a floodplain just as there are economic locational benefits often for locating on a floodplain.

I have a couple of points that I picked up during the day that I think something needs to be said about. Len Patushewitz said that formulation is the key. We have to integrate this into formulation. I really agree with that. There were a couple of comments earlier with regard to advance warning systems. Several districts were concerned that if they made a serious effort to develop a warning system they are going to steal the cream of the benefits off of some possible future structural or nonstructural measures. And the advice given twice today was, "Well, just assume that the warning system is just a temporary measure, and we are going to build a structural solution or we are going to adopt some other nonstructural measure to eliminate the problem more permanently." And I can't let that comment go without further comment. Unless I'm misunderstanding, I think that is wrong advice. I mean, if a warning system is going to work for the next 10 years, what logic is there to saying that it's not going to work for the next 90 years? And if your structural or other measures are not incrementally justifiable over and above a warning system, then so be it. But that's just the case. I think when you let that kind of reasoning get into your analyses, you're not doing justice to nonstructural planning, and that's what we're here for. Someone may want to respond to that later.

I think we need to take a much more incisive look into the NED manual and the way the economists tell us to evaluate the nonstructural plans, particularly with regard to relocation--evacuation and permanent relocation. I think we need to ask our economists to look at that in more depth, because there are some institutional and some financial arrangements buried or kind of hidden or confused in the economic analysis of what we're doing. And I hope that we'll get into that later in the conference.

JON KUSLER:

There are a couple of points. Do you think that the 1965 flood control task force said we'd have to look at net benefits in terms of comparison to all other lands in the community and region rather than just benefits in terms of what you do with the floodplain. That's rather key if you really are concerned about costs and benefits. It obviously alters the whole picture. And then open space with a floodplain does become a very practical alternative for the federal government or the state or the community as long as you're looking at putting money into all land and at what kinds of benefits you're going to get out of them.

It does seem to me that if the Corps is ever going to take an honest -- and it's really a challenge -- an honest look at what's in the national interest or state interest (and of course there's guidance from the administration, or congress), you have to get the broader picture.

A couple of positive points about regulation is one of the things which has come out of the center. As we've learned, you have to get the sense of the

benefits of the regulations. They're hard to measure. They haven't come simply from the community having some regulations, but rather that banks have not been giving money out unless it's secured, particularly during tight times. And they've been more effectively enforcing regulations more often than the community has, and by the fact that somebody has to acquire flood insurance. They get a pretty good idea that they're in a floodplain. And a lot of people didn't even know they were in a floodplain or the elevation of the 100-year flood. And I think this education combined with having the maps available and having the people go through the procedures should not be underestimated. I think it's a very important component. I think it's also a very important education component in terms of where you invest your public facilities, in terms of the local government -- where they are putting their bucks for roads and sewers and so forth. I think sometimes the benefits are more subtle. I really think that with all the limitations of the FEMA mapping, etc., at least that they've been really useful in education, awareness.

There's a companion report to this; it's one of the appendices. "Strengthening State Floodplain Management," which the Association of State Floodplain Managers did, is also available. One is called, "Innovations in Community Floodplain Management." I took a look at 150 communities that were suggested as having very innovative programs, and then narrowed it down to 75, then wrote profiles of those 75 communities. And that's appendix B to this thing, available from the Hazard Center, and I was trying to draw some conclusions of why community innovation.

As you probably would guess, one of the first things that gives rise to community innovations is that the federal government is not going to pay all of their costs. That is, as long as a community has the prospect of a flood control structure to solve its problem, it very rarely innovates unless it has some other objectives such as protecting some birds or bunnies or something like this. As soon as the community was told that it was an unfavorable cost-benefit ratio, or that it couldn't be done for technical problems, then they got creative. And that was an objective conclusion. I was challenged to find a creative community as long as it believed the federal government was there to bail them out. Communities have been getting more creative because the federal government hasn't been bailing them out for a while. They're beginning to really get the sense that the endless spoon is just not going to be there. And it's just beginning to dawn on some people, particularly with liability coming in there.

When a community gets the idea they are just not going to get all their costs paid for them, then they begin to start looking at it in terms of "their" problem. They have to solve it. They begin to do some multi-objective stuff. And that's again where I see the Corps is playing a really important role. Their open space, urban renewal, flood control structures in some areas, regulations--it's putting it together where it's going to serve multiple objectives, and that becomes attractive to communities.

I've been working on a housing committee with the American Bar Association this last year and a half, and this consists mostly of developers. They're very interested in hazards, they're interested in private incentives, from tax

credits to the Flood Insurance Program, etc.; but the other thing that they're interested in is that most development that's occurring--if you're talking about major commercial, industrial, residential development--it's not on a part and parcel basis anymore. They feel that there's been inadequate attention at the federal level -- and I would agree with them in terms of FEMA, maybe the Corps -- in looking at the problem of mitigating the hazards in terms of whole projects, 5000 acre projects, 10,000 acre projects, 200 acre projects. That with some creativity, the proper kind of technical assistance, good maps and so forth, you can often get your cake and eat it too. You can get what you want out of a project in terms of bucks, lets say clustering or condos, and leaving the whole floodplain as open space. And you can meet environmental objectives and flood loss reduction objectives. And the tax base in the community is protected. Anyway, that's an area that I think really needs a lot of exploration on how you get your cake and eat it too, and I'm convinced that it is possible.

JOHN BELSHE':

Well, I guess as the final panelist on the final panel of the day, I could mimic some of the words that Col. Galloway started with. It's a comforting position to be in, and perhaps because of that I'll reflect back over the day. And it comes very easy because I commend you, Colonel, for a feat I thought covered the required material very well and in a way which set off a certain counterforce on things which had come earlier. I commend you for the sense of balance having been brought to it -- a balance particularly, it struck me, in pointing to rural models as well as urban models.

Listening this morning, I found too easy a drop into almost totally urban life, occupancy, problems of man; and that continued even into the afternoon. You brought us back to reality on where flood control planning goes; a great deal does go in those areas. There is an applicability here. You also gave us symmetry -- perhaps not intentional, but it was there, just as the whole meeting has had a balance of duals here, nonstructural implies the structural, regulatory implies the non-regulatory. And I think both of those perhaps have brought the discussions today down to a point that I would like to encourage participants to be sharing a bit more in.

Even our histories tend to be bureaucratic histories. They're essentially the effects. This happened as an effect to something else. We haven't talked enough about the causes, what drove us. I tried to think back to matters like the channelization areas and the intense excitement that that generated in areas like this. Or the realities of a Hurricane Agnes to this immediate area where there's a greater constituency along the east coast. We've seen those many times, and I think we must not lose site of those. I wanted to move from this to talk more to the question of the binary classification.

If you're going to talk about nonstructural, you're almost using the twofold classification; you have to go and talk about the structural if only to give emphasis to what you are doing. I imagine the audience is sort of shrugging at this point and saying, "Well, we've moved beyond that, we're already talking about mix. We're very seldom talking cleanly structural, nonstructural; we're talking mix recommendation." But that's not really

enough. What we talked about here is really a change from what has been essentially a single-purpose type planning which we have often approached flood control with to what now has to be a multi-objective type planning. And I certainly will be speaking -- and I hope these words are a little bit of a precursor -- to the panel tomorrow. I will be speaking, have been speaking, very much from the standpoint of the ecological values, ecological purposes, of how that broad area, geomerphically, botanically, ecologically, defines the floodplain.

Again the thoughts go back to the channelization, because at that very same time another report was appearing in the other agencies. This was the so-called action report coming out with a number of state fish and game commissions. And what were they pointing to as the deficiency from the ecological standpoint of water resource funding? Essentially three things: for resident populations, a diminution, a loss, an absolute loss of wintering forage areas; for migratory wildlife, a diminished opportunity for resting and feeding; and finally, for the aquatic habitats, a loss of free-flowing cold-water streams. In these three matters are a point to be considered in a discussion about structural measures or the counterpart, how broad the nonstructural measures should be.

DISCUSSION FOLLOWING GALLOWAY ADDRESS

FRANK INCAPRERA:

I guess the bottom line from all of our speakers today is costs. Everybody refers to the benefit analysis as if it's a magic game. Whatever you can think of doing, we can come up with benefit numbers. Well, we've tried that for the last 12 years. And on the nonstructural plans that we first addressed were relocations, raising of properties, and things like that.

In our area we have found out that, economically, you can't find anything more than taking care of about the 10 year floodplain. In an urban developed area, that leaves a very big residual damage that you can't justify dealing with economically.

Another thing we've talked about today are the warning systems. They may be good to look into because we may not have the money for structural projects. The costs of warning systems are less, so we need smaller benefit numbers to justify them. Probably most of those benefits will come from industrial sources. What you can save from residential bases won't be much. Of course, the value of lives is always important, but we don't have consensus on monetary evaluation of that. We put life at the top of the list in actual consideration anyway. Another thing we cannot measure is the anguish that families have in separation from homes, friends, schools, etc.

Finally, I think we have to be aware of the real world aspects of planning, which apply to nonstructural measures as much as to any other endeavors. Our control of people is very limited. When we think of what we might like to implement, we must be mindful of this. We were talking earlier about controlling development on the fringe areas. We can't really do anything. Local governments are going to let people develop and control their own discharges. It's a frustrating problem for our hydrologists to hear lawyers say, "They can't do that; we won't let them." Yet all the communities let them do as they please. And we still have to come up with future mapping and try to plan a project with them. We can be optimistic, but we must cope with a world of behavior like that.

DALE KLEMME:

I'd be the last to defend developers per se, but what you described, Frank, was not a problem of developers. It's one of local governments in developing and enforcing building codes and ordinances. It's the city's fault if a developer is accommodated and helped to build in a location which causes grief to owners of homes there five years later. The city should have prohibited that in the first place.

For the most part, developers don't mind rules, regulations, and ordinances. So long as they're aware of them "up front," they are adequately explained and consistently administered, and predictable. If they have the rules they don't mind playing by them.

COLONEL GERALD GALLOWAY:

I think it's rules made after construction has started that makes developers nervous. No question about that.

KLEMME:

And they have good reason. It's poor government to make rules after the fact.

GALLOWAY:

If I may comment on what someone said about benefit difficulties. I teach water resources management to 61 seniors and a few juniors at the academy. They looked at this problem as directed to sketch it out -- showing the films of Prairie du Chien, and all the information. And they said, "Why are you people in the water resources business so fixed on dollars and economics when all the other federal programs look into social and ecological benefits and don't have all this detailed analysis?"

I think one of our problems is that we've gotten caught in this little circle of very tight economics, and I'm not sure we have the strength to bust out of it. We're trying to justify things that do intuitively makes sense, but they can't meet the numbers standards of OMB. I don't know what we do about that.

ROBERT HARRISON:

I'll tell you what we can do about it. I agree with you. We have become too centered upon economics. Economics is -- and I'm an economist and can say it with no apologies -- economics is meaningless without goals or objectives. This is one of the things that Colonel Galloway mentioned. I think if we could end this seminar with nothing else but a few goals discovered that we'd get a long way ahead.

It's obvious today that there is no agreement in this room about what we're trying to do in this field. We've said we can't find it "here, here, and here," but there's enough knowledge among us to put together some sensible aims. No one has stated any ideas about how economics ought to be responding, ought to be applied. How can it do anything if it isn't provided objectives to further?

It would be very good to focus on the objectives of nonstructural planning, not only the objectives of the federal government but objectives of other levels and all the interrelationships among those objectives. By that means we might achieve some real understanding of what it is that economics ought to be analyzing, evaluating.

INCAPRERA:

I'd like to respond to the earlier observations of Dale Klemme. I know there are developers of the sort you characterized. Unfortunately, the sort I was talking about had control of the commission which governed a county.

Believe this or not, the emergency program was in '69. Harris County did not accept it until '73 and the city of Houston didn't until '74 for those very reasons -- developer's obstruction. The only reason they finally accepted was because the law was passed that you couldn't borrow any money from a national bank to fund construction of a home without it. Were it not for that law, they would have continued from then until now to build houses in the floodplain that would certainly have been flooded more than once by today. I assure you of that.

KLEMME:

If local citizens allow that type of government, then they deserve the problems that result.

INCAPRERA:

The problem with that view is that there are large numbers of newcomers, continuously, who are unaware of the situation. Yes, you'd be right about deserving consequences of bad government, if there were full knowledge among the people -- perfect information. In a dynamic change area like Houston, that knowledge is not attainable.

DAVID MILLER:

I've heard people alluding to the fact that the benefit-cost analysis procedures are not taking into account all the factors that they think are important to decision making. I've understood Frank to say -- justifiably -- that the procedures we are saddled with now do not allow for nonstructural planning. At least they don't allow for relocation projects to be feasible beyond the 10 or 15 year level. There's a good study by HEC that was done several years ago that follows the procedures that were given and basically reaches that conclusion, too.

My question to this panel or the general issues forum is, "What are the things that they're considering not to be taken into account in the benefit-cost analysis procedures?" If they can identify them specifically, then we could possibly make some attempts to modify procedures and include them.

WILLIAM HOLLIDAY:

Well, the economists are attending a class down the hall, and they could probably give us a lot of insight. I think a lot of the things people mentioned today were difficulties in measuring benefits and difficulties in measuring costs, not that they were being arbitrarily excluded from analysis.

But with regard to relocation and resettlement, permanent evacuation from the floodplain, I do think that we are excluding some of our capabilities by use of the regulations. I guess we have so to speak, "externalized" a lot of costs. And we've externalized a lot of benefits. That's okay in economic analysis terms.

But one of the problems is -- let's say for example in the Tug Fork area, you have an awful lot of substandard housing. It's not decent, safe, or sanitary. One of the benefits of a relocation-resettlement plan is providing adequate housing. And a portion of that cost of that program should be allocated to housing. It may be someone else's program; it probably is someone else's program to pay for it. But the way that everything is externalized in our economic analysis it really doesn't identify the financial costs and what programs they're assignable to. It calls everything a flood control purpose. It says every benefit is a flood control benefit and every cost is a flood control cost.

We need to look behind that and see if we can externalize some of the financial costs and assign them to some other program recommend and get other agencies and levels to cooperate with us to do that portion of the program.

GALLOWAY:

I think that represents a good request to the seminar to try and identify those things that we complain about and see if we can put them on paper as a list.

CHARLES E. SIMPKINS:

Bill, I've asked a number of economists about the institutional problem of component costs and benefits allocations; you won't get an answer there. They can't give an answer on their particular disciplinary turf in our agency, because it isn't a matter of the content of economic theory or method. It's not an intrinsic inadequacy of the discipline, formally, that determines what they do in applying economics to the cases as given by Corps planning.

What determines what Corps economists do is the institutional and interest group politics behind the process of government that gives them the regulations and conventional practices which prescribe flood control economic analysis. Some economists are ideologically committed, for one reason or another, to the way analysis is currently done. Many others aren't committed. But all behave the same, as they must.

I sometimes fault economists because they are doing an analysis I think incomplete. But that's an unfair reaction of convenience and impatience on my part -- like killing the messenger of bad news -- in most instances. I do think, though, not in jest, it's neither fair nor useful to ask economists to solve our procedural problems in economic analysis, because the problem aren't inherent in economics but in the politics of U.S. water resources allocation and the agency system.

JOHN BELSHE':

I'd like to address that too and suggest that perhaps you're asking for things to incorporate into a model, David. I might dispute that that benefit-cost analytical model is itself just too simplistic for today's needs.

What I think is coming is probably something we've already seen appearing in certain areas of natural hazards work. Certainly we've seen it emerging in matters of health and drug enforcement. There are matters of risk assessment approaches. There has been over the last 10 years a considerable literature building there, particularly in the National Academy of Sciences, and through it some of the work out of OSHA or FDA and from other organizations concerned with regulating matters at the individual level. I think aiding decision making at the group level, the societal level, is coming by the end of the decade.

I think it is there that you should look more for help than within the rather narrow confines of what has evolved out of the benefit-cost methodology. For example, we tend to drive a project now to a point of diminishing returns. We look to maximize net benefits. Yet, risk assessment might more appropriately look at where the b/c ratio maximizes. It is the alternative investment opportunities that may be societally more important in attributing the flood risk they should accept in going forward with a given plan.

Looking at a point like that implies in itself a considerably lower level of structural protection than has been traditional. It would argue that in itself enhances some of the nonstructural planning measures. I think it is a broader, more complicated model and not an attempt to extend the present, rather linear model. I think the answers and the future are with the more encompassing risk model.

GALLOWAY:

But today we live with the model the secretary and OMB use, and I think we still have to come to grips with that.

MILLER:

I hear a double standard being applied often, saying, "It's alright; these things can't be evaluated with a benefit-cost analysis procedure." However, when the report goes up the line it's evaluated with a b/c analysis procedure. And if the justifying numbers aren't there, it comes right back down, all nice arguments aside.

Perhaps OCE has changed its orientation in the last several years. I would like to refer back to OCE's response to the St. Paul policy discussion on the development of nonstructural alternatives. The policy discussion suggested exclusion of certain amounts of project costs based on the fact that they were not being done for the purposes of economic efficiency. OCE's response was that the Corps of Engineers is not in the business of conducting "social programs."

Are you saying that OCE has changed its view of nonstructural planning? You'd now send a project to "Sec Army" and OMB without favorable b/c ratios? If you still aren't willing to do that, tell me that and I'll work on my benefit-cost analysis procedures.

BELSHE:

I think the latter is an easy one to answer because, as you should well know, for the last two years you have certainly had that option. The net benefit rules had been relaxed in principles and standards. We're now anticipating rather a revision with the principles and guidelines.

I would certainly admonish -- and I think you recognize that policy is policy -- that exceptions are made all the time. You only have to make a good case. You must study a policy ruling in order to see how to couch your argument. If you wish to try, move forward to the board. The board acts nearly every time with half the projects having some aspect of exception to policy. Policy is general guidance.

But don't talk about a single model. The NED manual is not one model but a set of models. Many of those are very modest attempts at groping for what I was talking about -- moving into a broader area of risk assessment. You could see that in some of the dam hazard safety discussions there. You can see it in other parts of the NED manual. It's already there.

JON KUSLER:

It seems, looking at community programs, that a very fascinating inquiry would be not only "cost-benefit from a federal perspective," but, "How much is a community willing to cost share?" After having looked at their communities, I think what's interesting is that communities define their goals much more easily than the federal government defines goals because communities have something very specific to deal with in terms of their own well-being.

I think an inquiry of that sort would lead us in some very interesting directions, and I understand the administration would like to move us in that direction. Very interesting in terms of goal definition and multi-objective planning. If you can work with a community and evaluate projects in terms of willing percentage of cost sharing, you'd get some very interesting stuff out of that approach to evaluation.

ALTERNATIVE LAND USES

ALTERNATIVE FLOODPLAIN MANAGEMENT LAND USES:  
ACHIEVING WISE LAND USE  
BY  
FRANK H. THOMAS

The Nation's relatively limited supply of floodplain lands has provided and will continue to provide highly desirable locations for a variety of land uses. Over time the types of land uses and their competitiveness have continued to change. Always, floodplain land use had to accommodate the risk of losses caused by flood waters. First, structural and more recently nonstructural tools have been stressed as means for reducing flood losses. At the time of the 1976 Corps Seminar on nonstructural tools, the concept of a national floodplain management program and an agenda for improving the use of nonstructural tools had been established. In the six years subsequent, important progress has been made in utilizing these tools. The following discussion reviews changes bearing on land use competition and on associated nonstructural tools. An agenda for 1983 is suggested.

Use of the Nation's Floodplain Lands

Historically in the United States, economic competition allocated floodplain land use to the highest bidder, usually industrial or commercial land users. This situation was modified by development of land use zoning regulations beginning in the early part of the twentieth century. It was further modified by the incorporation of flood hazard and environmental protection components into the regulations, especially during the past twenty years.

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This economic competition is based upon the traditional locational advantages of site, such as flat land and water supply, and situation, such as easy transport corridors linking different transportation modes. However, twentieth century technology has permitted the relaxation of site and situation requirements for many land uses and the twentieth century style of living has permitted amenity directed uses to compete effectively with commercial and industrial uses for the occupancy of floodplain sites. United States citizens place high value on living on the waterfront and having access to open spaces for recreational, aesthetic, and environmental purposes.

In the emerging competition for the use of coastal and riverine floodplain lands, dwelling units, recreational and open spaces, cultural and historic preservation, and ecological preservation are often viable land uses. Where market competition has been judged to unfairly disadvantage these uses, community and State regulations reserve use of some lands, for example, wetlands and beaches. As level of living and technology continue to improve, these land uses continue to become increasingly competitive for the limited amount of floodplain land along the edges of oceans lakes and streams.

Floodplains as defined by the 100 year base flood standard amount to seven percent of the Nation's land. Within the Nation's urban areas where land use competition is most keen, 16 percent of the land is within the base floodplain (Goddard, 1976). While aggregate data on occupancy of these lands is not well documented, several available statistics indicate trends. Since 1976, United States population has grown at the rate of 3 million annually and now totals 232 million. The growth areas are largely sunbelt cities, and especially coastal cities. Since 1976, the number of flood insurance policies tripled from 608,000 to 1,878,000 in 1981. It is not surprising that 47 percent of these policies are now held by occupants of four coastal metropolitan complexes centered on Miami, Tampa, New Orleans, and Houston (Federal Emergency Management Agency, 1982).

Competitive pressure for occupancy of inland floodplain locations continues, though less concentrated than in the sunbelt coastal cities. In inland areas there has been a growing awareness that actions at upstream, crosstream and downstream locations in a watershed can adversely alter flood hazard conditions. Unfortunately, national data on the effects of floodplain development are not available. Nevertheless, State and local floodplain regulations more frequently incorporate sections regarding fill in floodplains and development in upland areas (Kusler; 1982). Moreover, successful litigation seeking to fix liability for failure to enforce floodplain regulations is attracting the attention of government officials.

Competition for use of the limited supply of the Nation's floodplain lands continues to increase with growth of an affluent water-oriented population. Fortunately, as discussed hereafter, important progress has been made in advancing the understanding

and implementation of floodplain management practices.

#### The Floodplain Management Agenda of 1976

The proceedings of the Corps of Engineers' Seminar on Nonstructural Floodplain Management Measures and the Water Resources Councils Unified National Program for Floodplain Management identify the major issues on the Floodplain Management agenda in 1976. (Tang, 1976 and U.S. Water Resources Council, 1976). Major policy issues on the agenda are lack of policy clarity and the presence of policies inhibiting the adoption of nonstructural measures. The admonition of the Water Resources Development Act of 1974 (U.S. Congress, 1974) to give equal consideration to nonstructural measures found wanting for lack of definition of planning objectives and institutional roles consistent with national planning objectives and demonstration of a Federal interest in nonstructural measures. The nonstructural thrust of Executive Order 11296 directing Federal agencies to carry out flood hazard evaluations is found wanting for lack of satisfactory implementation and monitoring provisions. Inconsistent Federal cost sharing inadequate benefit-cost procedures are cited as policies inhibiting adoption nonstructural measures. Also cited are lack of coordination among Federal agencies and lack support for State floodplain management.

Two major sets of technical issues are on the 1976 agenda. First, data and methods to analyze social and institutional problems associated with the implementation of nonstructural measures are lacking, for example, attitudinal and behavioral research is needed. Second, specific technical documents and formal communication channels for informing and assisting state and local floodplain officials are lacking; for example, the provision of consistent flood loss data, improved flood warning and evacuation procedures, a floodplain management handbook, and the completion of flood insurance studies. Together these technical and policy issues were seen as impeding adoption and implementation of nonstructural measures and the achievement of wise land use in the Nation's floodplains.

#### Major Events Affecting Floodplain Land Use Since 1976

Since 1976, significant progress has been made addressing the 1976 agenda, yet some issues remain to be satisfactorily addressed. Progress is indicated by review of five major events bearing on floodplain land use. These are: the 1977 floodplain management and wetlands protection executive orders, the 1980 Federal interagency agreements, the 1980 Water Resources Councils's Principles and Standards, the Coastal Barrier Resources Act of 1982, and the implementation of the Unified National Program for Floodplain Management. The evolution of the National Flood Insurance Program is not addressed because it is taken up elsewhere in the seminar program.

Executive Order 11888, Floodplain Management and Executive Order 11990, Wetlands Protection, have had a major impact upon

floodplain land use decisions where Federal programs have been involved (Federal Register 1979). These orders tie together the previously separated goals of flood loss reduction and environmental loss reduction and recognize that there are natural and beneficial values associated with floodplain and wetlands. They embrace the fundamental nonstructural policy of avoiding floodplain sites whenever practicable and taking mitigating actions whenever avoidance is not practicable. They extend application of the 100 year base flood standard of the National Flood Program being applied in 17,000 communities to all Federal programs, thereby enhancing all Federal programs, thereby enhancing consistency of national floodplain management. The orders also establish an explicit evaluation process allowing for public input and have resulted in the adoption of implementing procedures by 55 Federal agencies. The net effect of these orders has been an enhanced awareness of flood hazards and mitigation alternatives. Available evidence suggests that more knowledgeable decisions are being made by Federal agencies and that many states have adopted similar executive orders or administrative requirements.

Two interagency agreements seeking implementation of nonstructural measures were developed as an outgrowth of 1979 Water Resources Council studies and recommendations prepared at the request of the Office of Management and Budget (Platt, 1979). In July, 1980, the Office of Management and Budget directed in agencies to establish an interagency agreement in accord with a Memo entitled "Nonstructural Flood Protection Measures and Flood Disaster Recovery" (Office of Management and Budget, 1980). This memo directs, all Federal programs that provide construction funds and long term recovery assistance must use common flood disaster planning and post-flood disaster recovery practices." The dual strategy of the memo is to utilize the leverage of immediate post flood situations to advance nonstructural flood loss reduction solutions and to link the efforts of disaster recovery and planning-construction agencies.

The resultant interagency agreement commits 12 agencies (including the Corps of Engineers) to a common policy implemented primarily through interagency hazard mitigation team under the leadership the Federal Emergency Management Agency. After almost two years of experience with more than 20 presidentially declared flood disasters, these teams generally have been successful in guiding hazard responsive relocation or rebuilding of infrastructure. Although flood hazard mitigation teams are untested by an area-wide catastrophic flood disaster, a growing cadre of experienced Federal, State and Local personnel have become aware of the availability and appropriateness of nonstructural options.

The second interagency agreement was developed in the Fall, 1980 by staff from the Departments of Agriculture, Army and Interior, the Water Resources Council and the Office of Management and Budget. The objective of this agreement was to establish a common policy at the upper levels of the administration among the water resource construction agencies pursuant to the Water Resources

Development Act of 1974 and the Water Resource Council's Principles and Standards (Federal Register, 1980). The policy statement provides a definition of "nonstructural" and deals with local complements to Federal activities, the mix of structural and nonstructural measures, benefits of nonstructural flood damage reduction measures, levels of protection, and cost sharing. On December 4, 1980 the Assistant Secretary of the Army (Civil Works) issued a memorandum for the Director of Civil Works reporting the Department's adoption of the policies in the agreement and indicating that preauthorization reports leaving the field after June 30, 1981, should be fully consistent with the policies (Department of Army, 1980). However, interest in implementation of this agreement ("Use of Nonstructural Measures in Flood Damage Reduction and Floodplain Management") was dampened by the uncertainty resulting from the 1980 national election. Perhaps as the current Administration's cost sharing policies emerge, the 1980 policy statement will take on renewed interest?

The Principles and Standards adopted by the Water Resources Council in September 1980 required formulation of a primarily nonstructural plan and the accompanying Environmental Quality Evaluation Procedures encouraged valuation of ecological attributes of the floodplain. Consequently, the natural and beneficial values cited in the floodplain executive order were further defined and given wider recognition. Although action was taken by the Council in September 1982 to repeal the Standards, the two years of experience with a required nonstructural plan and environmental quality procedures have stimulated interest in new methods of implementation and led to greater awareness and acceptance of the compatibility of the ecological uses of floodplain lands and nonstructural accommodation of flood risk.

The Coastal Barrier Resources Act of 1982 promises to be a major step toward utilizing the nonstructural approach of avoiding high hazard locations (U.S. Congress, 1982). This Act legislates the avoidance approach of the 1977 Floodplain Management Executive Order (E.O. 11888) by prohibiting new Federal expenditures and financial assistance on more than 700 miles of undeveloped coastal barriers on the Atlantic and Gulf coasts. In particular, it denies Federal Flood Insurance and disaster assistance and "... it simply adopts the sensible approach that risk associated with new private development in these sensitive areas should be borne by the private sector, not underwritten by the American taxpayer" (Ronald Reagan, 1982). This Act should eliminate challenges to E.O. 11888 in the designate undeveloped coastal areas and reinforce the policy of the E.O. elsewhere, especially in undeveloped riverine floodplains. Perhaps consideration should be given to extending this policy to selected high hazard floodplains?

The Unified National Program for Floodplain Management has changed markedly since it was first adopted by the Water Resource Council in 1976. In 1979 the Council adopted a revision of the Unified Program which updated its recommendations for improving floodplain management and incorporated the policies of E.O. 11888. Special

recognition was given to the strategies and tools for restoring and preserving natural and beneficial floodplain values. Two of the 1976 recommendations which had been accomplished were revision of old Executive Order 11296 and the establishment of an interagency floodplain management task force. Now the 1979 Unified Program might be appropriately updated to reflect the technical accomplishments such as the development of handbooks and manuals for local officials and industry on floodplain management, land acquisition, flood loss reduction, and regulation of flood hazard areas (Kusler, 1982). Also the policy recommendations should be modified to reflect the interagency agreements on nonstructural measures, the greatly enhanced capabilities of the States to carry out a floodplain management program, the thrust of the Coastal Barrier Resources Act, and experience with implementation of E.O. 11988. Reappraisal of the Unified Program will be undertaken in 1983 under the auspices of the Federal Emergency Management Agency which was assigned responsibility for the Unified Program in September 1982 when the Water Resources Council staff was disbanded.

Looking back at the 1976 floodplain management agenda, it is apparent the significant progress has been made in meeting some agenda items. There is greater national awareness of nonstructural options because of experience with the Flood Insurance Program, the E.O. 11988, the Principles and Standards, and the Unified Program. Better technical information is available to local officials and the private sector as result of the publication of handbooks and the dissemination of information by State Floodplain Management programs. Nonstructural policy has been strengthened by the E.O. 11988, the Coastal Barrier Resources Act and the interagency agreements. Overall, progress is significant when compared to where we were in 1976.

### Three Trends Affecting NonStructural Measures

Bearing in mind that acceptance and utilization of nonstructural approaches to flood loss reduction are but one aspect of larger concerns for use of the Nation's floodplain lands, it is essential to recognize three trends: integration of Federal programs, the urban orientation of Congress, and the Administration's federalism policy.

The first trend is the integration of Federal programs affecting floodplains. The current status of flood loss reduction activity stems from the evolution of Federal programs for water resource projects, disaster assistance, and environmental quality. Beginning with the 1936 Flood Control Act and continuing through the 1960s with the National Flood Insurance Act and Executive Order 11296, Federal responsibility for flood loss reduction expanded. Federal disaster assistance programs which had been expanding during the 1950s and 1960s were linked to the Flood Insurance Program by the Flood Disaster Protection Act of 1973 (U.S. Congress, 1973) and the Comprehensive Disaster Assistance Act of 1974 (U.S. Congress, 1974). This linkage was further strengthened by the 1980 interagency agreement on the use of

nonstructural measures in post-flood disaster recovery.

During the 1970s previously independent environmental programs were linked explicitly to water resource project planning and disaster assistance programs by Executive Order 11988. Thus, an increasingly consistent Federal posture regarding land use in flood hazard areas has evolved from both administrative and legislative actions. Continued integration of these programs will be influenced by changes in emerging orientation of the Congress and the Administration's commitment to Federalism.

The second trend is the growing urban orientation of Congress. In the Congress, for several years there has been great uncertainty regarding the Federal role in all facets of water resources programs and policies. This has been especially true for Federal water resources projects including flood control for which annual appropriations for new construction and project operation have fallen to less than one-third of the level of the mid-1960s (Davis, 1982). It has been argued that as redistricting has increased the number of Congressmen representing urban districts, long standing coalitions of western and southern congressmen have been weakened and it has become increasingly difficult to put together the needed votes to move water projects through the appropriation process (Caulfield, 1982). Urban congressmen tend to focus on environmental improvement, ecosystems protection and urban water quality. Moreover, the typical congressional response to urban problems is the grant approach exemplified by EPA programs, an approach alien to the traditional direct water project approach (Wengert, 1980). Senators Moynihan and Domenici have supported a block grant approach to water projects in each of the last two Congresses. The net effect of Congressional uncertainty is defacto increased reliance upon non-structural approaches to flood loss reduction. Also, it should be noted that passage of the Coastal Barrier Resources Act is consistent with urban orientation in Congress.

The third trend is decentralization expressed through the Administration's federalism policy. This policy seeks to shift program responsibility to States, to shift the burden of Federal program costs to program beneficiaries, and to reduce Federal regulations. Accordingly, Federal program posture is shifting from that of leadership to assistance supportive of State initiatives (Carleson, 1981). Upward adjustment of flood insurance rates and the non-Federal share of disaster assistance costs in evidence of increasing beneficiary payment of program costs. The recent efforts to modify the Clean Water Act's Section 404 permit program and the review of E.O. 11988 are evidence of the regulatory relief effort.

These thrusts of Federalism together with reduction in domestic program expenditures suggest the Federal agencies should not anticipate major increases in new control projects but seek new ways to expand floodplain technical assistance to State and local communities. Moreover, floodplain management technical assistance and flood insurance studies have not been targeted for full cost

recovery. In the case of the National Flood Insurance Program, a significant backlog of studies and restudies promises an opportunity to strengthen local and State floodplain management efforts (National Research Council, 1982).

#### Flood Plain Management Agenda for 1983

Consideration of a 1983 flood plain management agenda should be undertaken with some satisfaction in progress achieved in the last decades. Clearly there has been dramatic growth in the overall awareness of flood hazards by bankers, developers, government agencies, and other decision makers who now have access to an array of technical publications and handbooks for nonstructural and structural adjustments to flood hazards. Equally clear is the progress achieved with integration and consistency of Federal water resource, disaster assistance and environmental programs, phenomena also found in many states. Flood plain decisions reflect a better knowledge and responsiveness to flood hazards than ever before. Nevertheless, flood losses remain unnecessarily high and further improvements are needed.

Among the opportunities for improving flood plain use decisions, three warrant high priority by Federal agencies and the Corps of Engineers. Each of these opportunities is concerned with better use of existing authority and programs in discharging Federal responsibilities for flood plain management.

First, Federal flood plain planning and technical assistance capability need to be harnessed together. The Corps of Engineers, Soil Conservation Service, Tennessee Valley Authority, Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, United States Geological Survey and Bureau of Reclamation all have authority and capability to provide some aspects of flood plain management technical assistance. Reduction of governmental expenditures for capital projects means increased reliance upon technical assistance for nonstructural measures to deal with flood loss reduction problems. The expectation that States will assume primary leadership roles under the new Federalism means technical assistance will have to be provided to raise the management capability of most states. Given the current fragmentation of Federal technical assistance capability and these needs, interagency agreements should be utilized to take full advantage of available resources. The Corps' cooperative program with FEMA in the conduct of Flood Insurance Studies and the Community Assistance and Program Evaluation studies represent examples of the kinds of activity likely to be more important in the future. The interagency post-flood hazard mitigation team participation of the Corps is another example.

Second, clear and consistent definition is needed to demarcate Federal from non-federal flood plain management responsibilities. Definition should be undertaken by simultaneously addressing responsibilities for issue areas including urban drainage, floodproofing of structures, acquisition of structures, and special flood hazards such as mudflows, landslides, alluvial fans

and coastal erosion. Previous definition of the Federal interest one issue and one program at a time has led to confusion and inconsistency among Federal agencies and between levels of government.

Third, there continues to be an urgent need for consistency among Federal evaluation procedures and among cost sharing procedures. Non-Federal activities seeking Federal flood loss reduction assistance select programs that are easiest to obtain and that minimize their costs, but these programs may not result in the best combination of flood loss reduction measures to mitigate their problems. Differences in evaluation practices range from project by project economic evaluation of flood control projects to programmatic economic evaluation of flood insurance and programmatic general welfare evaluation of disaster assistance. Differences in Federal cost sharing practices are evident in percentage of share, form and timing of payment. These differences frequently work to the disadvantage of nonstructural alternatives but most important, may encourage selection of less than the best response to flood problems.

The technical assistance opportunity can be addressed by Corps initiative working with other agencies and is unlikely to involve major policy issues. Cooperative technical assistance should lead to near term pay-off. In contrast, the authority, evaluation, and cost sharing issues are ripe for Corps initiative but most involve policy decisions of the Office of Management and Budget, other agencies, and possibly legislative change. Consequently, the latter will be more difficult to achieve but no less worth while.

The 1983 agenda proposed for the Corps is ambitious. If the Corps can successfully address each agenda item, another seminar on flood plain management six years hence would record major progress in achieving effective flood plain management.

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PANEL VI, FOLLOWING THOMAS ADDRESS

BERNIE INGRAM:

I intend to make several general comments relating to alternative land uses and then to site some of the district's experiences in that regard.

Through this panel in part and through previous panels, we have determined that there are specific reasons why floodplains are used because of the advantages they offer to development. We've also set forth the very heavy support and findings regarding the ecological values of floodplains. So we see there are these spectral uses. We don't have any problems with identifying the alternative uses. They have their values, they have their supporting arguments. I think it's easy in specific cases to support either of these things, depending on the specific circumstances that you find. A fully developed, heavily industrialized floodplain does not leave an option for a preservation area or conversion to open space areas. On the other hand, if there are ecological sacred areas where there are unique values regarding the fish and wildlife interests, archaeological interests, aesthetic values, and so on and so forth, these would warrant specific consideration, and I think that the judgment needs to be made as to the direction which should be taken in these cases.

However, we found that in reality, in our day-to-day experiences, mostly our judgments don't fall in these extreme areas. The preponderance of them are in this wide chasm between. However, I think it's evident from the amount of remarks and discussion that we've had here now that we generally accept that there are these various land uses.

It has been brought out in several of the panels, and certainly I'm in agreement with it, that we sanction, we encourage, we philosophically say that these things have merit. We then look at the practical side, the institutional side of the application of these particular considerations, and we find that we do not have a clear course, we do not have a viable path to follow. I think many of the suggestions actually may get into these areas. Certainly we explained maps on nonstructural measures, and we know that there's something wrong when you fall flat in the consideration of something in the neighborhood of a few thousand dollars and you see social programs immediately adjacent to it, multimillion dollar developments, urban renewals, and things of this nature. We are not on parity. We do not, I think, have a suitable springboard for nonstructural consideration. That is an incompatibility of nonstructural as it relates to structural. We engineers become quite comfortable with benefit-cost ratios. And I like benefit-cost ratios. They provide an insight which perhaps nothing else would.

However, when it comes to nonstructural measures, unless we learn to put a value on many things which we can't evaluate today, they do not have an equal consideration. We can profess that they have equal consideration, but I question that they do. I hope that John will look further or discuss this value, some of the values related to the nonstructural measures.

I think, as others have commented, that there are very few economically justified conversions in developed areas to conservation and preservation areas. We did, however, find one that had an outstanding potential for evacuation, and by coming up with an elaborate development proposal for recreation we were able to put a positive price tag on the situation.

However, in a particular setting in rural areas with plenty of recreational area in the natural state, a development for recreation holds very little attraction. And for recreation, it was not socially or financially acceptable to the local sponsor. That was a futile exercise. That's one of the few that we found economic justification on, however, it's not the only one on which we've had conversion or preservation. And we did find that where these considerations are related to a structural measure, it opens many doors so far as what could be accomplished or incorporated into these. And through this means we have had preservation areas, mitigation areas, and conservation areas, which I think forms posterity, does set the man-use destiny of the area.

We feel that the floodway regulations associated with structural projects are successful. From the citation of the lawsuits yesterday, I guess time will tell if we're equally vulnerable. But we think that has been a highly effective tool and acceptable description, and time will prove that it has set the destiny of those designated floodplain lands.

Of special concern is the philosophical emphasis that we give to nonstructural measures but then establish constraints through artificial, and I think sometimes irrational, evaluations which do not provide a means to an end. It would seem advisable that if land use, evacuation, acquisition, and so on are worth their salt, that this is a desirable route, that this is going to be among our bag of tricks. We ought to look forward to making this real while we look toward honest recognition of the full values, of setting a goal of establishing acceptable values which bring these things on par with other considerations.

Part of that was that federal interest first needs establishment. We have to know where we're going and this rocks back and forth and sometimes it's not too evident. But what our base is and where we're going from there certainly is important, as is the establishment of real means of implementation--not theoretical, but what does in fact bring these nonstructural measures, land use included, on par with other considerations.

JOHN BELSHE:

I guess the question I have to ponder is what is the role of the panelist that I can sort of challenge, to perhaps give more emphasis to some of the questions here on ecological functions. However, I guess my natural predilection is to try and aid the audience in coming to grips which what might be some of these issue matters which should come up both here in our discussion and in the more general ones which follow.

And I think it is towards the latter that I incline to turn and let any questions pull me back more to the ecological base. I thought Frank Thomas

did a commendable job in giving us a well-structured and well-rationalized appraisal of the Washington management-level look at where we are in the matters of the total discussion of the symposium here.

To turn that a little towards the utility of the audience, I would perhaps make a couple of contrasts. Where you give the emphasis to the wise use of the floodplain land, I guess I would give equal emphasis to the use of the water. I'm urging that we don't treat the waters as something to be passed through as rapidly as possible, but recognize that the ecological values, particularly (the importance to man secondarily from that), of these floodplains have come because of the access to water. It is that even more than the geomorphological cutting and shaping of the floodplain, than the importance to the plant and animal communities that come from it.

That leads me then to make a contrast with you. Whereas your emphasis may be on the emergency aspects, I think to the ecologist the emphasis is more on the floodplain as a renewable resource. It is the perpetuity of it; it is the relative permanence of the cycles, the competitive patterns that are there, which are of particular importance.

And I think recognizing that leads me to approach still a third point, and that concerns what is this period of regulation. The 100-year standard for comparison has probably got something to do with the risk assessment-type matters we were discussing yesterday. That 100 years is not only comfortably beyond one person's lifestyle, life expectancy, his investment patterns, but it also gives him the feeling that he's probably talking about something with a one percent probability of happening in a given year. And that is probably reducing risk and hazard to a level of some personal comfort.

Ecologically, I'd approach it the other way. The 100 years is comfortably beyond the natural periods of any ecological processes. Let's take the hardwoods. That's probably just about the step beyond a single generation of the largest living elements of that ecosystem, the large trees themselves. A hundred years is the period where much of the ecological competition in succession can be easily worked out. Now there's nothing magic about this, any more than there is in probably about the risk level of the 100-year, but it does give me some confidence that it's about the right order of magnitude. That is, we should not certainly be intuitively feeling that we have to go up to the extreme values to reach full ecological understanding of the importance of the floodplain. And it should caution us very severely about making such base periods too short.

I guess my final point would be to play up a point that we were talking to yesterday, and that is to be sure that some of the recognitions of the importance be attached to both segments, both the urban and the rural. If our approach to the ecological more often probably talks in pictures of pristine ecosystems, the caution that I would place in your minds is that we cannot at the same time fail to recognize that they may be even more important--even though small, even though constricted, their uniqueness may be even higher--in the urban setting. And the opportunity there for man's appreciation and for giving some variety to the landscapes and the natural areas that he inhabits is perhaps even greater than it would be in the larger and suburban areas that we study.

That may be the final point of follow-up to your presentation. Perhaps a postscript would be not to challenge you but at least to put a counterview out on how sanguine you feel about Principles and Standards. And I guess this gets back to the setting of where do we stand in the managerial aspects of the Washington scene. You speak to the two years the Principles and Standards, as revised, were on the scene as having perhaps more importance than I could attribute to them. I think that the reluctance of some to move into the new directions probably caused a phased lag in their being put into application, and I think there was an early stampede out of them as soon as there began to be an appearance of change almost a year ago. I would be very doubtful that there would ever be any monuments built in the water program that can be pointed to as having reflected any lessons learned from the Principles and Standards. I say this not to belabor the point but really to cast the point in a little sorrow, because the cycle of planning is sufficiently long in this area that no matter what we are doing, structurally or nonstructurally, two years cycles for policy change are far too short for anything of significance to establish. We've got to get more stability. We've got to get a period for working out some of these matters.

At the very end of yesterday's discussions, there was some interchange with the floor and the panel about how do we make some of these presentations, how do we display particularly the non-monetary aspects. And that I think is what the objectives have been trying to come to grips with since the '70s which they have not yet accomplished, which they must accomplish. You cannot treat renewable resource problems with the same sort of present-worth thinking, the some sort of discount policies that you use for some of the inflationary fiscal matters that come into the benefit-cost ratio. There's got to be a contrasting way of dealing with these, and we've got to have stability in the policy areas far beyond what I think we've had through most of the '70s.

GRANT KELLY:

I would like to recite a recent experience in New England to illustrate a few points and then follow that up with a challenge to the policy and programs offices of both Corps and FEMA as to what we can do about the study process in some of these areas.

In June of this year, a rather apparently innocent low pressure system stalled itself over the southern coastal basins of Connecticut and Rhode Island. In a 24-hour period it deposited anywhere from six to 14 inches of rain on some of those basins. In the process of this, we had recorded flows approaching 100 year predicted flows in some areas, and we had recorded stages in excess of predicted 200-year stages. The damage was in excess of \$100 million from this essentially one-day event. In the process several dams failed, and it was only through a miracle that life was not lost. In the aftermath of this, calls flowed through our offices for requests for assistance in preventing a repeat of this kind of activity. And in the process of attempting to respond to these requests, we tested out the viability of some of our planning tools and planning processes. From my observation, most of these tools came up wanting--sadly wanting.

Structural solutions to this particular problem were inappropriate for a variety of reasons. Geographically, hydrologically, environmentally, and finally, fiscally, there were no structural solutions to the problem. Nonstructural approaches were clearly called for. The typical Corps planning process, the big feasibility study, the comprehensive basin study, was too unwieldy from both the standpoint of time and from current trends in cost sharing. The section 205 program was tested out in responding to these requests. It became very clear that the lack of local sponsors who were willing to pour money into what in most cases were private enterprises, small businesses, industrial-commercial establishments in the floodplain, made Section 205 inappropriate. We had approximately 30 to 40 requests come through our office. From these we selected one to make some sort of attempted response under the Technical Services Program, the Floodplain Management Unit, New England Division.

This particular instance was a small textile mill in North Providence, Rhode Island, which had sustained approximately \$70,000 worth of insured damages and an additional \$100,000 worth of non-insured damages, primarily down time and fixed-cost losses. The plea from the owners of this establishment was, "Give us some assistance by telling us what to do to prevent a repeat." For approximately somewhere between \$10,000 and \$15,000, we are just now concluding a study that has laid out a combination of small dikes, local drainage reroutings, some check valves, and some floodproofing by way of closures that the owners of this business are in the process of implementing, or will soon be. The net result of this will be that they will have protection from the dike for approximately the 10-year flood, the nuisance flood that hits the parking lot, some of the lower buildings. And through a series of closure mechanisms and interior drainage, they will have protection probably between the 25 and 50-year flood.

All this has been accomplished with private enterprise money. Our role was purely to come in, do a quick evaluation, reconstruct how flood waters got to where they got, and point out some possible solutions. Now, what did all this teach us?

Primarily, nonstructural solutions, at least in New England, appear to be on a one-on-one basis, case by case, building by building. The development of the floodplains in the New England region led to a series of small to medium-sized mill-type construction. Break down an area in a 10-year flood plan. New England is full of them. We are not talking by and large about regulating new development in the floodplain. We're talking about retrofitting existing development to cut down on these losses. We're looking at \$100 million worth of loss that basically we are not responding to by a failure in our programs.

It seems pretty apparent to me that if we could point out to private enterprise that there are opportunities for investments producing returns in the way of future savings from non-insured losses from floods, they will respond as this one industry, my case study, has responded.

So my challenge to you, Bill, is get us some more money in that Technical Services Program. It's there, the tools are there, the big studies aren't working. We need some one-on-one money. Get us some bucks in that program.

Frank Thomas, FEMA, the regulations attendant to the flood insurance program in New England are well in place. They are definitely controlling new land use within the floodplains. Once again, our problem is retrofitting. It's existing development in most floodplains. Your constructive programs, your 1362 programs, are fine as far as they go, but outright acquisition is not always the answer. It seldom is the answer in industrial and commercial establishments. The situation in my case in point in Rhode Island has a private company making their own investments to give them protection probably for a 25-year tornado or flood. In so doing, they have probably eliminated 80 percent of their average annual damages from flooding. There are no incentives currently that I'm aware of in the FEMA program that would have industry and commerce invest in flood protection to achieve less than the 100-year flood protection. Certainly there are no rebates, no lowering of insurance rates for so doing.

I would challenge FEMA to give some consideration to how they might consider motivating private enterprise to invest its own money in flood protection short of the 100-year elevation. In a case of this particular textile mill, 100-year protection was infeasible. For this building, the elevation would have been some six to eight feet up on the walls. Structurally they could not withstand it.

This is a case where something less than 100-year flood protection is feasible and industries will buy it. I challenge you to find some sort of tool to motivate them.

DISCUSSION FOLLOWING THOMAS ADDRESS

LAWRENCE FLANAGAN:

Frank, I'd like to know a little bit more about what the force is behind the idea of re-evaluating the use of the 100-year base. It would seem to me after spending 10 years and several hundred million dollars in developing the 100-year flood level that it's a pretty ill-advised thing to do. I'm a bit surprised at its even being considered.

FRANK THOMAS:

Larry, I know you weren't "planted" to ask me that. The 100-year base flood standard has been periodically challenged. It has been challenged in two directions. I think the most persistent and well-organized challenge comes from a group in the housing industry. Recently the president's commission on housing held hearings, took evidence, and compiled a report which indicated that the 100-year base flood standard was a serious problem for the housing industry, particularly the single-family unit part of that industry.

There is a division of opinion in the Department of Housing and Urban Development as to what the appropriate policy is. The housing production people feel very strongly that the 100-year base as applied is inappropriate. I think because of their position we now have that review before us. Last April a group of people spoke to OMB persons who were considering a review of the executive order on floodplain management. At that time the people in OMB were thoroughly convinced that the order saved dollars and was a good thing. Since April, things have changed.

CARL GAUM:

Frank, there is a good environmental reason for people locating in the floodplain in many parts of our country. The floodplain is green in many regions, has animals associated with it which people enjoy watching. I think this should be taken into account in the floodplain management program -- the assets of being near the water.

On the other side, we saw a curve presented yesterday which showed damage reduction with warning time. It may be possible to put in low levels of protection -- 15, 25-year protection, gaining that additional time which reduced the damages by 40 percent, according to the chart. So there may be some things here that we've been missing that would allow us to use the floodplain and, in combination with nonstructural measures, still reduce damages.

FRANK THOMAS:

I would agree that the need is to have the risk to losses and the impact on the functions of renewable resources both considered in the use of the floodplain. There has to be a compatibility of use with both of these. Sometimes we think of it as environmental losses and flood losses. Use must be compatible with the risk to both of these.

PAUL GAUDINI:

How does the nation, and the Corps, perceive the whole problem with floodplains and flood damages? Do we look at it as our having made a mistake as a nation in how we've developed floodplains and now that we should be looking at how to correct that mistake and moving into a future of compatible use in floodplains? If we look at it that way -- that's only one view -- then everything we do is interim or short term. And then I think your economics makes sense, in that even though we think of something permanent, say an industrial development or housing, it is just interim until we can straighten out the historic problem of floodplain land use. So the economics works out because maybe one solution is simply flood insurance to take the shock of people who have to suffer after an event. Maybe the floodwall or the nonstructural plan, in itself, is more expensive than suffering the loss and paying for it and doing some other action after that.

Or do we look at the floodplain as something that we want to reinvest and encourage reinvestment in? It could change your whole outlook. And I have never seen a declaration of our goals in flooding and the floodplain -- our perspective, how we do look at it. If we really do our job we'll eventually put ourselves out of business in the long term.

THOMAS:

It would be presumptuous of me to think I could speak for the nation or all those policies involved. But my mind runs straight to the philosophy of the Flood Insurance Act. That recognized floodplains as having developed conditions and undeveloped conditions and that the responsibility of the communities is to control new development so we don't make mistakes in the future. The existing development -- if it reflects mistakes in the past -- is to be addressed through insurance and other measures as a means of gradually making the uses compatible over time.

One of the bits of philosophy of the insurance program -- the idea of actuarial rates, full rates at some time in the future -- is an important element of getting back to self-adjusting mechanisms rather having a subsidy. The policy would then be to have that taken care of more in the marketplace than through government intervention.

I think that would also be true for the question raised about rate incentives. I agree, we do need better incentive systems, and FIA is working on that.

DALE KLEMME:

Mr. (Grant) Kelly, I believe when you were referring to retrofitting existing commercial structures you were dealing with some type or degree of floodproofing. I think you've hit some sensitive matters which need consideration.

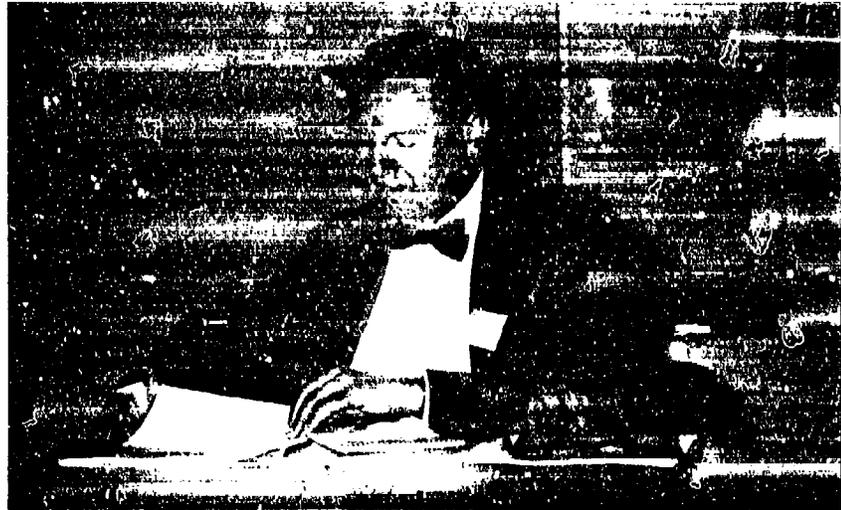
It isn't practical, as you suggested, for businesses to relocate from the floodplain. More than 50 percent of businesses that are displaced by a federal agency wind up going out of business as a result of the insufficient nominal compensation payments received for relocation. As was mentioned earlier, the land values are generally less, zoning has done something to inhibit values, thus you don't have the value there to buy a replacement property.

Counties certainly aren't interested in displacing businesses from the floodplain because they lose tax base, jobs, etc. if the relocation proves "fatal." On the other hand, we have a number of instances where current federal policy suggests that if you don't go the full bolt -- flood proofing or moving, then some small incremental action of less than 100-year protection isn't practical. It seems to me that it should be the owner's decision what he thinks is economically feasible if he's going to pay the bill. An imposed standard (and cost) doesn't seem to me justified.

BRIG. GEN. FORREST T. GAY, III:

A comment. I agree with everything that has been said about the advisability or desirability of adding other values to this equation when you are formulating nonstructural projects, particularly those which wind up with evacuation and relocation as the solution. But we're not going to get those things right away and we're going to have to play by the rules that exist right now if we're ever going to have any more projects like Prairie du Chien and Indian Bend Wash and others.

There's only so much value that you can get out of a golf course or a park, picnic table, or even a marina. We're going to need some kind of innovative thought on residual uses of the floodplain which are compatible and intelligent, and of high economic value. I would hope that either during the general issues forum or afterwards in correspondence I might get some good thoughts on what we can do with the floodplain after it's evacuated to make the overall relocation scheme economical by viable -- at a b/c rate that will stand up to current tests.



## First General Issues Forum





## FIRST GENERAL ISSUES FORUM

GEORGE PHIPPEN:

In this issues forum we want to highlight those matters in that group of unanswered or partially answered questions that have been raised in yesterday's session and this morning. As Bill has suggested, we hope that we will be able to get a large input from all of you. That, after all, is the main justification for having a large group get together like this. What I would like to do is take a few moments to refocus your attention on the nature of these questions.

What I have done -- largely on my own, but with the help of some of the panel moderators -- is produce a list of questions in probably five or six categories. Some deal with what really is the whole role in this idea of nonstructural. Can it stand by itself? (I would say no, but that's a question.) Is it clear where it fits in? What kinds of adjustments are needed in our formulation processes to properly handle this whole idea of nonstructural tools? Do we have a goal set ("we" being the Corps) for more intensive interaction with local interests, which this kind of planning requires? What are the limitations currently existing in Corps planning which in a sense prohibit the full utilization of these nonstructural measures and further limit our ability to help others who have problems obviously to be addressed with this kind of approach? How much are we interacting with other agencies and their programs and benefiting from the funding that they may have? (I don't know if there is an awful lot of funding out there at the present time.) Are there new initiatives the Corps should consider in broadening its response capability? Let's look at the questions. What I am hoping to do with this is to stimulate for each one of you the kind of focus you are thinking of on the kind of questions you would like to ask.

One of the things that interests me is can we all accept the possibility that careful formulation in the planning sense could lead to an FPM (floodplain management program) comprised wholly of nonstructural measures? Further, could there be such a well formulated program that ends up with only one so-called nonstructural approach? Given the circumstances that many of the kinds of FPM actions that are taking place out there in the real world are those which communities and perhaps states are taking largely on their own initiative, what has the Corps done in the way of re-thinking what has apparently been a reduction in the very important floodplain management services function? What tactics do we employ to assure that properly formulated plans are not in the end rejected by those whom we hope to benefit? Can the Corps work with different design criteria? Do Corps authorities extend to relocation? (Apparently it has been a longstanding problem in at least one division.) Whom in the Corps does the public turn to for help when they have problems in this area of use of nonstructural tools?

If an FPM unit still exists in a given office, should that unit be involved directly in the planning process? I'll caution in two respects. One is that typically in the past and in my experience (and I am sort of editorializing here), one could see that there is a temptation on the part of the planning group to only approach the FPMS unit when they have run out of

other kinds of ideas, or, put another way, that group is not in the full time and process of planning, which is essential. We cannot do good planning if these things are "hung on." The other is a problem of reducing your services capability if you do that, but it is a dilemma.

Can more flexibility be part of Corps planning? How is the Corps utilizing financial analysis, for example? Has social impact analysis become integrated in Corps planning? How can the Corps integrate the important experience from warning-response planning, for example, in the coastal planning in Florida, in its general planning effort? Why shouldn't the Corps be doing a greater amount of warning system design and also integrating this kind of action into their planning process? How far is the Corps prepared to go in developing useful nonstructural information where early indications are that it is unlikely that there would be any cost sharing?

How important to Corps of Engineer planning and implementation are the expertise and funding from other agencies with somewhat parallel responsibilities? Are we too concerned with turf? Where warning and response solutions are in the planning picture, how are the benefits to be separated for cost sharing, for example? Do local expenditures for flood warning merit consideration as part of overall local assurances? Is the Corps prepared to commit the time and resources required for the lengthy planning interaction with local interest then it is found that traditional measures are not among the remaining most likely set of actions?

Does the Corps see nonstructural as being a long-term interest? If so, what is the increasing preoccupation with liability likely to do in the way of discouraging or encouraging nonstructural measures incorporation in the Corps plan? Should the Corps stress negative incentives such as liability in dealing with local interests, until more positive arguments become persuasive? Evidence gathered recently indicates that the g.oss of our major interest on the part of communities is the storm water management problem. What kinds of changes and guidance would be required to get more Corps involvement in the planning and in providing technical services? This may not be all nonstructural. Would the Corps be interested in taking up the slack in an area of more meaningful mapping for floodplains, which is seen as a developing need.

Given that the key to implementation is formulation, how far is the Corps willing to go in evaluating benefits and costs for floodplain regulation? Can R&D effort be a start in this direction? Don't we need a set of standards by which to judge program effectiveness -- presumably, standards beyond those in the P&S? Is the Corps too "loose" in its requirements for floodplain regulation? If so, how should this be overcome? How far can the Corps go in recognizing community needs beyond the floodplain in arriving at the best plan for the floodplain? Wouldn't the greater recognition of ecological values of the floodplain strengthen the nonmonetary support for some of the nonstructural tools? Are Corps procedures giving a fair shake to problems or potential problems in rural areas?

Does the Corps have the strength to "bust out" of the traditional BC procedures "straightjacket?" Is the need for clear goals recognized as a prerequisite to good economic analysis? What items should be brought into formulation that are not in the so-called traditional approach? Could an approach using risk assessments be used to complement, supplement, or replace the traditional approach? And, last, are some of the environmental values so strong and so fragile as to merit automatic protection that is not required to pass the test of formulation?

I would like to ask Don Duncan to start off with a pair of questions: How can the Corps integrate the important experience from warning-response planning, and why shouldn't the Corps be doing more with the design of warning systems and integrating these in the planning process?

DONALD DUNCAN:

I'd like to first of all talk "turkey" with you for a minute. It has been said two or three times but I'm still not sure if it has soaked in. This next hour and a half or so is very important to me, and I think it is very important to you. The seminar objective is not to bring you people together to hear us give you a lot of answers to questions you have not asked. We don't have a lot of answers. I'm not going to do a lot of talking; we want you to talk. You people from districts and divisions that are involved in nonstructural measures -- we want you to tell us what's going on out there. There are no major initiatives going on right now, as far as I know, at the Washington level in the Corps. Our question to ourselves is, "Should something be going on?"

If you are at district and division level and are involved in this and are not doing anything in the nonstructural area, we would like to know why. What are the constraints? What are the problems you are facing? What is it that is causing nonstructural measures not to be a part of your flood control program in your district or division? If you are doing something, we want to know what the good news is and we want to know what the bad news is. If someone in another district has had a favorable experience and you've had an unsuccessful experience in that same area, we want to know about that. Let's get some dialogue going. Let's find out why it is working in one district and not in another or vice versa.

There are three potential things that we might be doing. One is we might be improving the Corps' efforts in the information transfer. Are experiences going on in one part of the country that the rest of the Corps is not aware of and could benefit from? Another area is policy initiative. Are there important policy initiatives that we should be getting involved in? And the third category: are there procedural improvements that need to be made? Are we shooting ourselves in the foot, so to speak, with our own Corps procedures -- things that we could relax ourselves or improve so that they would work.

My experience in the flood control business tells me that there are three reasons why the floodplains are utilized. First of all, there is a lack of knowledge of the flood threat on some people's part. Those are the unfortunate people who move into the floodplain with a ball bearing

manufacturing concern, only to find a year later that it is very susceptible to flooding. The second reason is that I occupy the floodplain but somebody else pays; that makes it pretty smart on my part. If I don't pay the cost of being there, then I may be very logical in being there, but the reason for being there is because somebody else pays the price. The third reason is because it is the right thing to do. And that is something that is missed all too often. I hear very few people propose that we stop farming the Mississippi delta. I don't think that would be in the nation's best interest, although it would certainly reduce flood damage. That's why any objective you hear that is to reduce flood damages is a pretty hollow objective. It doesn't say a lot. So there are a lot of reasons why people should be in the floodplain. Some are economic and some are other reasons, but some people have made that decision on a very rational basis, and we shouldn't disturb that and we shouldn't fret about it too often.

The three areas that I would like to hear about from you are on the preparedness, the emergency preparedness: What do you think the Corps' role should be in the planning, designing, and implementation of emergency preparedness? We have heard some experiences in the Jacksonville District and a couple of other areas. I would like to hear your experiences. What do you think? What would you like us to have? What would you have us attempt to achieve as a Corps role in emergency preparedness? Do you have the idea, the concept, of "that's someone else's business?"

Another perspective that I would like for you to address is should it be a Corps role as an interim measure, until the states or some local level of government pick up the slack? Should our effort be something in the order of, let's say, a 50-50 proposition, where the government would help the states build the capability to do this kind of activity, perform this function, and then us get out? Or is it something that is a legitimate, long term Corps role?

The regulation of the floodplain: There is one question that has to be answered with every proposal for regulation of a floodplain, for every proposal for evacuation or for building a levee around an undeveloped area. That question is, "Why can't nonfederal interests regulate the floodplain?" I think the answer to that has to come as much from the nonfederal interests as it does from the Corps of Engineers. Florida has initiated a tremendous program to buy floodplain lands. And they want to buy them for three purposes, one of which has to do with flood control. One is to replenish the groundwater supply. Another one is environmental pursuit. They would like to use Section 73 for cost sharing with the federal government. But it is never going to work unless that question of why can't they regulate the floodplain rather than buying is settled. Changing the ownership of land from one entity to another doesn't do anything of itself in preventing damage.

The alternative uses of the floodplain: There just isn't any benefit in throwing things away that are still useful. I don't care how you color it, through social, economic, or any other way. There just aren't any benefits to be gained from throwing things away that are useful. As I go to work every day, I see buildings being torn down -- functional, useful buildings. The people who are doing that are not crazy. But they are not doing it just to

see a vacant lot there either, they are doing it because they have another objective, another use for that land, which is of a higher order than its existing use. They are not tearing down functional, useful buildings just to let the land sit idle. So the idea that there is something wrong with our evaluation because we can't move into a floodplain area or find it economically feasible to move buildings and residences out of the floodplain doesn't surprise me. I really don't understand why it surprises other people.

COL GERALD GALLOWAY:

I will talk about "busting out" for a second; then I'd like to add a couple of other things. They are all in the same vein, in essence.

How do you bust out of the BC straightjacket? I'm not sure we ever will. Perhaps the answer is as Togo said: "We have met the enemy and he is us." I have never met a more talented group of individuals than are represented by the people in this room. Since I left the Corps, so to speak, and went out and dealt with the many other federal agencies, I have been impressed, and everyone that I see tells me the same thing. They are impressed with the professionalism of the Corps. But it is a little bit like the Biblical saying of lighting the candle and putting it under a bushel. I am afraid that one of our problems in busting out of the benefit-cost straightjacket is that we may have some solutions, but, as Don said, we are not putting them out; we are not sharing that information; we are not getting it put forth.

There is a cast of characters in the academic world -- public policy, public administration, economics -- who have chosen to make benefit-cost ratio their particular toy. And they write reams and reams of information about this, hardly ever challenged by anybody. It seems to be their world and not yours, and yet it is our collective world in which we are working. They go to the tenth decimal place in analyses that we know don't really make that much difference and that they couldn't justify if they had to sit and testify before the Congress. But we have let them capture this.

I am really saddened to see the principles and standards die. I think the principles and standards were really good for us, or good for you. It gave you the opportunity to break out. For the first time you could throw some of the noneconomic into the equation and have a legitimate reason for doing so. I talked to many of you during the survey I did of why projects take so long. And very few of you ever came up and said, "Principles and standards are the problem." Really the problem is the application by certain individuals of principles and standards. What we need is some way to express ourselves and, in many cases, many of you supported principles and standards. Yet it was almost as if everyone was cheering when they announced it was going to go by the board.

I'm not sure but what you are going to get in its place is much like the devils that you get -- when you chase out one, the new ones that come back are worse than those that were there before. We do a lousy job of presenting the ecologic, social, cultural, and non-quantifiable values in our reports. No question about it. Some people are doing a good job, some people are doing a better job, some people have neat ideas, but we are not sharing in these ideas.

How do you get out of this straightjacket? You get out of the straightjacket by all of us collectively working to share our ideas, and, as General Gay said, get the word, when you have an innovative approach, to Washington. Share that information; get to IWR. IWR comes up with a lot of neat ideas, and it's amazing to me when I go to the field, the number of places where they have never even seen the report that is put out by IWR -- don't know what happens to it, where it goes in the districts or where it goes in the other agencies. But you all have got such talent that I could say we are going to break out, we are going to have the way to do this, we are going to be able to do it when you are willing to put down case studies on paper.

Let people working in your district summarize their ideas. Get that information sent forth. Get the districts and the divisions to support the program and push these ideas forward collectively to the people at the Washington level. Then maybe if the Washington level of OCE pushes the secretary and OMB, we can come up with some solutions to this.

Part of this has to do with the second question I'd like to ask: How do we get the train moving? The train is moving, but it appears that it is moving back and forth in the yards. If you look at the track record of the water resources development community over the last eight or nine years, that's really what's happening. We are shoveling freight cars from one side of the yard to the other. They are going back and forth from the Forrestal Building or the Pulaski Building to the Pentagon and back to the Pulaski, back and forth, but nothing is getting to the "hill." Why?

Well, people are frustrated, and there are lots of good reasons for this. What's going to happen in the business we are talking about today is if you are flooded, you can't wait for six or seven, eight or nine years, and you will turn to other programs. I would like to echo what Frank Thomas said about the Domenici-Moynihan block grant. Everywhere that I have traveled, people are saying that if they can't be more responsive, we've got to come up with some other way; they're saying that Domenici-Moynihan may not be the best way, but at least it will get us some money. To tell someone who has been flooded for three or four years in a row, or has just gone through a big flood, that we will get to this in eight or nine years -- and besides we haven't had a project authorized in six or seven years -- automatically turns them off.

Somehow you have to conquer that. How do you work within the system? General Gay has pointed out that we have to be realistic and live within the current ground rules. The problem is, I think -- and, again, I would like to stimulate ideas on this -- we have a bad habit of saluting and saying, "Yes sir, we can do." Somebody comes out to the field and says, "This is a neat new program, I've got innovating financing, I've got cost-sharing, I've got these new ideas." Can we make it work? "Oh, we will give it our best, and we will try to do it." Sooner or later we will have to say, "We will do our best and we will try, if you tell us that's the way to go, but we want you to know that these are the distinct problems."

Again, feedback. When you run into a problem, you have got to do what you are told to do, but you also can tell people. The word I get from people that visit the field is, "Oh, there is great field support for this." It's interesting. Somebody ought to say, when one of these new programs comes up or there is a roadblock, identify the roadblock. If somebody doesn't do something about this, at the Washington level, if you can't clear the roadblock in OMB and you can't get the secretariat to move faster, if you can't give us some definitive goals here at the administration level, we are not going to get the job done. Somebody has to speak up in the field and talk about this.

I'm not looking for a revolution; that's not what I'm advocating. But I am advocating that, when you do get visitors from Washington, tell them the story, the same way giving more feedback as to what is going on. What are the realities of dealing with the locals. What are they going to turn to? What are their alternatives? If we are talking about a 35 percent cost-sharing proposal for somebody who has been flooded by somebody upstream from him, they are going to laugh and go somewhere else for their solution. And it is not going to be the Corps of Engineers, it will probably be some other program where they can just walk in to the till and go to the bank, pull it out, and get some support for that program. And that's happening more and more often.

The last point I would make is: Do we want to encourage continued occupancy at less than the 100-year level? That is a very controversial issue. I just got off a study for FEMA on what should be the height of the levees that FEMA recognizes for the federal flood insurance program. The most controversial issue throughout the year in which the study took place -- and many of you participated in this study -- was should you recognize levees that are less than 100 years. Doesn't it make economic sense.

The decision was made by this group of people who had looked at it -- representing engineers, sociologists, risk and uncertainties specialists -- was no, we should not encourage in any way use of any levees less than 100 years. It may make economic sense for people to relocate or locate behind the levee that's only at the 50-year level, but by and large we are looking for a disaster. Can the insurance program, can a nation, take the case where we get the 200-year flood or the 500-year flood and we have said that we will let you build the 50-year levee and move in behind it, and more and more people start developing at this level? As part of our nonstructural controls, we have got to look at what is that standard that we're going to support. You can support it a lot more ways than by simply establishing a 100-year standard. If we encourage this sort of development, what are we doing to ourselves?

ROBERT HARRISON:

The goal problem is probably is the biggest thing back of moving ahead on many of these issues the other two panalists have talked about. Bill yesterday held the "green book" up. If you read that, you will see that one of the emphases in there -- and, by the way, some of the people of the Corps were major authors in there -- the emphasis there on the very first thing is to try to get your objectives of program, and goal objectives, straightened

out. And I think that unless you do that, unless you have objectives, you cannot have values.

Economics deals with values. We have made this benefit cost ratio into some kind of straightjacket. It was never intended to be that in any way. This has been sort of hanging over us as a black cloud this whole meeting, that we would have to not look at economics as an outgoing, as a developing, science but look at it as some "given" that was concrete.

Don't you realize that the U.S. is changing? We are becoming a multiracial country. We are multinational. We have all kinds of groups that have all kinds of problems that they didn't have a decade ago. The Blacks are in one way, the Hispanics are in another. I suppose you might say that there is a problem in our middle country; we are expanding outward to the coast. We are simply doing a lot of things differently; therefore, our goals are probably shifting. That possibly means our values are also changing. That also should mean that we are being able to look at various values quite differently and incorporate them into economic thinking.

Now for a decade, the Corps has been aware of this overlying problem. When the Institute for Water Resources was started, one of the objectives clearly stated, written down, was to try to greatly broaden the economic concepts, methodologies, techniques that were usable to the Corps. I think that is still a very important objective. I have been trying myself in a minor way to bring those ideas together in social science conferences and other things. I think above everything else what we need now to do is to really focus on this problem. And I think more and more people have begun to see the way that we go about economic analysis as a hindrance rather than as a helpful tool. And this is a tragedy.

Economics is nothing but another discipline to help us get a perspective on our problems. But we haven't been able to get them. And until we do, we are going to be in trouble. It is unfortunate, in a way, that the economists are meeting down the hall. God knows what they are talking about. I hope they are talking about some of these problems that have already been mentioned by Don Duncan and by Colonel Galloway here. Because at the heart of those is this question of trying to identify and get clearly our objectives in mind. It is not the most easy thing to do.

When you look into floodplain management, you have objectives that are related to people. Obviously, we can't do all the floodplain management problems that exist. But there are some that are more important than others. Why are they more important? We should identify that. Maybe some of them have got a particular group that has been stressed for a long time. There is no distribution of resources for those people. They need help. Perhaps it is a resource problem, maybe some important resource. Belshe mentioned that specifically several times during the meeting, that we have to look at this thing a little more perceptively, so there is a resource objective. Certainly there are many places where economic development in the more traditional sense is the need, and therefore we can adapt an economic plan for the given floodplain to meet that objective. So I think that it is not wrong to say that until we get that dichotomy straightened out between the things that we

need to do here, here, and here, that we are not going to really be able to formulate a satisfactory floodplain management plan or do many of the other things that the other participants on the panel have suggested we need to do.

Now, if we look back, I think we can see in the past, some examples of things that I have been saying. This floodplain management business has been going on and adapting to floodplains for a very long time, and it hasn't always taken much federal overall initiative to do it. Look at the French settlements in Louisiana. They were all trying to adjust to the fact that the high land was along the river bank and that the marshes, etc., and the ocean water was at the back. So they adjusted there. That was a real adjustment to a floodplain plan. We have many others that were higher up in the delta of the Mississippi, where we had people who had certain high roads that they could escape on when they needed to. The whole history of settlement is using land forms and the knowledge of environment in order to adjust to it.

It is a very old story, and I don't think we ought to make out like it is anything very new -- I don't think we have. We have already mentioned this several times. When you begin to look at it in terms of the continuum, you see that the objectives can be met in many different ways and have been met in many different ways. These are goals, and those goals, it seems to me, once they are formulated, aid you greatly in your evaluation. That, perhaps, is an obvious sort of thing. I agree that it is. But I look upon it as one of the very first things we have to understand.

Mr. Thomas also mentioned the relationship between the federal and the state -- the federal government and the state governments or the nonfederal interests. That also comes to hinge very importantly upon the objectives. National objectives, the national economic objective that we talk about so much, or any national objective, is a very tricky business. We have made a sort of god out of it. In a way, nations themselves are changing. Look how we are changing. We are beginning to think, to some extent, in this country of North America rather than just the United States. Mexico is looming there as a very important question mark for the future. I don't mean a question mark in any bad sense. What does this mean to us? So, a national objective is a complicated thing. Look at our relationship with Canada, too, for that matter. Do we have a clear idea of what we are talking about when we talk about national economic objectives? It is exceedingly doubtful. Yet that phrase is used a great deal; it is sort of a God-given theme. But it is obviously subject to a lot of dynamics as to what these are. I think it is going to take a lot of thinking on the part of us. I am certainly not naive enough to think that I could give an answer to this.

But to some extent this breaking of objectives into national, regional, local, and so forth, is a problem. I think that we cannot immediately say that every local, personal objective is a national objective. On the other hand, how you aggregate into the national objective is a problem relating to the goals in some ways, relating to the sources of data, relating to the changes taking place in society. I think that all of this comes to be very important.

We are approaching that problem now as if it were some kind of accounting problem. Economics in the Corps has turned into a numbers racket, sort of a bookkeeping thing. Well, economics is a little bit more than that. We used to call it political economy. It had a broader, more dynamic context. It is losing that. I don't want to dwell on this, but, I consider it the very key item we have to face. I think it ties together some of the things that Don has said and that Colonel Galloway said.

PHIPPEN:

Just as a way of showing that I am not wholly independent here, I am going to say a little bit in rejoinder to something Don said and also as a follow-up to what Bob has been talking about.

One of these ideas that Don put forward as to why people go in the floodplain, I think, is exactly why there has become a federal interest and perhaps a state interest in what I call the floodplain management approach to things. His second item was that, after all, there are people smart enough to see that they can go in and shift costs to others. I think there are people smart enough to go into floodplain areas with full recognition that they can shift their costs to others. But that is one of the absolute, essential, key underlying reasons why we have a concept of floodplain regulations. Also, the right thing to do counts there.

I agree with what Carl Gaum said earlier, that some of these areas are really attractive. People wouldn't be there if they weren't. But here, in this case, they might not be smart enough to recognize that they are shifting costs to others, and we sit back and say yes, but we are smart enough to see in fact that they are shifting costs, not only in terms of the kinds of losses that we put on the BC curve but also ones we should be putting on such as those costs for bailing them out when they get in trouble -- the costs that they shift to others, that others wouldn't be the recipients of had these people not made that kind of decision.

So I would say that I agree, but aren't in fact these latter two of the three reasons the very basis for our concern in a floodplain management context? With that, I'll say hopefully we have got you thinking about things that you want to talk about.

DUNCAN:

I want to clarify one point. We have many guests here, many people are not Corps district and division personnel, and I did not mean by my remarks to inhibit their participation in this discussion. But I do sense that the people from the districts and divisions are a little reluctant to stand up and speak. Three, four, or five people have done that, but I would like to see everybody who's here from the districts and divisions who have got actual experience from the ground have something to say. If you are doing great and you don't want us to bother you, then we want to know that too. It would be very nice if you thought everything was going well and you didn't need any additional information transfer, policy initiative, or procedural improvement.

HARRISON:

Several times, the word economic was used. There is nothing that is not economic. I just thought I would put it out of the way, if we can. Maybe there is some kind of celestial thing that is not economic, but man is a user of things, time, and existence; he is economic. He is not non-economic.

PHIPPEN:

I think Don is right. Don't think that your own experience is common to everybody else because obviously it is not. What seems as though it should be everybody's bag is just not. That's one of my problems. Once I get something in my head, I think everybody should obviously know it the same way I do. My old staff used to criticize me for that. So, speak up.

FRANK INCAPRERA:

Five years ago when we had this same meeting, I made a suggestion; it was probably five year too early. There is a way to take care of existing development in communities like you are talking about. I think it could be done through a program where advance money could be given to critical industries, such as low interest loans, where they can go in and provide their own protection. I have since then gone back and checked my economics on that in different areas. I know that floodplains are different and that depths are different, not only to the same floodplains but for different areas because of the topography, etc. From the investigations that I conducted, I would say that about 80 percent of the structures I did -- commercial, industrial -- can come up with feasibility for such a loan for 25-year protection. I would say that about 60 percent can come up with 50-year protection. There is hardly any feasibility for 100-year protection. When I say protection, I am talking about protecting an individual building. I am not talking a large site. There's always a uniqueness about every building and every industry.

The implementation of the program, though, doesn't belong with the Corps of Engineers. I think that the potential areas that could be implemented would be with the flood insurance people, because they are the ones who stand to save the money. In other words, for the money they give in advance, it would say in the claims that they would be paying within that period of time that the loan would be paid back. Say, you give them a 10-year period of time, or a 15 to 20-year period of time, the money just on the loan itself, without the interest they would gain, even though it is a low rate of interest. They could economically give out these loans for people to do their own work.

I would like to think that the Corps could provide the technical guidance on these, but given today's constraints on our human resources that we have working for the Corps, we run into the same problems that we did when we started making maps for the flood insurance people. We were doing a lot of the maps when we came out of the emergency program and trying to get them all done for them, and there was no way we could do it. They knew that and they went out in other agencies and started contracting with the private sector, and I think it was the right thing for them to have done. I

think that we would run into the same situation here, because, when you start talking about areas with hundreds or thousands of buildings, you really need that type of support, that type of information. I just don't know that we have the resources to do it.

I think we can give them information in terms of all hydrology information we have, we can tell them what the floodplain levels are; there are a lot of other technical data we can give them. We also have handbooks. There are so many handbooks out now on how to floodproof a building for the many things they need to consider that I think with a consultant very quickly they could come up with a design to take care of that particular problem. Maybe now is the time that idea can move to implementation. But, again, it would have to be the flood insurance people who could conduct the program. I think if they would conduct these investigations like I did, then they would find it is economically feasible to do so.

JAMES RAUSCHE:

I think Frank raised a good point. Many times there are a lot of flood prone industries out there that could use the technical expertise that the Corps has as an agency of engineers. We had some flood damage reduction surveys of industries, and we found that they were very effective from the community standpoint. Frequently, a community would prioritize which industries they felt were critical to the economy of that community. And frequently we were working with communities that had one or two or possibly three industries that, if they had moved out -- made a decision that they could not exist on the floodplain anymore, they would have to close shop and move -- that could make a critical difference for that community. So I think that the Corps does have an important role that they can play in terms of working with one, two, or three critical industries that a community would prioritize. While I realize that there are a lot of industries, that we just don't have the capability to address all of them, nevertheless, I think we can play a really valuable role in working with a few that have been prioritized by the community. In the fact that we are an engineering organization, we do have some good capability to provide in that area.

JON KUSLER:

Ten years ago or so, when such measures as relocation were just talked about, there wasn't much around on floodproofing and there wasn't much around on flood warning systems. I am sure that working with communities is very frustrating. There wasn't much information; people weren't familiar with approaches, the problems and definitions of goals. But I think we have come a long way in the last 10 years in terms of the expertise within the agencies like the Corps, and the people knowing something about some of these other techniques out there.

I would like to argue that putting together floodplain management plans in these communities is still not an easy process. We are at a point to do some additional work, for example, procedures for getting the community to help find its goals. There are procedures for working those things through pretty quickly -- cost sharing and so forth. We are at a point where somebody needs

to help communities crack these plans. Who is going to do it? FEMA can't do that; they can work with loans and insurance but they don't have the technical expertise in that staff out there. You are looking at what agency. I see possibly the Corps and SCS. SCS has it's own area of expertise. I think that it is not an easy set of problems to deal with. I would like to raise the challenge that we have come a long way and I think that they are do-able and needed.

UNIDENTIFIED:

When we begin to think about these areas we are operating in, some get to be a wet blanket. I will be a wet blanket for the minute, in that the same information that Jon identified as having been developed is now available also to a lot of private engineering firms. I am not saying that we have the answer to this, but I would want you to perhaps think of those circumstances in which a Corps technical services activity doesn't go against a longstanding rule that we did operate under, at least a while ago, that we not put ourselves in competition with legitimate commercial enterprises. Just thought I would bring that up, because I think clearly they were in the same boat 10 years ago that we were, or perhaps not as well off. But today, with all the dissemination of information, there is an engineering force out there in addition to the Corps, which I think we should recognize in our discussion.

UNIDENTIFIED:

Somebody has got to maintain the data base. Somebody has got to be in charge in a given region. I've talked to several people here, and I see several heads shaking. If too many people are presenting their own data and allowed to free-lance beyond a certain point, then it gets to be very difficult. Obviously, we don't want to compete with engineers for some things, but, when you get to the base level of information, as you said, somebody has to put it all together in a given region or a given area. The Corps seems to be the people that have that expertise.

UNIDENTIFIED:

You have to have continuing interactive capability. You know, everybody knows, what is happening with all those billion dollars spent one way or the other by FEMA or maps, storage of that data, etc., and what's happening to our federal investment in basic raw map data.

UNIDENTIFIED:

The technology is there to handle it and work with it if somebody wants to become the custodian and the user and the interpreter. Who better than the group sitting here?

ART HARNISCH:

We have heard about the vast array of problems in dealing with nonstructural measures to prevent flood damages. For example, George Phippen told us about the problem of our not meeting community goals and recommending

projects that are not acceptable to the community. Solutions may be excellent from an engineering standpoint, but in many cases under current cost sharing policies the lack of local funds would prohibit implementation. Basically, locals cannot afford projects we propose. Grant Kelley has told us about problems of private developers being impeded by changing regulations and directions of governments, making private investment in the floodplain a high risk due to uncertainty. These are typical problems which may be solved by improved communication and coordination with floodplain occupants-owners and representatives of all levels of government in the planning process.

Colonel Jerry Galloway and Bill Donovan have told us about the tools available to implement nonstructural floodplain management measures. They have enumerated the various federal, state, county, and city regulatory weapons we could use and what level of government does the regulating. One additional tool that may be added to the list is money -- which government agencies, private corporations, or even individuals living in the floodplain may have funds available to pay for the floodplain management objectives.

I would like to suggest that a different kind of approach be used to accomplish the communication, planning, and implementation of nonstructural measures. This would provide a catalyst action in identifying problems and objectives and use of available tools in solving the problems. This could be called an "institutional approach" to get all concerned institutions and individuals together and going in the same direction.

A concept has been developed by the Kettering Foundation of Dayton, Ohio, is what they call a negotiated investment strategy (NIS). This communication process has been used in metropolitan areas for urban renewal projects. All interested governmental units, residents, and private developers agree on objectives, a construction package as well as funding commitments for a renewal area. The Corps of Engineers and some districts have been involved in this process. NIS has been used in St. Paul, Minnesota; Columbus, Ohio; and Gary, Indiana.

All levels of government from the federal agencies right down to town and city departments have an interest in, regulations pertaining to, and in most cases funds available to do something with floodplains in their jurisdiction. A negotiated nonstructural investment strategy for a flood-prone area would involve setting goals and objectives by property owners and local governments. Technical assistance for the engineering feasibility and costs could be provided by the Corps of Engineers. All levels of government with an interest in the area would be expected to participate.

The key to the NIS is an impartial mediator who would learn the capabilities and constraints of agencies and would coordinate negotiating teams representing each level of government in achieving local goals. In previous NIS programs the mediator has been an independent consultant funded by the Kettering Foundation. The negotiation process could also involve technical assistance by the Corps.

The product of this process would be a written agreement including commitments from the government participants, property owners, and even

residents to accomplish their part of the agreed-on program. Here again, technical assistance can be provided by the Corps, and the Corps would fulfill the part of the program that requires structures to prevent flood damages.

Nonstructural solutions to the prevention of flood damages are more of a people (person-to-person communication) problem, requiring knowledge, understanding, and cooperation of all involved. The approach should be different than solving structural engineering problems. The use of a mediator or catalyst may be all that is needed to implement many of the tools that are already available.

PHIPPEN:

Thank you very much for a thoughtful presentation. Is there a comment on this idea that anyone would like to make? It is an interesting idea.

UNIDENTIFIED:

I think we are getting to why do we look at evacuation a little bit harder than maybe floodproofing or raising structures. Probably, we see a more traditional role for the Corps under a GI program. We can see that there is an investment, a definite investment to be made. In most of the nonstructural, I think, the larger investment is in manpower and expertise, and we are getting back to technical assistance. Probably more suited for a technical assistance program was the Corps being the focal point of research, development, and expertise. That would probably be the major effort. If you go into evacuation, you get real estate involved, you get a surveyor involved. We don't have a traditional role, and I think that's why it is so hard to force some of these things through our GI program, even for looking for other benefits.

Let's say we get into a study area where flood control is only 20 percent of its future decision for open spaces, and it won't stand on its own. Probably the overwhelming benefits are social and recreational. Incrementally, the 20 percent is not going to be justified; you can't push it under a guise of flood control. Are we going to send this through and say we'll contribute 20 percent, or are we going to go into major recreation and social benefit-type programs? I think this reinforces the general position here: the best thing to offer is expertise. There are plenty of exceptions around the country, but in a bigger program. I don't know if the Corps wants to do that.

JIM GODDARD:

I would like to comment on a couple of things, and, after commenting, I would like to present a suggestion for Corps action. Yesterday morning, George Phippen commented on something that I would like to follow up on just briefly. He mentioned that, with floodplain management being a broad approach, he didn't like structural and nonstructural separation, independent consideration. Well, bear this in mind: Even in this conference, we speak of the nonstructural alternative. I don't like to think of nonstructural alternatives. I like to think of alternatives. It could be a dam, a

reservoir; it could be a levee; it could be a channel improvement; it could be floodplain regulation; it could be floodproofing. These are the various alternatives for solving your problem.

Actually, back some years ago, the term floodplain management came out. Why did we come to floodplain management? Flood control was something which meant one thing to the general public. That was: here was a structure to keep water away from man, forgetting all about keeping man away from water on the total approach.

I was at TVA at that time. TVA wouldn't consider doing away with the term flood control. Why? "Flood control" was in a TVA act. They weren't about to go back to Congress and take a chance of Congress changing the act. The rationale was that if Congress changes the act this way, they can change it that way and the other way, and TVA might lose. But they couldn't do away with "flood control." I talked with the Corps of Engineers, other federal agencies, and Congress, and everywhere was the term flood control. We couldn't get away from that as we went along, so actually it became "flood control and other measures." In time I came to agree with George Phippen, who all long didn't like the term nonstructural. I never did particularly either, but it just happened to come along. But bear in mind that really our approach here is floodplain management. That's an idea here of managing floodplains and their related water resources to the benefit of all. You can say "wise use" if you want to.

I would like to mention our straightjacket and our BC ratios. I say we engineers are, in the large measure, part of the reason for this straightjacket. We elect our politicians and the politicians have to explain to me and you -- who vote for them and put them in office -- why they are spending our money. They can come along and say, "Jim, we are getting three dollars back for every one of your dollars." Who told them all this? We engineers came up with it here.

I say now that we engineers also who work with the other disciplines have a responsibility of coming up with some manner of either putting a dollar value on these other items, which so far we haven't done, or in some way informing that public about who control the fund. After all, a general can ask for all the money he wants, but it is the Congress that votes it. The people put the Congressmen in there. We are going to have to help out on this if we want to break out of this BC straightjacket, so to speak.

Brian Moore yesterday morning mentioned that whatever we come up with, it has to be, on the nonstructural side anyway, a matter of activity not by our people, who are going to come up with the plan, but the local people. We are going to have to reach those local people in some manner. That really is the payoff, when we go out and start talking with the community. I would criticize you just as much for going out there thinking nonstructural only as if you went out thinking structural. I think we should go out there, there is a problem.

What is the best thing to do with it? In many cases, there is going to be a combination of structural and nonstructural. On the nonstructural side, you can always start out with the floodplain regulations that keep the status

closed. Things will only get worse on that until you develop the rest of your program, because your regulations can always be adjusted; in fact, they just must be adjusted as time goes on and conditions change. That is simply the first activity.

Where do we go from there? The original concept of the FPMS program when it was set up back in 1966 and 1967 actually was for a total approach. We are treating that in the matter of the acceptance, credibility from OCE down through the division to the district offices here, and we suggest to people out there to go out and work with communities. We did get a few people, but, unfortunately, too many of the people in the FPMS program actually were assigned the matter of getting out flood reports. These reports were a very important element, and there are a lot of problems that we have to deal with in getting them out, but I still say that's about 10 percent of the problem; the other 90 percent of the problem is working with people.

I haven't felt through the years that our Corps offices, our program, actually has met that challenge of getting out there and working with people. In fact, most of the large structural projects actually have already been built throughout the country anyway. Whether or not the public knows what it is talking about, the public in the last several years has gradually raised its voice. The people want to have a voice in so many decisions even if they don't know what they are talking about. I know that's a strong statement, but just stop and think about what is happening. As a result, to get any project through, you are going to have to have the support. I guess what I am leading up to here is this: Is the Corps ready, actually, to give enough funds and manpower so that you can get out there and talk with the local people?

That is just the one thing -- the money and the manpower; the second thing is, is the Corps willing to let its people actually get out and handle human relations, working with the people out there and not just sticking too closely to our technical nature. Sure, we are experts on the technical, but our Corps offices and our people are not yet actually expert when it comes to working with people on many of these things. Are we going to actually get into that field? I think it is high time.

We didn't have follow-through with this in the FPMS program. Congress gave it to FIA, which is now at FEMA. FEMA didn't follow through with it either until about the last six months of the last administrator's program, where they started getting out flood reports and actually following through with the rest of it. Then there was a reorganization for FEMA's drop-back on that.

I think there is a good opportunity here now for the Corps to actually get into that and push that portion of it, but it can't be unless the Corps does change the policy there and actually permits and encourages this activity with more interplay with that public. Sure, I know I am an engineer, too. Years ago, frankly, I kind of wondered, why should I listen to this layman out there telling me something about this? We go out and we get 10 ideas expressed and nine of them aren't worth much of anything. You can wipe them out, but the main thing is that you get their support and you get their understanding. If

we get this spread around enough, that's going to impress the politicians, going to get into Congress, and maybe we can get out of this straightjacket.

ROBERT POST:

Responding to some of the things you mentioned, Don, I believe that the Corps, and our district in particular, has had some opportunities to develop total flood emergency preparedness plans. I think we ought to get into that a lot more than we have before in terms of developing not only warning systems but also emergency defense in times of flooding. If there is a disaster declared, we can provide assistance to include organizing communities so that they are capable of taking care of the disaster at the time. We can help them with what agencies they should have pre-positioned and what their responsibilities and duties are. As a minimum, I believe we should be doing this for our ongoing studies, but I think it should be expanded beyond that to any community we could provide assistance to.

I believe that we are the premier organization in being able to handle flood damage reduction, and we ought to take a leading role in that. I guess I disagree with one of the things that Frank had said earlier -- that we ought to have a program in flood damage reduction run by anybody other than ourselves. I think we have the context, we have the technical background, we have the data base from which to work, and we ought to take advantage of it and use it and provide that assistance to the communities.

In terms of saying we need more manpower to do it, I don't believe that we ought to be saying that sort of thing. I believe we need the money to do it. I believe that, in terms of manpower, that time would come when we would be able to handle that situation, too. In some respects, much of the work, perhaps, would go to contracting communities; but it would still be overseen and maintained by the Corps of Engineers, which has the data base and all the Corps of Engineers activities to make sure that it happens correctly.

On one other point, with respect to economic justification of some of our nonstructural alternatives, I believe that we have to develop a less rigorous approach to reviewing the economic justification that some of the field offices come up with. I believe that the field offices have some very creative ideas that they can put forth. I believe that they can send those in with reports and that they should be justified, whatever benefits they come up with. But in terms of continued scrutiny and debate about whether these are acceptable and whether we have gone far enough in examining whether they are acceptable and properly evaluated, I think that we ought to be less rigorous in that respect. Most of us do not justify our own personal actions as rigorously as we do many of our Corps actions. I think in the nonstructural area, in particular, we have to get a little bit less rigorous.

PHIPPEN:

How many people have actually had discussions with nonfederal entities about emergency preparedness or regulation of floodplain? Is there anybody here willing to tell us why they haven't had these discussions -- whether it is an atmosphere in your district.

WILLIAM REID:

The trouble we have is that people perceive us to be doctors. And doctors don't solve the cancer problem too well. Flood problems are like that. So when you can't solve the problem, you really can't deliver and you have trouble facing the public. In some of the things we talk about, we really aren't delivering. I don't know that we really can't. We just aren't.

PHIPPEN:

How many of you had a very negative experience, like the nonfederal interests that say, "We are not about to regulate the floodplain, and we will shoot any 'Fed' who comes into town preaching that doctrine." Or it was a complete turn-off?

LAWRENCE C. CIESLIK:

I had a project that started out with a flood insurance study in Lincoln, Nebraska, on a levee system which the Corps of Engineers built in the 1960s. Through a series of floodplain information reports, after construction of the project, we indicated to locals that the levee provided 100-year protection. When the flood insurance program came along, we found out that we didn't have 100-year protection in the levee system. They don't believe our numbers. They think that their flood problems have been solved because their nuisance flooding has been stopped. They haven't seen a flood in 15 years. So we do get a lot of negative comments.

One thing I might make a point here about is that the federal insurance program gets people's attention. We have several different project studies going on right now that were precipitated by the federal insurance program. FEMA came in and started telling the people what was required of them in the program and they come to us and say, "What can we do about this?" Some of them are looking at wide floodways and some are just looking at the problem: they are going to have restricting the development. There are a lot of private developers that maybe have put money into lands in the floodplains that would be restricted.

One of the things that I can see is a greater role here for the Corps and FEMA to work together a little more, maybe get FEMA to start thinking about structural type solutions or nonstructural plans that would help alleviate problems of the floodplain and work with the Corps with our technical expertise. For example, we may not come up with any economically feasible project to help the city of Lincoln. We might not be able to pay for any of the engineering feasible alternatives. But they could go into some kind of long-term plan. One thing they are going to ask us is, "Why should we do this?" They are going to say, "What is the incentive? Why should we pursue this?"

One role FEMA could play here would be to come in and tell these people, if you embark on a long-term plan, say a 10-year plan, and if we in three years find out that you are pursuing this plan, we may change the maps before you are done with that plan to reflect the ultimate outcome. We might, in

other words, carry you for that other seven years. We might assume some of the risk as long as you go ahead and pursue this long-term plan, this nonstructural plan that will alleviate the problem. I see that as something we could pursue. I would like to get some comment on that from other people.

PHIPPEN:

Let me ask one more question. How many people feel that the Corps policy on when you should terminate GI studies is a detriment to your pursuing the type of thing that we are talking about here to a point that is useful to the nonfederal interests in solving their flood problem. Is there anybody who thinks the policy we have now on how you terminate a study is good, or is it a constraint, a problem to you. Does anybody think it is a problem?

GARY ROHN:

It seems to me that it is a constraint in that, if a problem is worth studying with federal money, then the solution -- whatever it is and whoever is the implementing agency -- ought to see the light of day. I think, too often, solutions are suppressed because of poor interest in the implementation. I think that, as a technical agency, maybe the best thing we can do is to study the problem based upon all the tools that are available -- to formulate the best plan, identify the benefits and costs, in terms of the BCR or any other socioeconomic or environmental factors that we know of. Let the decision makers -- the Congress and others -- decide whether that problem is worthy of solving from a federal interest.

Even a positive BCR doesn't necessarily solve the problem. As we know, there are positive reports sitting in various stages right now that have not come to fruition in solving the problems in communities. Unless the lawmakers are in a position to appropriate the money, regardless of the benefits and costs, there is no real solution for the local people.

BEVERLY GETZEN:

I am wondering, as we listen to all the discussions, if some of the problems we are talking about are not perhaps in some way the reflections of an institutional identity crisis. We have often been reluctant to go out into the public and deal with them because we honestly haven't known what the answers were in nonstructural. There are a couple of parts to that. One is that we have always been a technical engineering agency and we have dealt with the structures with an admirable capability, but when we moved into the nonstructural we were in an area in which we did not have a long institutional memory. We did not know what the solutions were and quite often they were things we had no experience in developing. In fact, for a lot of the things we did we had to hire private industry to accomplish for us the kinds of answers that seemed to be falling out.

We also tended to take nonstructural aspects of our studies out of the mainstream. I don't mean this as a criticism to anyone who has worked in floodplain management, but in some of the districts, the people who were in floodplain management who were not a straightforward plan formulation group of

people handled the nonstructural. It was like a sideline, not really a part of the study, and we stuck in later. I think part of that is because we were working in an area where we didn't have that long memory of how to do those kinds of solutions.

The other part of it -- and Paul mentioned this yesterday -- is we tended to be a solution oriented agency, and if the solution was not a Corps-implementable solution, we stopped looking at it. We stopped too soon. Now we are in an area where we have a lot of policy questions. We are moving into a two-stage planning study, in which local people are going to be paying a large share. I think we are going to owe them a lot of answers. What you are hearing here is that most of us do not know how to answer all the questions. Can we give you a flood warning system? May we continue to conduct the study, even if there is a BC ratio of .001? Yet the solution is something the local people want. If they are paying half the money, they may very well say, "We want that study finished."

DALE KLEMME:

We had said from the outset that this would be a rough-and-tumble sort of thing, so don't throw me out the door. What we are dealing with here is a marketing PR problem. It is going to be more so if you get into the nonstructural local involvement, local share, local perceptions of what the problems are, and local perceptions of how you are dealing with the problem. Also, as was mentioned earlier, the locals have to get out and get the congressmen to fund it as something less than normal one-BC, or whatever the criterion is. They are going to have to be involved.

I think we need to realize that the engineering field, per se, is a very technical field. It isn't necessarily a marketing PR oriented area. Perhaps there should be a crash course for a number of people who are going to go out in the community so that the initial reaction isn't necessarily a negative reaction among the locals. I would not come before a local council in a small community and start talking about economical analysis and the 100-year standard and the EDA and the NE and OEC and the other alphabet stuff. Yet, we're so accustomed to talking that jargon that we throw it at these local officials and they are immediately turned off.

You need to do a lot of soft-sell sort of stuff. At times it's going to be, perhaps, in your first few visits to the community, that you think might have a problem. You might get to meet more formally with some of the shakers and movers in the community, so that you can at least get in the door and lay out some plan or some overall strategy that you would like that community to implement or at least plan. You really need to take a very close look at how you're selling this whole thing and how people are receiving it. It is not what you are saying that counts; it is what they perceive you are saying that counts. Maybe the answer is having some other discipline to be the representative. That's going to be a common face that group is going to see all the time and can identify with; they are going to get to know you and relate to you. Or maybe the answer is a crash course for some of the people who are more technically oriented. But I think you need to address that question somewhere down the line.

ROBERT CARNAHAN:

If you'll permit an observation from the National Weather Service, I was very interested in the comments you just made. The weather service has very few people nationwide that are designated as warning preparedness meteorologists. These guys have had the job of a lot of this public contact. We get fewer and fewer of these kinds of people all the time because of the cuts, the money cuts and personnel cuts. But, still, most of the offices have somebody who is designated as a focal point for this sort of thing. When there comes an opportunity for somebody to talk to the public, this is the person who normally takes this responsibility.

This is often a rather young person in the office. They are regarded as attractive positions, in that the people who take those responsibilities do recognize that they're learning a skill and getting contacts that really are training them in a managerial sense. They are stepping up in the organization. So it is an attractive position to a lot of people, even though it means a lot of personal sacrifice. I said yesterday that dealing with the public is not always a pleasant thing. It often requires a lot of night meetings and things like that, which a person isn't very eager to do unless he sees some personal advantage. Sometimes there is a personal advantage from a career point of view.

Let me just move on to a couple of other things. One of the things that the weather service recognizes is that we have a lot of small offices and that means we do have a lot of personal contacts. We often end up with an inquiry from a community and a request for some help. We try to be of as much assistance as possible, but we are not engineers; we believe that when it comes to the question of developing an emergency preparedness plan, somebody else has to do that. The weather service can provide some information relative to vulnerabilities from the weather point of view, but it really requires more expertise than the weather service can bring to bear.

In my own role in the weather service right now, I deal quite a lot with FEMA and with our field offices. When I speak with the field offices about their relationship with FEMA, they say, "You need to recognize that FEMA doesn't really have a field structure." FEMA has regional offices, that's true. But beyond that, when it gets down to the local community, you are dealing with the state and local governments. FEMA can exercise some leadership and deal through their regions, but it is state and local governments that you end up dealing with, and our people do the same thing.

I think there is much that can be done along this line, but I would be pleased to see the Corps begin to take a role in emergency preparedness. One of the questions that has been raised here several times is the question of turf. Believe me, as far as the National Weather Service is concerned, the Corps of Engineers is quite welcome, and we would welcome your involvement in this kind of area.

DUNCAN:

It seems to me that, based on talks over a period of years with some of you people, that one of the problems with working with communities is the incentive problem, which has been talked around quite a bit here -- what real goals the community wants. What does it mean in terms of what you can do with cost sharing.

It seems to me that there has been quite a lot of discussion on some of the incentives; for instance, there is a lot of interest on the part of industries in floodproofing. But there is interest in other groups. It seems to me that right now, maybe coming out of this session, you're in a position to suggest to FEMA some of the incentives that would help implement the administration's overall goals of cost effectiveness in terms of federal programs and greater state and local responsibilities. Flood control is quite an incentive for communities to grab and put together something that would be less costly to them. There's incentive in terms of the private sector with loss reduction.

There is the flood insurance program, saying we want to go ahead and we want to have a graduated rate schedule that reflects actual risks. The critical comment from the outside is that they are not making a lot of progress. What are the reasons they're not making a lot of progress? My candid perception is because they don't have the data on where the hazards are in a very specific sense in terms of velocity, special hazards, and so forth. They aren't making a lot of progress on it because they don't have any kinds of plans that they could relate reduction in rates to. It seems to me that you could make some proposals to FEMA and OMB, etc. If a community comes in, has a public management plan, has regulations, has structures in place, has channelization, etc., they can get reduced rates. It seems to me that we are dealing with kind of a new ball game in terms of this whole incentive structure, and this is an opportunity for you people to come up with some ideas that might be attractive to the administration.

In terms of goals, there are ways, again, of getting the community to define its goals so you don't have to operate in a morass. If the community has incentives in terms of financial incentives, part of the goal problem is defined. Then, of course, it has to be translated, it seems to me, into some flexible policies for you to be able to go out and say, "We'll cost share" in particular types of situations. That is something that has to be worked out internally.

In looking at all the agencies right now, it seems to me that you people have an opportunity to input to FEMA and OMB, but really the FEMA people don't know the situation out there with the communities as well as you do. Certainly the FIA people do not. They don't know the technical aspects of floodplain management like you people do. You come up with some suggestions on incentives and goals. Interact on a process that's going to implement what the administration is proposing. I think it would be a shame if a lot of the good things the administration is proposing right now disappeared in two years and you got another administration without some good, hard proposals that make sense on how to implement all this.

RON HILTON:

I would like to respond to Don Duncan's question on whether the Corps should be involved in emergency planning. Of course, I am a little biased, since I have been involved in it for the past five years.

The hurricane evacuation studies they we have conducted were funded through the floodplain management services program. We did not have all the expertise to conduct the entire study, but we were able to contract portions. The locals really liked it because the Corps was involved, not because they had the money, necessarily, but because there was a lot of infighting going on in Florida between city governments, county governments, and even the state government. They looked to us as the impartial person to bring all these people together to get the study completed. We also were able to get FEMA and the National Hurricane Center and some other state agencies in our coordinating effort to attend our meetings and review our reports.

Now, the state of Florida has taken a very active role in originating studies in areas where the Corps, Jacksonville, could not participate because of the funding problem. FEMA is also now getting involved and is looking at financing a three-state regional hurricane evacuation plan along the gulf coast of Florida from Pensacola, Panama City, the coastline of Alabama, and the coastline of Mississippi. They've talked to me and I provided information and some advice and guidance on that study; also, the state of Florida has called upon me to provide guidance. The hurricane evacuation studies that the Corps has completed in Jacksonville need to be updated periodically. The Florida population right now is about 10 million people, and we are growing at the rate of 4000 to 7000 persons per week. Most of these people are moving into the coastal areas. So I believe that it is in our best interest to stay involved in the hurricane evacuation planning studies, but we need money.

One thing I would propose is that instead of the Corps trying to compete and do the studies alone, FEMA trying to compete and maybe do the studies alone, that we should get together and have a cost sharing arrangement, with the federal share maybe 50 percent -- the Corps 25 percent and FEMA 25 percent -- and the state pick up the other 50 percent. In Florida, I believe they would do that. They could divide it between the state and the local communities.

HARRISON:

I am glad to hear you say that it is not too difficult to do, because my perception is -- and it may be inaccurate -- that it is very difficult to put out a feasibility report of any sort. It is almost impossible to put out a good one.

I am talking about the direct federal. As you move away from the direct federal, into these areas where the nonfederal interests have a much greater role and the solutions are much more individualized as opposed to the collective solutions, the degree of difficulty must escalate astronomically. My perception is that one reason we are not doing more in this area is because

it is just too tough. Maybe the rewards and the incentives to the district planner are not in that area. I have a feeling that when these efforts do take place and come out to a fruitful conclusion, that it is really on the basis of a very dedicated individual. Without him, acting a great deal above and beyond the call of duty, it would never happen.

EDWARD PASTERICK:

At the risk of anticipating my talk this afternoon, John makes some very good points about this whole relationship. It is critical to the flood insurance program, the whole relationship between the insurance structure, with all the economic incentives in this area, and any kind of hazard mitigation taking place.

One of the problems has been that we have based the insurance structure on a great deal of data that I think we have always been a little edgy about because we don't have the years and years of experience from the damage standpoint. We based those rates on information that only now we can begin to analyze the validity of. Even within the flood insurance program, we have only recently been able to start to accumulate loss experience against which we can test the technical bases for the rate structure. Only recently, I think, have we built into the flood insurance program the real economic incentive for something to be done at the local level.

We mentioned here before the fact that the flood insurance program gets communities' attention; it gets communities' attention now more than it ever got before. At one time it got the communities' attention only because if you weren't in the program you didn't get certain loans, certain mortgages guarantees. It gets attention now because the rates have been raised to a level where it becomes a serious economic decision to build in a certain location. The response to that at the local level, often, is frustration, because they don't quite know what to do to address that problem. I think the Corps is in a very good position to come in with a kind of technical assistance that can not only help to address the individual property owner's problem of a higher rate, but also this whole question of community rating, which comes up at every conference that I have been at of this nature. Our chief actuary has lived with this rate structure for 14 years now. He has expressed the willingness, the readiness, to really accommodate that community rating concept. The problem has been, I think, that we need an organized, consistent approach to the whole issue of community rating. It always comes up in a sporadic kind of context -- wouldn't it be a good idea, so we put together a task force and look into the feasibility of it. If you use a task force to look into community rating, you will not have a community rating for 20 years. What I think you really need to do, and again this may be the ideal group to do it, is to have the Corps of Engineers look into the kinds of technical bases that can support a community rating system, a system that will legitimately reward hazard reduction kinds of measures at the local level that can be substantiated, that can be justified, and that can be borne out over the course of time, in terms of reduced loss experience. So, my major point, I guess, is to very much support that objective of looking into that whole area of community rating.

We don't have the resources at FEMA. I don't intend to speak for the whole department, because I am only in the insurance end now. But I think that is true, we don't have the resources to look that extensively into that area right now. The resources that at one time were devoted to the flood insurance program out in the field are now being diverted somewhat to other emergency preparedness kinds of functions having to do with the civil defense program, the plans and preparedness kinds of objectives that the reorganization into FEMA necessitated. I think it is a question of where that expertise is going to come from, and this as good a source as any.

RAUSCHE:

A couple more thoughts on flood emergency evacuation plans. I think that these plans can be good interim measures. As we all know, there is a big gap between initiation of a reconnaissance study and completion of construction. I think an emergency evacuation plan does have some real good use there. If you think in terms of a hurricane evacuation plan, you are talking about big bucks, and that can be very prohibitive. But I think there are many instances where, particularly with fluvial flooding, you can work together with the community at a fairly low cost in developing a plan that the community feels they had a lot of input into, so there is very strong acceptance on their part for the plan. It also gives the Corps a good opportunity to work hand in hand with the National Weather Service, FEMA, and the state and local agencies in developing the plan. I think there are a lot of good opportunities for the Corps to get involved in that.

PHIPPEN:

Is Steve Eli here? You might want to comment on your experiences. I think you could follow Jim's remarks very nicely in terms of the low cost input required for, say, Barbourville and Pineville. Would you be willing to do that?

STEVE ELI:

We had some experiences in Nashville, I guess about four years ago, with a little community in Kentucky. They wanted some additional protection. They had a flood in '77 where they nearly had an overtopping situation. They were faced with a situation where they were really incapable of handling the problems that came out of that flooding from the standpoint of knowing exactly who should do what, and when. We were faced, apparently, with the first situation in the Corps of trying to handle an evacuation response.

We had some problems trying to wade through the administrative mumbo jumbo, trying to find exactly what the Corps response should be to that request from the community. Having done that, we finally came up with a response of sorts, but we did not even, at that point, feel comfortable with putting the Corps name on the document we came up with. It was an emergency evacuation plan, which we feel very good about, because it was tested again in a flood later in which they were actually able to implement that plan and evacuate the city. They allowed themselves the organization and time to go back in and actually sandbag and do some emergency procedures which prevented

an overtopping in that situation. Again, we followed on a year later with another similar report in an upstream community (Pineville, Kentucky).

UNIDENTIFIED:

I was impressed with the amount of money that the Corps put into those things. We were talking about Ron's problem with big dollars. As I recall, with the cooperative arrangements you worked out, the Corps ended up with about 30 percent or 20 percent of the cost.

DUNCAN:

Let me ask one more question. How many of you have seen the policy we put out on something like "Corps Responsibility" or "Emergency Planning for Areas Downstream of Corps of Engineer Dams?" Anybody see that? One of the facets of that was a very specific requirement that the plans that were developed be nonfederal interest plans. That has been mentioned a couple of times in the coverage we have up to this point. I think in the next two-hour session that some of the other people involved in these things may want to give some clues on how the Corps of Engineers can do this emergency preparedness planning but still have it be the nonfederal people's plan. Because it is not going to work. If they don't perceive that, it's their plan, it is not going to work.

PHIPPEN:

I am very happy from my own standpoint to have seen the large response here. I think the issues were covered well, and I am certainly pleased at some of the thought that has gone into the kind of questions that have been asked. I am certainly glad the people from outside the immediate Corps were willing to contribute to our effort.

FLOOD INSURANCE

## INSURANCE AND NONSTRUCTURAL FLOOD HAZARD MITIGATION

By

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### INTRODUCTION

The National Flood Insurance Program (NFIP) was initiated in 1968 with enactment of the National Flood Insurance Act of that year. The passage of the legislation followed an extensive study authorized by the Southeastern Hurricane Relief Act of 1965 to examine the feasibility of developing an insurance program to replace the traditional methods of providing financial relief to flood disaster victims.

The study examined the various alternative components of an insurance program which include a system of hazard mitigation or, in insurance terms, risk management. Risk management involves an identification of those controllable factors which contribute to the peril against which the insurance is designed to protect the insured and a program to mitigate or eliminate the influence of those factors in the future.

In setting forth the elements of a proposed flood insurance program, the study cited the frequent inefficacy of structural flood works and recommended a policy of non-structural mitigation which would impose on local communities choosing to participate in the NFIP the requirement to adopt and enforce a program of flood plain regulation which fostered development outside the flood plain and established effective standards for development which continued to occur within the flood plain. This local flood plain regulation would be buttressed by an insurance rate structure which reflected the factors which contribute to flood risk and transferred the cost of paying for the risk to the policyholder actually at risk, rather than visiting it upon the general taxpayer. This kind of rate structure would ideally reward safe flood plain construction and impose a higher financial cost on unsafe building. The history of the NFIP has since been one of identifying the nature and extent of the Nation's flood hazard, isolating the individual factors which contribute to flood risk and developing and implementing the flood plain management standards which will best mitigate future damage.

### NFIP ACTUARIAL RATE DEVELOPMENT

The development of an actuarial rate system which could serve the NFIP required the application of certain basic principles of actuarial science as well as the need to verify the presence of certain characteristics which must be part of any insurance rating system. By "actuarial rate," I mean a rate which generally reflects the risk to which a property is exposed, and which, if applied consistently across an entire book of business, will result in a self-sustaining insurance program.

Generally-accepted actuarial principles require at a minimum that the rate system provide protection against the economic uncertainty associated with change occurrences by exchanging the uncertainty for a predetermined price. This price for insuring the uncertain event must:

- protect the insurance system's financial soundness;
- be fair; and
- allow economic incentives to operate and thus encourage widespread availability of coverage.

The broad grouping of risks with similar risk characteristics for the purpose of setting prices is a fundamental precept of a financially sound and equitable system. Since each property at risk is different, a rating system which attempts to identify and reflect in prices every risk characteristic is usually unworkable and costly. Therefore, the basic features which must be present in sound risk groupings in order to meet the above criteria are:

- (a) a sufficient number of insureds with similar risk characteristics to make a credible group;
- (b) a group which has a significantly different expected loss cost than the average;
- (c) the determination that risk characteristics of a group are objective and administratively feasible to apply;
- (d) a system of risk groupings which is practical and cost-effective; and
- (e) acceptability to the public

In addition, in the case of flood insurance authorized under Public Law 90-448 the system of insurance and pricing must further the purposes of the Act, which include, among other things, to (1) encourage State and local governments to make appropriate land use adjustments to constrict the development of land which is exposed to flood damage and minimize damage caused by flood losses, and (2) guide the development of proposed future construction, where practicable, away from locations which are threatened by flood hazard. In order to give practical meaning to these objectives, the 100 year flood standard was adopted by the program since it is now used by virtually all Federal, State, and local agencies, in the administration of flood plain management programs. The risk of experiencing a flood of this magnitude or larger is one chance in four during a typical 30 years mortgage period. In terms of flood insurance, this elevation standard generally yields reasonably priced insurance protection to the property owner. The use of a lesser standard which approximated pre-1969 building practices would expose future risks to a better than 50% chance of being flood damaged during a typical mortgage period and results in insurance rates which would be three to four times those reflecting the 100 year standard. It was just this consideration of unaffordable full risk premium (actuarial) rates which prompted Congress to "grandfather" in existing construction at subsidized rates.

The National Flood Insurance Act of 1968 separated the flood insurance ratemaking process into two distinct categories, namely chargeable premium (subsidized) rates and estimated risk premium (actuarial) rates. I will not deal at length with the category of subsidized rates. These are countrywide rates by broad occupancy type classifications which produce a premium income somewhat less than the expense and loss payments incurred on the flood insurance policies issued on that basis. The funds needed to supplement the inadequate premium income are provided by the National Flood Insurance Fund. The subsidized rates are promulgated by the Federal Insurance Administrator for use under the Emergency Program and use in the Regular Program on construction or substantial improvement started on or before December 31, 1974 (this additional grandfathering was added to NFIP in 1973) or the effective date of the initial Flood Insurance Rate Map (FIRM), whichever is later and have resulted in an annual insurance premium of \$95 per policy paid by policyholders and an average premium subsidy of about \$107 per policy borrowed from the Treasury of the United States.

Because the subsidized rates do not differentiate between varying degrees of risk, they do not possess the mitigation feature which characterizes actuarial rates since they provide no economic incentive to safe construction. However, FIA has more recently attempted to address this particular quality of subsidized rates by applying as of October 1, 1982, a rate of differentiation to new structures built in Emergency Program communities. This differentiation is based upon whether the community used the best available hazard information for building standards even though FEMA elevation data had not yet been made available.

Actuarial rates are promulgated for use under the Regular Program (the phase of the National Flood Insurance Program which a community may enter following the initial publication of the FIRM-detailed risk zone and elevation map). The actuarial rates are applied in the rating of post-FIRM construction and second layer limits of insurance on all construction (e.g., in the case of 1-4 family residential, amounts of insurance of excess of \$35,000).

In the development of these actuarial rates, the following factors are considered:

- Base flood elevation
- Minimum water surface elevation relative to lowest floor at which flood damage occurs
- Maximum elevation at which flood damage approaches a maximum
- Lowest floor elevation of structure
- Water surface elevation probability
- Damage to value ratio
- Loss adjustment expense
- Policy deductible
- Insurance-to-value
- Expected loss ratio

The various risk zones are derived from hydrological studies done on a community basis which establish the 100-year elevation for particular areas of the community as well as the frequency with which various degrees of flooding will occur.

The actuarial rate formula containing these factors may be expressed as follows:

$$\text{Rate} = \frac{\text{Max} \quad (PELV \times DELV) \quad \text{X LADJ X DED X UNINS}}{\text{Min}}$$

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EXLOSS

Where: Min = minimum elevation relative to lowest floor at which flood damage occurs.

Max = maximum elevation relative to lowest floor at which flood damage approaches a maximum.

The variable identified as PELV is the probability of a particular water surface relative to the 100 year base flood elevation. For example, in Zone A10, the probability of water rising to or above an elevation 1 foot less than the 100 year flood elevation is 1.6%, 1 foot above the 100 year flood elevation or higher is 0.6%, whereas the probability of rising to or above flood elevation is 1%.

The assignment of PELV values must be accomplished in such a way as to keep the rating of policies as simple as possible and still distinguish expected average cost differences among the rate zones. There are currently 80 numbered A Zones for which different sets of PELV values may be assigned. However, there are three main technical reasons for combining risk zones for rating purposes. These are the fact that (1) Lowest floor elevations are measured to the nearest foot, (2) the base flood elevations are approximations based on best available data on the major sources of flood (local urban drainage problems, urbanization of other parts of the watershed, etc., are some of the factors which increase the flood hazard but are virtually impossible to quantify and still keep the Flood Insurance Study process cost effective) and, (3) the basic frequency curves are truncated at about the 350 to 500 year event. As a practical approach, five risk zone combinations have been established reflecting 1.0 foot incremental differences between the maximum flood levels and base flood elevations, and a minimum elevation difference of 1.5 feet between the maximum flood level and the base flood elevation has been established for the risk zones with the lowest flood hazard factors. The lowest flood hazard factor (0.5) delineates the difference between the estimated 10 year flood level and the estimated 100 year flood level as one-half feet (Zone A1) whereas a flood hazard factor of 2.5 delineates the difference between the two flood levels as 2.5 feet (Zone A10). The average

change in flood levels between the 10 and 100 year event for Zones A1 is 1.5 feet. Considering the relative variance in flood levels that can occur because of conditions which affect a particular building site during an actual flood, the estimates that are made by the engineer/hydrologist in calculating the 50 year flood level, 100 year flood level, and 500 year flood level and the nearest one foot rounding procedures, a combination of Zones A1-A10 for insurance rating is reasonable for buildings constructed at an elevation of minus 1 or above. For buildings constructed at minus 2 or lower, internal staff guide rate tables were calculated based on separate combinations for Zones A1-A5 and Zones A6-A10 because of the higher PELV values associated with small elevation differences below -1 for the lower numbered zones. Individual underwriting decisions are needed for buildings constructed at these low elevations. The accepted hydrologic methods used in the studies done to establish these minimum values tend to underestimate the calculated flood frequencies when there is little or no recorded flood data. Generally, recorded data relating to flooding events exceeding the 100 year event is sparse, and the number of years of recorded flood data rarely exceeds a 30 year period. Even in those instances where longer records exist, changes in the flood plain characteristics partly invalidate the usefulness of the data. Furthermore, it is generally accepted that the uncertainties involved in calculating the 500 year flood level are significant. Therefore, it has been concluded that complete reliance on the traditional flood frequency tables in the calculation of insurance rates would produce only about one-half the insurance premium required to meet the insured risk.

The variable DELV is the ratio of the flood damage to actual cash value of the insurable property and is obtained from depths percent damage tables. These tables are subject to experience checks by the FIA from a review of actual flood insurance claim files. The DELV values are calculated by weighting the actual insurance claims experience and the previously established depth percent damage values. The weighting is accomplished by using standard actuarial techniques (credibility).

The FIA has converted specific tables of PELV and DELV values to mathematical expressions. The purpose of this undertaking was to facilitate computerized calculation of the rate formula which involves thousands upon thousands of computations.

The variable LADJ is the loss adjustment expense factor expressed as a function of losses (claim payments to policyholders). This provides funds for the payment of loss adjusters fees and special claims investigation costs which are required to determine the appropriate insurance value of the flood damage and the amount due the policyholder under the terms and conditions of the flood insurance policy. The LADJ is 5%.

The variable named DED is the deductible offset. This variable is required to reflect the insurance policy condition that the first \$500 of damage does not qualify for an indemnification payment.

The variable named UINS is the under-insurance factor and is included in the formula because flood insurance policyholders do not always insure to value. This requires that the impact of the DELV values in the formula be

adjusted to account for the difference between property values and the amount of insurance purchased for each category of risk. The present factors are 1.25 for 1-4 family dwellings and 2.0 for residential contents, 2.0 for other buildings and 3.0 for non-residential contents.

The variable EXLOSS is the expected loss ration and serves to load the actuarial rates for insurance agents' commissions and other acquisition expenses incurred in the selling of flood insurance policies and a small contingency loading. The EXLOSS factor used in the most recent rate revision is .80.

This formula follows in principle the "hydrologic method of estimating flooding damage risk" outlined in the 1966 HUD Report entitled "Insurance and Other Programs for Financial Assistance to Flood Victims" (see Report page 50).

There are a few risk zones (Zones A, B, C, D, AO, AH, and V) where costs to obtain the hydrologic and topographic information needed to develop flood magnitude-frequency relationships would be extremely high in relation to the flood plain management benefits. Average rates based on actuarial and engineering judgements were promulgated for these zones. However, as noted above, we have introduced Zone A rates based upon elevation criteria. The NFIP flood plain management regulations require communities, through their permit systems, to obtain, review, and reasonably utilize any base flood elevation data available from a Federal, State or other source as criteria for requiring that all new construction and substantial improvements of existing building have the lowest flood (including basement) elevated to or above the base flood level. This new Zone A rating system is designed to encourage adherence to some reasonable elevation criteria.

#### APPLICATION OF NFIP ACTUARIAL RATES

The implementation of the rate structure is accomplished through the interaction of the local community, the insurance agent, and the individual property owner.

The local community is required, as a condition of participation in the program, to enforce through its building permit system, the base flood elevations which have been established for the community. In practical terms, local officials must ensure that any new structure built in the flood plain (A or V zone) have its lowest floor at or above the base flood elevation. In V-zones, where the additional hazard of wave action exists, that elevation includes also the wave height factor.

In preparing a flood insurance application for such a structure, the insurance agent must know the zone in which the property is located, the type of structure being insured, the base flood elevation for the area, and the lowest floor elevation of the structure. Both of the latter elevations must be certified to by the local community or a licensed engineer or surveyor. With regard to type of construction, the program has distinguished between one or more floors, no basement, unfinished basement or finished basement, and mobile homes. Insofar as experience fairly limited duration can be analyzed, this type of differentiation has shown itself to have relevance.

The calculation of the basic premium involves the application of the rate established for a particular zone at a particular location to every \$100 of insurance coverage requested. Added to the basic premium is an expense constant of \$20.

Unlike the loss and loss adjustment costs, the acquisition costs and general expenses of the insurance program can be predicted with some degree of certainty and can be provided for in the annual insurance premium structure.

This \$20 expense constant was determined as follows:

Cost:

(1) Cost EDSF Contract Per Policy	\$14.72
(2) Map Distribution and Information Service	0*
(3) Flood Insurance Restudies and Related Expenses	0*
(4) Total General Expense	<u>\$14.72</u>

\*Budgetary provision for future consideration

Charges:

(1) To Cover General Expense and Adjust for 3 Year Policies	\$17.00
(2) Agents Commission (\$17 x 5%)	<u>3.00</u>
(3) Policy Charge (Expense Constant)	<u>\$20.00</u>

## OPERATING RESULTS

One of the major obstacles to determining the impact of the program's hazard reduction measures has been the inability to accumulate accurate loss experience data. It has only been since 1978 with the FIA's assumption of direct responsibility for the insurance program that any sort of useful information has become available to enable us to analyze the effects of the program's policies.

The loss and expense experience for the period January 1, 1978 up to March 26, 1982 (a period of relatively light flooding) by program and risk zone show the following operating deficits:

Calendar Years 1978 - 1981

<u>Program and Risk Zone</u>	Operating Surplus or (Deficit)	
	Paid Basis	
	<u>\$ (Millions)</u>	<u>\$ A/g. Per Policy</u>
Regular Program - Post FIRM		
Zone V1-V30	(\$ 2.22)	(\$132)
Zone V	0.03	135
Zone A-1-A3	(3.30)	(20)
Zone Z	0.44	11
Regular Program - Pre FIRM		
Zone V1-V30	\$11.53)	(\$65)
Zone V	.06	27
Zone A1-A30	(157.70)	(95)
Zone A	(40.94)	(137)
Regular Program - Pre and Post Combined		
Zone B	(\$49.34)	(\$92)
Zone C	(140.13)	(135)
Zone D	(8.23)	(194)
Zone AO, AOB, AH, AHB	0.93	27
Emergency Program	(262.72)	(\$128)

While it may be too early in the program's history to determine how representative these figures are, certain tentative conclusions emerge a interesting.

The most gratifying of the figures are those surrounding Post-FIRM (Zones A1-A30) construction in riverine flood plains. This is construction built after elevations have been determined for a community and more restrictive building standards have been applied to the individual structure. The operating deficit for such structures was only \$20 per policy compared to \$95 per policy for structures which were already there prior to the establishment

of elevation standards, and \$128 per policy for Emergency Program communities, where no elevation standards have yet been imposed.

On the other hand, in coastal areas (V-zones), the loss experience for new structures was twice as bad as that for existing structures. It is difficult to know how to interpret this, except to speculate that the program's standards may not be sufficiently restrictive (e.g. the absence of the wave height factor early in the program), or, and there is substantial evidence of this, there has been significant violation of the program's standards at the local level, one notable example being the enclosing of the space below the lowest floor after policies have been written. We are attempting to address this problem both through the rate structure itself by combining a rate increase with an optional higher deductible and through a post-claim underwriting policy of deducting premium adjustment from claims payments.

In summary, the program's rate structure has been tied intimately to its hazard reduction objectives to a point where, currently, it may well serve as the most effective incentive to sensible building decisions at the individual and community level. Certain initial indicators seem to point to the effectiveness of this structure. More insight will become possible as the hazard reduction system and rate structure become further institutionalized.

PANEL VII, FOLLOWING PASTERICK ADDRESS

FRANK INCAPRERA:

I always look on the relationship with FIA as a sister-to-sister or brother-to-brother type relationship. There are few left around here who realize how involved the Corps of Engineers was in the initiation of the FIA programs. President Lyndon Johnson in 1967 made a statement that there were more buildings being built in the floodplains than the Corps of Engineers could build projects to prevent. We have prevented a lot of billions and billions of dollars of properties being built in the flood zones. And we have prevented millions and millions of dollars of damages on these same properties I speak of.

Just because we haven't implemented a floodplain management program that was tied on to the carrot of the flood insurance program, the rates that we were talking about were very interesting to me in that I was with the initial group in 1968 that was issued a blank sheet of paper from the director of FIA. They called various members from the districts and we all met in these barracks over here across from the National Airport. And with this blank sheet of paper we came up with more or less the same idea as was presented today. And we started out as five zones, then we ended up with three, the A zone, the B zone, the C zone; but it was interesting how to put this apparatus together because we didn't have the advantage of the life insurance or whatever other insurance companies there are to provide historical information to give you the actuarial rates.

So the only thing we had left was to go to the economists and find out what the damage frequency relationships were throughout the country. We went to all the districts and found out what they were using for computing damage relationships, and how they would come up with the average annual damages, and so forth. And this is really the guts of what he was talking about. You can turn these around and say these are the average annual damages for a house at different elevations on some particular stream.

The thing we use for the zone idea came out of the Galveston District, I'm proud to say. We had a computer program that could evaluate stage-damage relationships by zone. And we quickly identified that the risk was much different in the five and 10-year zone than it was in the 50 and 100-year zone. And of course the gathering together, the grouping that you keep referring to, was a very important formula that was developed later on and in a more sophisticated form by FIA, and made the program very valuable.

I just feel very proud that, after this many years, the Corps of Engineers and FIA and all those people, all they need to see is that they have contributed to this system, have really done a good job. I'm really proud to be a part of this, and I think the Corps should be proud to be a part of this.

In the intervening years we've had a few squabbles like you would have in any family, and I should think we'll continue to have our squabbles. I know that some of you back home are having problems. Whose 100-year flood zone are you going to use? And I think that's going to be a long-lasting problem and it

leads up to a point which I would like to make. I think the problem is going to get worse, not because of our differences but because of the development we can expect in the areas. We found in our investigations, back then, that in some areas--because of development and the watershed, and because of subsidence, and because of other factors--that within a 50-year period at least, you can have as much difference of elevations for this 100 years as 12 feet. I know that in most of the developing urban areas--and I'm thinking of Houston itself, since 1956, four feet. And with what you've got sitting on your maps today, wait 10 more years and they're going to be four feet off. I'm really concerned about that kind of problem. And it drives me to the next thing I want to present.

I think this is an idea that might fall into some of the other ideas that have been flowing through the audience for the last couple of days. I would like to see--and I think it's possible that we could have with the survey scope reports, and the authorization of the survey scope reports--the inclusion of a separate report. I go back to the beginning--I say authorization--because I think that's the only time we're going to get the bucks to do it, the inclusion of a technical supplement report. This report has to stand on its own, alone, outside of the planning concept. No one should really need to go through the survey report and dig out what they need, and I'm talking about the people on the local level. They need something now; they don't need something when the report is finally implemented 20 years in the future, but something that they can turn to the day we finish. We say, "Here's the report and you can use this and do something today."

In this report, I would like to include the emergency preparedness plan for a particular community. I think the Corps is very capable of doing something like that. I think we can include technical data that are not included in our survey reports, not even in the appendices, particularly hydrological information. I mean it all goes into the drawers, three guys leave the district, it goes in the warehouse, and Lord knows where it is today. This type of information, not samples like are in the survey reports but technical data of all the hydrological, the economic, the sociological studies, the environmental studies that are made, would be helpful in many ways to the local people. They could use it the next day.

For the floodproofing process, there's a lot of information they could be using that we could give them out of our files. The particular information I was referring to that you could use in the FIA would be the hydrology information that has been developed for future conditions. We have done extensive studies in locational models where the development will be in 10, 15 year increments, right down the road, and these are sitting in the files. Nobody has them but us, and those areas that are critical to these changes--the hydrological changes, and economic growth development--would be available in this particular report.

Now I would like to say in the implementation of this idea of the separate technical supplement report that it be identified as a separate report with separate funding. I say separate funding; I don't mean initial separate funding, but a line item funding, just like you have line item funding for environmental studies, planning studies, formulation studies.

I would not give that report away. We're going to have to have a 50-50 cost sharing on survey reports that are supposed to be coming up. The local's got to get his copy free; he's paying for it. But for anybody else who wants it, I would like to see that report being sold at a reasonable price not even subsidized in any way. I mean \$100, \$200, \$300 for a report with this kind of valuable technical information, and the money collected for these technical papers could be sent to a pot in the chief's office where we could finance other technical supplement reports that were not attached to a survey report. In other words, we would have a vehicle here to have monies to finance these studies for our other technical supplement reports that were not tied onto a survey report.

WILLIAM JOHNSON:

I'd like to second something that Frank said about the cooperation with FIA and particularly Frank Reilly and his unit there that does the rate structuring. HEC became involved in the flood insurance rates back in 1977. They had a problem with the rates, and the problem was a somewhat minor one out a somewhat bothersome one. As the rates should be decreasing, we got a little in their data where it would go down, then up, then down, and they realized that that wasn't the way it should be. So they asked HEC to analyze their methodology, their computer programs, and they sent all of the information out to us. We looked at that and we found a couple of minor things in their computer program. We pointed out what the problem was and sent the information back to them.

Since then, I've been just kind of keeping up on flood insurance rates and what has been happening with Frank Reilly. FIA has always been extremely cooperative, providing all the information we needed. As I've investigated the computations of flood insurance rates, I believe they are theoretically sound. I believe their method is sound, their computer program with a couple of minor exceptions is sound. The problem is with the input data, and that's of two types. It's the depth damage, and it's the elevation frequency, which is characteristic of all of our economic analysis in the Corps. Basically what Ed put on the chalkboard up there is expected annual damages times the factor, and that's an administrative factor, a load charge or whatever you want to call it. And that factor is about 1.7. So you take your expected annual damage that you would get from your economic analysis in your region and multiply that by 1.7, and that's the methodology that they're using.

Well, what goes into that computation? Two things go into it: elevation frequency, elevation damage. And I think, with all the effort that FIA has gone to to get better elevation damage data, that the Corps has a hard time coming up with anything better, since FIA has all the data and is analyzing the data.

I have a question, and I think it's something that FIA ought to look at. In order to create credibility, we also have to look at the elevation frequency--and I guess, Ed, my comment would be to you, that this is the area that you're going also to have to address--not just the elevation damage. Because what FIA has been using has been a generalized frequency curve that there are no data for, there's no back-up for, and multiplying that times the

elevation damage. So you really don't know what you have. You don't know how close you're coming to what actually exists. And this is a problem of data again. Who has got the data? Corps of Engineers has got the data.

So there are two approaches that could be taken to improve this. One is that you could go to Corps offices and get the elevation frequency curves that they got written. See if you could put them in categories like your flood hazard factor categories like they did, and see if they fit some sort of polynomial form like they have done in the past. And that might work; you'd have generalized frequency curves based upon actual Corps data in 1982 or whenever the hydrology was done. The other approach is to create a regional data bank where you have regional frequency curves and regional damage curves, and then, using that data bank, compute regional rates. That's another approach that could be used. The technology is certainly there; it's just a matter of getting the data into the data banks.

So I feel good about what FIA has done in terms of insurance rates. I've been very open, very straightforward, and I think from everything I've seen that they've done a credible job, a professional job.

One of the things that Ed talked about was the lumping together of the A zones, say A1 to A7 on their own rates, or A1 to A10. Well, they've done something very clever. He didn't point that out to you, but what happens is when you start averaging A1 to A10, you run the risk of having A1 significantly different from A10. When you average things out, you could be off for a house in A1 or a house in A10 if you're lumping them together. But they've done something very clever in that if there's a large difference, they put a little star in their table and say we'll take a look at this individually. And so what you have in these averagings is A1 being very close to A10 and consequently the difference in the averaging being not significant.

So I have a lot of credibility for the work you've done. I think it has been very professional, and I'd like to see it improved in the area of frequency analysis.

ROBERT W. HARRISON:

I'm not very well qualified to say anything hardly on this, but I will anyway. Bill, I think, brought up a point. No one can doubt the importance of all this. And I can recall quite a long while ago working on crop insurance. It had a lot of the same aspect. In Agriculture we had a big group trying one time to develop some kind of insurance program that the commercial companies would buy. Eventually they did, to some extent, to insure properties against such things as hail, and other things--not just hail. But, above all, you cannot get away from the fact that this is a terribly risky game.

There's something rather suspect about insurance to start off with. It's too closely related to gambling. It's hard to be totally without a little feeling that it has got to be watched closely. Now, I don't say that in any mean spirit at all, because this is important, but this watching process is a part of the accumulation of the experience. And how regional or how local things have to become before this watching can be relaxed a little bit is now unknown in the flood insurance field.

Insurance in other aspects of life is not enjoying any great popularity right now. Automobile insurance has its problems with "no-fault." As for medical insurance, most of us look over this thing and we're not happy. I suppose insurance, to some extent, that is required by banks that you borrow for fire insurance and all that kind of stuff, may be a little bit more subtle. But if you will take any individual and take his whole experience, what he pays out for insurance under each one of these things, you cannot help but wonder if flood insurance is part of that--whether there isn't some combined approach that society can use for these risks that every individual in one way or another is subjected to. He is subjected to risks by situations, geography, his age, to some degree the state of his health, his occupation, his location in society whether he's an owner, a renter, or something or other. Couldn't we try to have some kind of a combined approach.

Now you think that's far away from the Corps' responsibility, but I'm not sure it is because insurance is an enormously expensive aspect of the society. And are we getting our money's worth out of it? Are individuals, is the state getting its money's worth out of it? Are they achieving the objectives that they want to achieve? I think perhaps I don't claim the building insurance program isn't beginning to achieve some very important objectives. But this watching process may lead us in the long run to some kind of understanding about the risks. After all, it's the people who are taking risks; it's individuals, they are the ones who ought to be able to package their risks and put them on the shoulders of the elected.

WILLIAM JOHNSON:

I'd like to make a comment, Bob. Let's follow this through. The flood insurance rate is the expected annual damage times a constant for any particular type of structure. You say that this should be watched carefully. Well, when we have a variable times a constant, then we should watch the variable--the variable expected damage, the damage which is the heart of the Corps of Engineers' benefit analysis. Who does the Corps of Engineers' benefit analysis? The economists. I surmise that the economists should be watched carefully.

DISCUSSION FOLLOWING PASTERICK ADDRESS

CARL FOLEY:

I have three quick questions on the flood insurance program. First, the deadline for the emergency program gets extended every year. Are they still doing that? Can you still join, and is the deadline extended every year?

EDWARD PASTERICK:

Yes, there are periodic looks at the emergency program. How long will it be around? There are a certain substantial number of communities where the determination has been made that it's probably not cost effective to study them to determine elevations. Therefore, there is some question as to the best way of bringing those communities into the regular program, without the study process. That's one element of it.

But at this point there has been no policy decision made to eliminate the emergency program.

FOLEY:

Another question. One of the numbers we need in our benefit analysis for evacuation plans is the average cost per policy, FIA overhead cost. I believe P&S, when you come to this point, says contact FIA. Do you know that number?

PASTERICK:

What do you mean, "average cost per policy"?"

FRANK INCAPRERA:

The last number they gave us was less than a dollar per policy.

FOLEY:

Less than a dollar? Wow! Forget that.

The third question. The concept of the program originally was that we were not going to have any more federal subsidies in the floodplains until the community at least joins the program. You would think that this would prohibit the Corps from building flood control projects until the community joins. But it's just the opposite.

In our planning guidance notebook we're told that this doesn't apply to a Corps project, that you don't have to join the insurance program in order to be eligible for a Corps project. Can anybody explain the rationale for that? Maybe Don Duncan?

DONALD DUNCAN:

Well, I think someone from planning should disseminate planning information.

FOLEY:

It would seem reasonable that we should require that a community belong to the flood insurance program before we build a flood control project.

BRIAN MOORE:

Yes, there is something, Carl.

WILLIAM HOLLIDAY:

We do, quite frequently, and the Board of Engineers' reports quite often have ABC's requiring the local community to adopt and enforce regulatory controls. And that has been interpreted by the field, quite often, as being participants in the regular program of the FIA.

EDWARD PASTERICK:

Practically speaking, I would wonder how many communities there are where you'd be building projects at this point which aren't in the program. I think its a good question. For example, disaster relief in a number of other kinds of federal construction activity is conditioned on participation in the program. And I think you're asking for some consistency.

At this point we have some 17,000 communities in the program. Many among those that are still not in the program are communities where the areas that are affected by flooding are very much unpopulated. There are, finally, a few communities that have just resisted. In most of those cases the impact of not participating is not significant.

GEORGE PHIPPEN:

There is one point, Carl. Bill Holliday has touched on the fact that the language is there on participation, if not strongly. I would say that we implicitly put the flood insurance program there. Unless they've changed it since I left, the requirement is that you assume that there is no future development in the 100-year floodplain. That, in effect, is recognizing the program. Whether you re-enforce that by insisting that communities join is another matter. In that sense, it is recognized.

WILLIAM J. DONOVAN:

It's a part of the "without the project" condition, Carl, so it would affect the benefit computation.

FOLEY:

That's true. But they "go out of their way" in the planning guidance notebook to say that we don't hold it against them if they don't belong to the program. I was just curious about the rationale behind that.

DUCAN:

The flood insurance doesn't prevent any damages at all. There's just the question of how you want to pay. The real issue is the regulatory constraints that are associated with the insurance or with the "local cooperation" requirements which the Corps lays on them.

JIM D.DAVIDSON:

As a point of interest, Carl, pursuing one of your questions. we testified before the House Public Works Committee in June, with something like 120 projects. We were asked by Congressman Edgar to give him a list of communities that were in the flood insurance program. Practically all those protected were in, either in the emergency or the regular flood insurance program. The only ones that weren't were those incidentally protected by a large project covering a much bigger area.

LARRY LARSON:

I'd like to ask an unfair question. It seems that the flood hazard boundary maps, which are the original general maps before the detailed setting or "A" maps are done, were done rather conservatively. They outline a larger area than the finished map would do with a detailed study, which would shrink the A zone, where insurance is required.

There is rumor that -- for that reason -- since there would be some people no longer required to buy insurance, FIA doesn't support doing those additional studies. Is that true?

PASTERICK:

We don't support doing the additional studies to expand the flood hazard area? I'm not clear. Give some background.

LARRY LARSON:

Well, you'd lose some income base if you did those studies which would shrink the A zone.

PASTERICK:

The problem is the perception of the flood insurance program. You're right--in one sense you are. In another, I may disagree. Initially, this was a policy decision way back. When we first started doing the maps, we used standard blocking areas. We went out to identifiable streets and landmarks to take in the flood hazard area. As long as the purchase of flood insurance was voluntary, that really didn't make any difference. The fact that you were inside or outside the draw line wasn't of consequence.

When the 1973 act was passed requiring the purchase of flood insurance as a condition of getting mortgages and disaster relief, there was a great deal of concern as to whether owner's property was technically in or out of a flood hazard area. Being in or out then meant having or not having to buy a flood insurance policy. Flood insurance was not viewed as a benefit to the public when it was made mandatory. It was viewed as a pain. Banks viewed it that way and many still do. It's seen as an imposition which initially was resented a great deal.

Therefore we went to the policy of using a curvilinear line to delineate the flood hazard area. That tended to constrict the flood hazard area. Not because we wanted to, but because the pressure from the lending community and general public was such that we believed we had better be as accurate as possible with our lines.

If you say we're losing income, we are insofar as we're technically not requiring that people live outside the curvilinear boundary, even though they would fall within the blocked line. How much we're losing in that regard, I don't know. The decision about restudies has nothing to do with that policy decision of years ago. The problem that we have with restudies has not as much to do with whether we'd be finding larger or smaller hazard areas, but with whether in fact we need restudies to support the insurance program.

One of the big problems that we have is this "changing condition" issue. What's relevant today may not be so five years from now. And the problem we face with the flood insurance program is the intimate connection between the insurance program and the land use measures taken at the local level. A fire insurance company that sells you a policy doesn't require that community to do anything, not in location of firehouses, or hydrants, or in wiring. They first look at how you are and charge you a rate.

The flood insurance program is different. We've made a deal with the community. We've put out elevations and said, "If you impose these elevations on new construction, you're going to get a reasonable rate." If we come back five years later and say, "You're two feet lower than you ought to be," what happens to the deal that we made? Do we then say, "Really can't help that; your rate has now jumped from 60 cents per hundred up to \$2.80 per hundred? It's a public policy kind of consideration that is difficult to know how to proceed with.

# THE IMPACTS OF THE NATIONAL FLOOD INSURANCE PROGRAM

Larry A. Larson

## Program History

The National Flood Insurance Act of 1968 (Public Law 90-448) established the National Flood Insurance Program (NFIP). The Congress found that this program could promote the public interest by providing appropriate protection against perils of flood losses and encouraging sound land use by minimizing exposure of property to flood losses. The Congress also found that the objective of the flood insurance program should be integrally related to the "Unified National Program for Floodplain Management". Purposes of the act were to encourage state and local governments to make appropriate land use adjustments, to restrict the development of land exposed to flood damages, minimize damage caused by flood losses and to guide development of proposed future construction, where practicable, away from locations threatened by flood hazards.

The NFIP is a quid pro quo program. The federal government provides owners of existing structures the opportunity to purchase low-cost flood insurance on the provision that their community adopts and enforces adequate flood hazard management regulations to guide future development so it is built to protect lives and property from future floods and flood damages.

While community participation is voluntary, the Congress provided in the Flood Disaster Protection Act of 1973 (Public Law 93-234), which amended the 1968 Act, that flood insurance coverage must be purchased and adequate safeguards and land use restrictions must be enacted to minimize future losses of life and property if federal financial assistance for purchase of structures or construction purposes is to be made available. The 1973 Act required (1) designated communities to participate in the flood insurance program or face restrictions of federal financial assistance, and (2) property owners to purchase flood insurance to receive new or additional federal or federally-related financial assistance for acquisition or construction purposes in identified special flood hazard areas. Federal disaster assistance for construction or reconstruction purposes is also not available under this Act unless property owners first purchase flood insurance.

Under the NFIP, there are specific roles for local, state and federal governments. The primary responsibility to manage the floodplains in the nation rests with the local unit of government. This is true whether one is talking about regulations to guide future development or flood hazard mitigation activities to reduce damages to existing structures. On that basic premise, all state and federal activities should be oriented toward assisting the local units of government. The state role is important since they are close to the local communities. As much technical assistance as possible should be provided by states since they are in a better position to help local communities integrate flood hazard management activities with other community needs and goals related to housing, economic development, revitalization, etc. A more detailed breakdown on the appropriate local, state and federal roles would include:

## Local Role

Prime responsibility to reduce flood-associated costs and suffering by:

- Develop and administer land use regulations tailored to local needs
- Implement flood damage reduction (mitigation) programs
- Implement flood warning systems
- Implement stormwater management
- Identify mapping and data needs for these programs
- Develop comprehensive programs to combine these goals and objectives.

## State Role

Data - Study coordination  
Study repository

Authority - Acquire statutory authority for  
Local regulation and state assistance

Standards - Develop minimum state standards  
Ordinance preparation tailored to local needs  
Community assistance and training

Community Monitoring and Enforcement

National Flood Insurance Program

- Recommend community admission
- Recommend community suspension
- Provide insurance information

Emergency Preparedness

Flood Warning and Evacuation Coordination

Lender Training and Assistance

Flood Mitigation Planning Assistance  
for nonstructural & structural measures

- Pre and post-flood planning program
- Technical assistance to implement
- Cost-share implementation
- Establish priorities for federal assistance programs

Stormwater Management Coordination

Information and Education

Coordinate among Communities

Support Local Implementation Efforts

## Federal Role

Data - Study coordination  
Study funding

Standards - Develop federal  
standards with flexibility  
for states to achieve  
standards

State monitoring and enforcement

National Flood Insurance Program

- Community admission and suspension
- Implement insurance program

Disaster Relief

Flood Forecasting

Lender Monitoring and Enforcement

Flood Mitigation Assistance for  
nonstructural & structural measures

- Cost-sharing for flood damage

- Insure federal disaster assistance programs don't increase cost exposure during next flood

Research

Information and Education

Coordinate among States

Support State Efforts

The participation in the NFIP has been substantive in the nation. As of December 31, 1981, over 17,100 communities and other political subdivisions were participating in the program. An additional 3,200 had special flood hazard areas identified but have decided to not participate. About 1.9 million insurance policies are in force, providing over \$99 billion worth of flood insurance coverage.<sup>1</sup>

There are 54 "states" participating in the NFIP by providing a state coordinator for the program and providing technical assistance about the program to local units of government and citizens. This includes all 50 states plus the District of Columbia, Puerto Rico, Guam and the Virgin Islands. The extent of coverage in the nation is considerable and the costs of the program have been significant although somewhat variable from year to year. As indicated above, there are approximately two million insurance policies in force providing nearly \$100 billion worth of flood insurance coverage. However, it is estimated that there are about 7.4 million structures in the flood hazard areas of the nation. This means that only about 39% of the eligible structures in the nation have flood insurance. Furthermore, in highly urbanized areas, a large portion of the flood insurance claims are being paid outside the identified flood hazard areas due to urbanization and stormwater runoff (more about this later). Because of this factor, it appears that as few as 20% of the nations structures which are subject to surface water flooding damage may be covered by flood insurance.

Since inception of the program in 1968 to December 31, 1981, the federal government has provided over \$1.5 billion to subsidize the flood insurance program. According to unaudited GAO records, about \$866 million has been collected in insurance premiums during this period but \$1.249 billion has been paid to the insured for flood loss claims. In addition, over \$408 million has been paid to the operating contractor, insurance agents and claims adjusters; \$520 million has been spent to prepare flood community maps and \$174 million has been incurred for interest expense on the U.S. Treasury borrowing.<sup>1</sup>

Perhaps \$1.5 billion over a 13-year period, if the program has been at all successful in guiding future development away from flood hazard areas, is not an unreasonable investment for the nation. Especially when one considers that average annual flood damages are in the \$2-3 billion range and in 1980, the Water Resources Council estimated that expected damages in the year 2000 will exceed \$4.3 billion per year (in 1975 dollars). Losses from urban and urbanizing areas will increase most. The cost for disaster funds obligated from the President's Disaster Relief Fund for assistance to flood victims for calendar years 1974-1979 exceeds \$1.7 billion including \$172 million for individual family grants. States contributed another \$57 million as their share of these grants. Loss of life nationally continues to average around 200 lives per year. It is interesting to note that 5 states; Delaware, Maryland, South Carolina, Florida and Texas account for 46% of the 1.9 million flood insurance policies outstanding; 54% of almost 100 billion of insurance coverage enforced; and 30% of over the 1.2 billion in claims paid. Louisiana is the other state that has a very heavy amount of coverage and claims paid.<sup>2</sup>

## Effectiveness of the NFIP

The NFIP has been emphasizing its role in guiding new development as opposed to mitigating damages to existing development. With over 17,000 communities participating in the NFIP and approximately 10,000 communities in the regular program, there are many ordinances guiding future development. All regular program communities must have an adequate ordinance in place that guides future development out of floodway areas and adequately protects structures in flood fringe areas. All communities with an ordinance have the authority to guide future development, the question is are they in fact enforcing and administering those regulations in such a way that the development is being properly guided. It is the author's opinion that the adequacy of administration of local regulations varies considerably nationwide and may reflect the adequacy of the state program as much as any other single factor. For example, in Wisconsin, the author's home state, the state program is very active; technical assistance provided to locals improves the quality of local decisions. Since the state has good legislation with enforcement capability, if a recalcitrant community knowingly permits bad development, the state can enjoin such activity from being constructed. In states where there are weaker programs or where they have no state legislation to require communities to adopt and properly regulate, improper construction is more likely to occur.

The GAO report noted that some communities are allowing improper construction because they don't know how to properly administer their ordinance, which means they aren't getting enough technical assistance. Some communities are knowingly violating their ordinances in allowing new development. In those cases, enforcement is needed. That was the reason the GAO recommended FEMA develop a better monitoring and enforcement program to assure that local communities are adequately enforcing their floodplain regulations. FEMA, with its limited staff, cannot adequately provide technical assistance nor monitoring of all 17,000 local communities. For that reason, FEMA is working with the states to build adequate capability to provide that assistance closer to the local level.

States use other sources and other federal agencies to provide technical assistance to communities, for example, the Corps of Engineers through its Floodplain Management Services Program (FPMS) and the SCS provide assistance in many states to local communities. This usually involves mapping assistance and other types of technical assistance to give communities proper tools to regulate or develop mitigation plans in their communities. Additionally, regional governments such as regional planning commissions often assist local communities to develop ordinances and to administer them. Progressive regional planning commissions such as the Southeast Wisconsin Regional Planning Commission help communities develop comprehensive ordinances that include flood hazard regulations. In many cases, these comprehensive ordinances provide a standard of protection that is beyond federal or state regulations. It may leave the entire floodplain area open as green belts or open-space use where no structures are allowed. In summary, we aren't sure how many communities are properly administering their regulations and

enforcing violations. The community auditing process, through FEMA and through the states, is being beefed up and within a few years we should have a much better handle on the picture. In the meantime, the data is somewhat spotty.

What are the cost implications? Have damages been prevented? To what extent?

The best available data seems to indicate that the rise in flood damages has been increasing at a rate of 4% per year in real dollars. There is some indication that this rate accelerated during the recent years to 6-7%. It is noted this increase will result in losses of \$4.3 billion per year by the year 2000. However, without such improvements as the NFIP, it is estimated that the damages could approach \$6 billion per year by the year 2000.<sup>2</sup>

The above reduction in flood damages has been achieved primarily by preventing construction of additional damageable property within hazard areas. Under the NFIP, little had been accomplished until the past few years. Construction of major water resources projects from the Corps of Engineers, Bureau of Reclamation and SCS have been reduced considerably during the past 10-year period. It should be noted that even when major structural projects were being built, however, damages were not necessarily decreasing. Many structural projects were built without the requirement that communities regulate "protected" areas to prevent further encroachment. Because of the false sense of security from structural projects, communities many times allowed development to encroach even further upon the floodplain because people felt safe. The net result was additional damageable property in flood hazard areas.

The NFIP provides three basic mitigation tools: 1) constructive total loss (CTL), 2) Section 1362, and 3) the requirement for hazard mitigation teams and reports following a disaster. The first two are actual funding mechanisms that exist under the program, the third one involves an interagency agreement where all federal agencies work together after a flood disaster to ensure that wherever possible mitigation was performed rather than reconstruction in the flood hazard area. This prevents the continuous cycle of damages, disaster relief, damages, disaster relief, etc.

Constructive total loss (CTL) is a very effective tool in the NFIP and essentially says that the Agency head can determine that the flooded structure is damaged beyond a reasonable repair and that it would be more cost-effective for the tax payers to pay the full face value of the policy on the provision that the property owner move completely out of the flood hazard area and deed the property over to the local unit of government with a deed restriction retaining the property in open-space use. That program has been stopped during the past year and a half due to a legal interpretation of the authority to proceed. Hopefully, some changes in the law or that interpretation can be made to reactivate CTL.

Section 1362 is a small fund of money provided to the NFIP through the budget process which can be used to purchase structures that have been substantially damaged (more than 50%) or repeatedly damaged (more than 3 times in 5 years). The fund of money has fluctuated over the years but runs somewhere between \$3-5 million per year. FEMA has used the fund to purchase structures, either relocated the structures or relocated the people and abolishing the structures. While 1362 is limited in funds, where it has been used it has been very effective.

The hazard mitigation teams have been operating for approximately a year and a half and are a requirement of every presidentially-declared disaster. A team of federal agencies headed by FEMA, and including such agencies such as the Corps of Engineers and others, comes into the flooded area immediately following a disaster to make recommendations of federal actions. These recommendations are geared toward assuring mitigation is accomplished wherever possible. Wherever possible, those measures are nonstructural so that the federal expenditures are done on a most economic basis. The idea is to avoid using federal dollars to reconstruct in flood hazard areas or to provide the infra-structure to support additional development where it is subject to damage. The experience of the teams have been limited to date and its success is somewhat unknown at this time. However, there is tremendous potential for achieving mitigation providing appropriate funding mechanisms can be established. The critical element in making this approach work is the existence of a hazard mitigation plan in the community before the disaster strikes. Many states are helping communities prepare predisaster plans aimed toward hazard mitigation and they are asking the Corps of Engineers, through FPMS, and SUS to assist in these efforts. This is an embryonic effort which, however, holds much potential.

#### Impact of the NFIP on Water Resources Planning and Nonstructural Measures

Does the NFIP drive planning efforts? As noted above, most planning efforts if they are on the scale of major water resources projects are not all driven by the NFIP, except to the extent that persons are required to purchase flood insurance and the awareness of the flooding potential increases. Even if floods have not yet happened, the requirement for regulations does trigger planning efforts to undertake mitigation in many communities. Some major flooded areas are not able to get planning assistance from federal agencies, such as flooding caused by stormwater.

Do other planning efforts incorporate NFIP as a key element? Many planning efforts initiated at the local, regional, state or federal level address flooding as a single goal. Structural projects may address other factors such as recreation, which have been added to count benefits to help the benefit/cost ratio. These projects have not looked at achieving multiple goals from the community level, perhaps because federal agencies did not know how to quantify benefits and costs and the local, state and federal share of those benefits and costs for such things as upgrading the housing stock, achieving better water quality, reducing erosion, economic development, water supply, total energy management, etc.

Does flood insurance encourage nonstructural measures or impede use of nonstructural measures? This seems to be random. In some instances, through the existence of the program which may either increase awareness, educational efforts or impose regulations or provide the opportunity for mitigation, nonstructural measures come to the forefront that were not previously considered. It seems, however, that the factor which encourages communities to look at and attempt to implement nonstructural measures most often is the success of a community in a similar situation. Surely the success of Soldiers Grove on the Kickapoc River in Wisconsin to achieve a nonstructural relocation project has encouraged many communities in similar circumstances, including some of its neighboring communities on the Kickapoo to undertake nonstructural measures such as relocation or floodproofing of structures. The hazard mitigation teams, in many instances, recommend structural projects which have been on the shelf for years, and in some instances recommend projects with a benefit/cost ratio which has long since been obsolete. Perhaps the largest impediment to nonstructural programs in communities is the promise of a federal structural project, even though it long since passed the realm of reality or possibility of construction. The community wants to believe the project is merely being delayed until a new administration or a new benefit/cost benefit process or new source of funding will be found. They hesitate to implement any nonstructural action which could possibly be achieved on its own or with minimal help because they believe that the structural project can be done without upsetting their lives, life style, location of their structures, or any other sacrifice on the part of the locals.

#### Trends

It seems clear that federal programs should continue to be oriented toward building capability and the state and local level. There will undoubtedly be decreased federal involvement in terms of personnel and federal staffing. It is uncertain if there will be funding for major programs such as nonstructural mitigation. Water resources projects will undoubtedly continue to be limited and decreasing. Most federally-funded efforts will probably be tied to incentives to secure appropriate action at the state or local level. The NFIP must continue to be the cornerstone of all federal efforts.

The state role needs to be increased. Since local programs are more successful where there is a strong state program, we must move more and more toward building state capability to provide technical assistance to local units of government. Many state staffs have very sophisticated technical engineering personnel and planners. All states should have that capability. In the meantime, federal agencies should help fill the gap.

The local government level should bear the primary responsibility for flood hazard mitigation efforts. As a result, there are certain specific local needs that include an adequate data base through mapping and engineering studies, the sharing of experiences on a national scale so that communities can utilize the successes and failures of others, and technical assistance to adopt and administer regulations and develop appropriate flood hazard mitigation plans. State and federal programs need to be oriented to supply

the basis of these needs at the local level. We at the state and federal level must reorient our thinking from "doing" to "assisting", so that we can key on local action. We are merely the facilitators to make things happen locally that are aligned with local goals for flood hazard management, damage reduction and the multitude of other community goals that could be achieved through a broad program of flood hazard mitigation on the local level.

### Problems and Likely Solutions

There are a number of critical problems that exist throughout the nation that need attention at the local level. To address these problems, federal and state programs need to develop appropriate data, methodology and provide the technical assistance to communities to solve them. Problems include:

Stormwater Management - Without a doubt, damages from stormwater management in urbanized areas are increasing at a far more rapid rate than the average in the nation. A few communities in each state have a stormwater management program and those are the more sophisticated urbanized areas. Some preliminary reports from the flood insurance program indicate that over 70% of the damage claims on flood insurance policies within some communities are in the "b and c zones" which, of course, are not in the 1% chance floodplain at all. These claims are being paid because stormwater accumulation is causing damage to structures repetitively and people, of course, can buy insurance in order to get reimbursed for the damages to their structures. This problem has been ignored to this point by all the federal agencies. This includes the Corps of Engineers, FEMA and others. It is simply one that cannot continue to be ignored. We must modify federal programs to make stormwater management eligible for project status and cost-sharing, or at least provide data delineating these hazard areas and require that communities consider and regulate them to avoid future flood damages. We should also be able to develop some incentive programs for addressing stormwater and assist communities to undertake mitigation efforts dealing with existing structures subject to stormwater damage.

Predisaster Planning - There is little doubt that mitigation plans are much more effectively implemented if they are developed in a nondisaster setting. While most of the available assistance to implement mitigation plans occurs post-disaster, the chances of developing a mitigation plan that appropriately addresses all community needs and allows input from the entire community is difficult to do during the trauma of a disaster event. Federal agencies should increase efforts in helping communities in predisaster planning effort. The Corps of Engineers, in many parts of the country, is focusing on such efforts and we strongly urge that they continue along this path. Most Corps Districts are unsure what a flood hazard mitigation plan should contain at the local level. While there certainly cannot be one cookbook approach nationally, a general approach should be developed in cooperation with each state so that the Corps and the state are addressing state and local needs that are tailored to local conditions. The approach must take into account that it has to be a locally developed plan that considers local problems and needs. The

process should be designed to bring out local problems, have them addressed through local process involving community officials and the public and to reach a decision that is a local consensus, which is implementable at the local level even if federal funding is never available. Agencies such as the Corps of Engineers should not attempt to require all such plans have the benefit/cost ratio based on current methodology since what they are helping the community do is to develop a plan which might be entirely implemented at the local level. It may also be implemented with the use of disaster funds, payment of flood insurance claims, 1362, Section 205 or others. But the benefit/cost ratio should not play a heavy hand in the original planning effort. The SCS is also capable in the developing hazard mitigation plans and we encourage their continued involvement. With 17,000 communities in the nation, there is ample need for states and many federal agencies like the Corps, SCS and FEMA to share the work. The Corps should not expect FEMA or any other agency to pay them for this effort, it should be part of the FPMS or project budget. The "Unified" program outlines the federal role and indicates the need for involvement of many federal agencies. This provides agencies with the basis to proceed. Avoiding duplication does not mean one agency must do or pay for all actions related to a single item like studies, mitigation plans, mapping, etc.

Cross-Cutting of Other Programs - There are many other programs, for example the Section 404 permit program by the Corps, that foster nonstructural efforts. Surely the preservation of open-space storage in the nations flood hazard areas, which is a usual by-product of wetland protection, is important. We must continue active support of strong programs for Section 404, state water permit programs and the water bank program, since they assist in flood mitigation.

Floodplain Management Services - The FPMS program must be continued at an appropriate funding level. This program has a long history of providing technical assistance to states and communities. While many of the technical studies are now being done under the flood insurance study program, the Corps provides an invaluable service through this FPMS program as does the SCS through its Floodplain Management Programs. As stated above, with over 17,000 communities, many agencies need to be involved and continue their efforts. The FPMS program needs firm policy direction that technical assistance will be provided to communities through the states. Only by building state capability, can we hope to develop an appropriate line of communication for technical assistance and monitoring of local efforts that will accomplish our national goals. Furthermore, the FPMS program should have clear direction that studies will not be done to benefit a private developer. In the past, including in Wisconsin, the Corps has done technical studies at the request of private developers or individuals. This should not occur. The expenditure of taxpayers money to provide engineering data should only be done for other public agencies at the state or local level. All detailed technical studies for profit development projects such as harbor development, etc., should be done by the developer as a logical cost of development. Any other policy misuses public monies to benefit private development; and the federal agencies are

undertaking engineering work which is best done by consulting engineering firms.

Specific Corps Actions - There are many opportunities for the Corps to foster nonstructural floodplain management using their existing authority and programs. It may require some changes in policy, priorities or funding requests. These include:

Data Collection - (1) The Corps should inventory all levees in the nation and analyze the sensitivity of each to damage from overtopping or failure. This data will be essential in determining where restudies are needed if NFIP regulations or flood insurance rates are changed behind levees. (2) Dam breach analysis may also be subject to regulation changes and the corps is capable of doing these. FEMA has no fund to pay the Corps to do these, and budget must be requested. It seems current Corps staff should be used.

Flood Hazard Mitigation - Again, the Corps must not look at "projects" but toward providing technical assistance to locals. In that way, data can be collected such as first floor elevation, for the community to use in mitigation planning. Also, alternatives can be developed for mitigation, even if there is no Corps program to implement. Communities then have the information to implement mitigation, either on their own, or from any source including post-disaster. These plans should look at a mix of alternatives, not all relocation or all floodproofing or all levees, etc. The interagency agreement points out the need and provides the basis to move ahead on these plans. Section 205 Study Standards must be revised so nonstructural has a chance to meet benefit/costs.

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Notes

- 1 Report by the Comptroller General of the United States on National Flood Insurance Program: Marginal impact on floodplain development --- administrative improvements needed GAO/CED - 82-105, August 16, 1982.
- 2 Flood Hazard Mitigation, National Science Foundation, September 1980.

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PANEL VIII, FOLLOWING LARSON ADDRESS

DAVID BURROUGHS:

What I have are a few random observations as tempered by our experience in flood insurance while working with the study. Some of the comments are almost self-understood, but I feel compelled to restate them.

Flood insurance, as I think most people realize, only repays the monetary losses associated with flooding. It does not reduce flood losses. All it does is change the instance of the loss from an individual to the general government and to all of us who are taxpayers. It does nothing to the pain and suffering and emotional losses occasioned with flooding. This in itself is one hindrance to effective selling of a flood insurance program that should be recognized.

Today, and yesterday, and as I look at the program for tomorrow, we're all concentrating and listening to several and various talks and presentations on nonstructural measures to alleviate or transfer flood losses in urban areas. On the entire panel, Bob Harrison made a mention of hail loss. Bill, I would think that if we had something like this again, it might be appropriate to have a presentation on crop insurance from the people in USDA who do sell flood-loss crop insurance, which is another subsidized federal program.

These two programs, crop insurance for the rural area, rising water or flood insurance in the urban area, are but two devices which we have and are two reasons why we should never put out a so-called negative report. The insurance programs do not reduce losses; they do transfer the loss to the federal government, which, by the laws of Congress, has been determined to be a public good.

Our own experience with flood insurance is that there is a big run on it right after a flood event. Just like in the rural areas, right after a hail storm, the local bank or insurance company sells all kinds of hail insurance. But wait three to five years and go out and check, and you'll see an enormous number of lapsed policies. And nobody will be interested in it again until you have another event. And then you'll go back through the same cycle.

Flood insurance is and should be an integral part of our planning programs. It is an effective device to offer something to those people who are located in the areas which are uneconomical or are not practical for preclusion of damages by structural elements. The discussion this morning on consideration of reduction of the 100-year flood criteria or standards, I thought, was quite interesting. I guess I'm categorically opposed to it for structures, because I think people who live in homes deserve special protection. But the thought that occurs to me is "have we become too wedded to the 100-year standard for industrial property?" An industrial property under the tax rules for all practical purposes will be fully depreciated in 20 to 25 years, so maybe we want to consider structural or floodproofing up to the 20 to 25 years and then work out some device on flood insurance for all those people for those infrequent amounts which would go back to the original concept of insurance for protection against a catastrophic event. Might lower the cost, too. It might be really interesting, what type of reaction you get from people.

The 1362 program, which Larry mentioned, I think maybe all of us need to look at and see if everybody can give some assistance to increasing the monetary amount in that program. That's where they had paid insurance claims two or three times in the past five years, and the loss is equal to 50 percent or more of the value of the structure. If something is getting damaged that frequently, I think a tremendous case can be made for buying them out.

One last item--a difference in policy which I think is quite interesting: OMB is charged with the requirement to make federal policies the same all across the board for all federal agencies.

You can buy subsidized flood insurance any place in the basin, but the Corps of Engineers cannot provide a structural improvement above 800 CFS points in a basin. A little bit about being at cross-purposes there that I find interesting. I can't solve it, but I think it's something that needs addressing.

JEROME PETERSON:

I have to complement Larry. For those of you who don't know Larry personally, take my word for it that he's an advocate on the part of the states. He feels very strongly about the states and their capability, which is a very good reason why we have him here. Most of us respect his views, and, in connection with that, one comment that Larry made regarding working through the state is very valid. Our instructions to our district offices or central division is, in dealing with financial services, you go through the states to the maximum extent possible; but there are cases where, because of the law which says we provide information to local organizations on request, we have to be careful that we don't get at cross-purposes between the local governments and the state. This requires a lot of close coordination with all the state organizations to be sure that we develop an understanding, that we work through them to the maximum extent possible.

Frank and Paul Johnson made a few comments about how they've been involved in the insurance program since the beginning, so I think I'm going to point out my relationship. I started off in '69 in the chief's office. George Phippen didn't tell me that that's why I was coming there, but it turned out that it was going to start out as a sideline and turned out to occupy just about all my time.

My objective in the beginning was to cooperate and coordinate with FIA and provide technical assistance on behalf of the Corps for the flood insurance program. And I think we did a very good job. In the beginning FIA had a very small group, and the Corps, SCS, USGS, National Weather Service, and other agencies provided a lot of help. And I think we got along with them, leading up to a very extensive participation on the part of the Corps and other federal agencies in doing flood insurance studies and in providing other support. Over time, of course, the agency grew and became more independent, but during this expanded role it's very obvious to me that the insurance program was really a carrot and stick.

Over this growing period of the National Flood Insurance Program, it really developed an awareness of nonstructural measures. And because of the emphasis on the flood insurance program, I think nonstructural measures became easier to implement even though by virtue of this meeting today, this seminar, we have problems incorporated into our projects; nevertheless, it's widely known that at this particular time we have an able group of people in dealing with structural and nonstructural. And again, it was stated, we've got to be careful in differentiating between these two alternatives. Consequently, we like to refer to it as floodplain management, which means all measures.

The Corps participation in the program has been quite extensive. In doing flood insurance studies, and that has primarily been our activity to date, we have been allocated over \$96 million. That's a lot of technical work--over 2125 studies of communities; that's way back from the beginning, 1969.

In doing this, the Corps of Engineers has benefited a lot because we have used our technical capability and expanded our technical capability to do hydrological and hydraulic work which is basically the backbone of the Corps.

The impacts of the National Flood Insurance Program are pretty evident. As I've stated several times, the Corps planning assumes that the insurance program is in operation in the community when you're looking at future growth. And that was no future growth in the 100-year floodplain. And it would seem that communities will participate in the program and enforce the regulations, which basically means no development in the 100-year floodplains below the elevation of the 100-year flood and no development in the floodway. But the criteria for the National Flood Insurance Program, as many of you are aware, have given us some problems. The hydrologic and hydraulic computations are based on current divisions, what's there today or what's going to be in existence at the end of the study. Now the Corps and all other agencies strongly recommended to FEMA that they consider future growth, but they concluded that they could not do it. So that is one of the problems.

Consequently, for many areas with future growth, the studies are no longer applicable. They need a revision. This is also a problem because when the Corps of Engineers was in a survey study, and there's a published flood insurance report, many times there's a difference in flood elevation. I think it's important that the districts realize this and realize what the reason is. And I think as long as you know this, you'd better explain this. But in many cases--and I've always been a very strong advocate for maximum participation in doing flood insurance studies--if you do the study and you incorporate it in the same technology that is used for the feasibility study, there's less of a chance of any conflict in data. And you can recognize the difference between future growth and current conditions. So future problems and conflicts would be minimized. And in doing flood insurance studies, this supplies every field office with a wealth of information, background and data that can be used for their studies for quick reconnaissance reports even if you're not doing a feasibility. So there is no doubt in my mind that there's a tremendous relationship between the National Flood Insurance Program and Corps feasibility studies. It's all dealing with the basic ingredients of hydrology and hydraulics. No matter what we do, you have to start from that common base.

One of the serious difficulties--as I pointed out--in using current conditions for the insurance program is that the communities adopt the regulations and development occurs, and when the 100-year flood is exceeded, you've got a tremendous amount of damage because everyone has constructed at the 100-year elevation and every levee may be designed to meet the 100-year criteria. Coupled with what I just mentioned about the obsolescence of the data, then we have a gradually developing serious future problem insofar as damage once the old 100-year elevation is exceeded. So there are a lot of problems involved with the National Flood Insurance Program in having very stringent requirements, and I think that is offset by the fact that under the insurance program, they have at least been able to maintain a certain level of compliance.

Compliance, however, is another serious problem. In dealing with the National Flood Insurance Program in FEMA, there's a lot of discussion between our offices, and General Gay has been deeply involved in these discussions with FEMA people about future opportunities in working with FEMA. They are saddled with a lot of the same problems that a lot of our offices have been saddled with, and that's a decreasing work force. And they've asked us to consider new ways that we can support them. And notice I say, "Support." Many people in the Corps have loosely used the terminology "takeover." Gentlemen, it's not takeover, it's provide additional support.

Quite honestly, when you start talking about taking over somebody's activities, there's something permanent about that relationship. And we are not intending taking over permanently any activity but providing the needed technical support to them so they can operate their program--again, because there's a lot of interrelationships between what we do and what they do.

I think, in summary on the relationship, there's no doubt in my mind that the National Flood Insurance Program has come a long way in reducing flood damages, and I think it has accelerated the acknowledgment of nonstructural measures in all activities and in the Corps plan. And, unfortunately, it's the enforcement of these regulations that is causing a serious problem. GAO has just concluded a report that points out that there are several deficiencies in the program, and FEMA is very willing to acknowledge.

That brings around another point of evaluation of a community's compliance, which is another area they have asked us to get involved in. A community can adopt regulations, but unless they enforce them, there's not a whole lot that you can do.

So all these things mean several things to me and to you. The Corps has a lot of expertise. We would like to help FEMA in handling their program, and, because of our expertise, I think we can help them a lot in coming up with good strong technical solutions to their problems.

FRANK THOMAS:

Let me begin by saying there's one observation about the Flood Insurance Program that is often missed. And that is that the Flood Insurance Program itself is a package of nonstructural measures. The legislation prescribes

insurance, regulations, acquisition, and floodproofing. There are four of the major nonstructural approaches that we talk so much about, and that I think is why it's so central to our operation--our thinking about progress with the implementation of nonstructural measures.

It also is concerned with floodplain management. Indeed, the legislation which creates the insurance program calls for a unified national program for floodplain management. That program was assigned years ago to the Water Resources Council, and now it has been reassigned to FEMA. And I think, at this time, it's a very good opportunity for us to utilize the unified program as a vehicle for furthering some of the objectives in nonstructural measures and working together on floodplain management.

In particular, there's one task that I've always been looking at but can never get my hands on. George Phippen tried to instruct me properly when I came to Washington about this. I don't know if I've learned anything, George, but I'll say what I think anyhow. I feel very strongly that we need to have a strong data base on experienced flood losses. And we were unable to marshal either the financial resources or an agreement as to how to proceed as we addressed this need over the past several years. It's my hope that in the near future we'll be able to take this up again and move toward establishment of a program which will provide us with information on experienced flood losses, key this information to the computer data files which we have developing and becoming accessible through the Flood Insurance Administration, and thereby develop a yardstick by which we can evaluate what's going on in different communities and also some of these tools that we're so interested in working with.

The second item. I'm reacting here to Larry Larson and I'm also reacting to Art Harnisch's comments about negotiated investment strategy. If you look at what we've been talking about here, Larry talks about the roles of the different actors. There are four actors in the floodplain: federal, state, and local government and then the private citizens. If you look at the tools of floodplain management, there are 20 different tools if you count the structural and nonstructural tools. Maybe there are more, but at least 20. The authority for exercise of these tools is dispersed among the federal, state, and local governments and the private sector. I think this argues very strongly for the need to harness, or bring together, the different levels of government and the private sector in terms of what should be done for floodplains. It was mentioned, the idea of a negotiated investment strategy--intergovernmental agreements, in other words, and I know in the area from which you come there's history with the agreement. I believe that agreement has fallen on some hard times, but it was a very interesting example wherein agreement was reached among cities and counties in the area and the major interest groups as to the kind of future that they would like to see for the floodplain.

I think this kind of agreement offers great potential for the future. I believe that it offers an opportunity to deal with the kinds of questions that we get in the insurance program when you have two or three communities side by side, check to jowl, with flood insurance studies carried out at different points in time--and not necessarily having the same kinds of information available.

It offers an opportunity, then, to move toward common hydrology, and perhaps more of a basin-wide approach in dealing with the Flood Insurance Program. It offers an opportunity to look at the future conditions that are suggested by a number of people. It offers an opportunity maybe to readdress the structuring form of flood insurance studies and restudies. This year, a report from a national research council addressed the question of flood insurance studies. They pointed out that there were needs and opportunities for improving flood insurance studies, not only in terms of a communication device which could be used by local people and others, but also as a device which would permit additional information to be disseminated for purposes of floodplain management.

One suggestion was to show other levels of flooding, so that if a mayor of a community was informed that he would have a 25-year or 50-year defense, he could take appropriate action by looking at his flood insurance study map and making some useful decisions.

Authority, I think Larry addressed very well, but we've heard it asserted here that FEMA does not have adequate personnel to carry out the kind of floodplain management technical assistance program that is needed. I believe that is true.

If this is true, then we should ask ourselves, how can the Corps of Engineers and the other federal agencies and the states provide additional technical assistance that is needed? What are the opportunities to be explored? I think a very immediate opportunity, which I understand the Corps is beginning to move into well, is the experience with the hazard mitigation teams that are sent into the presidentially declared flood disasters. Here's an opportunity to combine the planning and the disaster recovery. Here's an opportunity to get at the existing structures and make some suggestions for retrofitting. I think there's a great deal of opportunity in this particular area. A second opportunity and that which Jerry mentioned, is the CAPE studies, the Community Assistance Program Evaluation studies. That's where you get into the enforcement of local regulations, and I think this is an important opportunity. A third great opportunity is the improvement of the flood insurance studies. The capabilities for doing that rest very much with the people who are in this room.

DISCUSSION FOLLOWING LARSON ADDRESS

JOE D. AUBERG:

Larry, could you tell us where the Kickapoo Valley situation is now?

LARRY LARSON:

I don't know. There are a lot of experts on the Kickapoo Valley in this room.

AUBERG:

None of them work for the state of Wisconsin.

LARSON:

Kickapoo Valley was the La Farge dam, a recommended Corps project that was stopped halfway through construction. Things were in limbo for a while. There was a federal-state task force appointed by President Carter to look at alternatives. What came out of that was that FEMA did fund a planning effort to work with local communities on developing local alternatives to the dam.

There were about five communities affected downstream. Soldiers Grove was one of those. Soldiers Grove moved after the '78 flood disaster and solved its own problem. It did so mostly through the use of either HUD grants (partly out of the secretary's disaster fund, which no longer exists) and the rest through CDBG and local money.

The bottom line on that project at Soldiers Grove is it's going to be about 50-50 federal and nonfederal. Most of the nonfederal will be in either the form of tax incremental financing locally, or in private contributions for new buildings. They relocated their business district out of the floodway.

The other communities. Gays Mills is one that has been trying to work with the Corps. There's a feasible level project there. They've used block grants to relocate houses from the floodway. They'd like to protect the fringe with a levee. That's caught up in, "Gee, it would meet our '205' criteria, but we can't do a '205' because you have an authorized project." So they're caught between the devil and the deep blue sea.

The next community upstream is Viola. It also has a business district parallel to the streams that gets flooded. They, through the FEMA project, had originally looked at a number of alternatives and seemed to favor a levee to protect them. Within the past six weeks they've changed their mind and decided after seeing Soldiers Grove that they'd really like to do a relocation. They're seeing the ancillary benefits of that project. As Tom Hirsch says, "A levee would have changed Soldiers Grove from a rundown, dying, community subject to flooding to a rundown, dying community not subject to flooding." That didn't seem attractive to Viola.

In fact, if you go to Soldiers Grove now, not only is the business district totally out of the floodplain, but the businesses have new buildings. It revitalized the entire community. All those buildings are new solar heated. I'm sure you've heard the story of their solar community; they require that 50 percent of heating be solar. Viola seems to be saying, "We like what's going on there, we'd like to try that sort of flooding solution."

But they, like Gays Mills, are a community sitting there with an identified and desired solution which they aren't able to fund completely themselves. And there is no agency or program to help fund it.

In the meantime it just sits there and the ball gets thrown back and forth. My opinion is that it will continue that way for who knows how long. I really don't see anything ever happening with the dam.

DONALD DUNCAN:

I have a question for Larry. One of the problems you identified was the state being left out of the activities that go on between the Corps of Engineers and the local community. The president has recently issued an executive order that sets up a new state coordination mechanism. Do you see that as improving the situation, or not?

LARSON:

I guess it depends on how it's implemented. I think we've reached the point in Wisconsin where we don't have too much of a problem anymore. I don't believe we have a problem with our Corps districts. I don't believe we have a problem with FEMA any longer. It took a few years to hammer out those agreements, but we're at that point now.

But as I look around the country, I don't see that as generally true. I can point to some of the FEMA regions who say, "We couldn't have the states do CAPES in our region because they first don't have any staff, and it takes years to train them." I don't believe those staffs are inadequate, for a minute. The problem is that FEMA believes it.

I don't know if that's true of the attitude of Corps districts in other regions of the country. Do you feel that there is no capability at the state level in some instances? I hope you don't. Representatives of other states might be better ones to respond about the probable helpfulness of the executive order than I, from a state where the problem is solved.

DUNCAN:

It (the executive order) will establish, if the states so choose, a single point of entry for all federal agencies to accomplish coordination with the state.

LARSON:

I think that provides some opportunity. How it gets implemented will be key.

HELEN INGRAM:

I wonder if we could pursue this future role of the states, and where that leaves the Corps, a little further. I'm surprised, Frank (Thomas), that you didn't join this issue. Earlier today you speculated about the possibility of block funding, you said you thought the Moynihan-Domenici bill has a future in that most water projects will occur in a block kind of way. States will get grants and then the states will spend their money for technical assistance, structural or nonstructural projects as they're inclined. If they wish to do so they'll ignore benefit-cost analysis and choose projects for a variety of nonquantifiable reasons.

Now supposing states had such block grant money, what is it they'd want from the Corps? And where does that put the Corps in terms of technical assistance it has to offer? I don't know if you see this kind of specific future. Do you? If we have that kind of future, what should the Corps be thinking about in terms of what it should have to sell these days.?

LARSON:

I think that every state will use the block grant program from a different perspective. I'm sure Colorado has a much different view about the use of block grants than we in Wisconsin do. That's true of most of the western states. They're looking at block grant programs to implement water resource projects of the structural nature that have been stymied for these past 15 years.

We in Wisconsin would not do that and would expend most of our effort toward making a grant program provide community desires and needs by primarily nonstructural means in the area of floodplain management. We have different water resources needs than they do in the west, however.

What do I see as a role for the Corps if we were in a block grant program? I don't see it terribly different than now. That is, I think those communities continue to need some planning and technical assistance to evaluate alternatives, and, whatever those alternatives are, to develop some local mix there. I am sure we (state) aren't going to have the staff to assist every locality nor do I think we should build up to do it. I think there are some capabilities within the Corps to do those kinds of things. We ought to take advantage of that rather than create another whole staff of our own, duplicating it.

Frank (Thomas), do you wish to respond to Helen's points of inquiry as well?

FRANK THOMAS:

No, but I think your observation that each state will respond differently is one reason why it might get a lot more political support than people may think. It will be everything to everyone.

JIM BATES:

A point of clarification. The Moynihan bill is not a block grant bill. It apportions funds to each state based on certain criteria. But the traditional water resources agencies will continue to do their thing. That is they would work on the authorized projects but the authorization mechanisms would be different.

FORMULATING NONSTRUCTURAL PLANS

EXPERIENCE OF THE HYDROLOGIC ENGINEERING CENTER  
IN FORMULATING NONSTRUCTURAL PLANS <sup>1</sup>

William K. Johnson and Darryl W. Davis <sup>2</sup>

Introduction

Since 1975 The Hydrologic Engineering Center (HEC), Corps of Engineers has been engaged in research, training, and special assistance in nonstructural flood control planning for Corps offices across the United States. Eighteen published documents covering a wide-range of nonstructural topics have been published and are available from the Center (see the publication list at the end of the text). Included are research documents which report on investigations into technical aspects of nonstructural measures; user manuals for computer programs developed for analysis of nonstructural measures; and project reports which describe studies in which nonstructural alternatives were formulated.

Training in nonstructural planning has also been conducted. Since 1975 three training courses and one seminar have been conducted by the Center. Another training course is scheduled this year. These group activities have provided the opportunity for exchange of insights, information, counsel and advice on the planning of nonstructural measures in Corps' field offices.

The experience gained by the Hydrologic Engineering Center through research, through analysis, through project investigations, and through training and seminars is the subject of this paper. Much has been learned. The paper will focus on four specific topics: lessons in the role of nonstructural measures, lessons in creativity, lessons in analysis, and a brief description of tools for analysis.

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<sup>1</sup> Presentation for the "Seminar on Implementation of Nonstructural Flood Plain Management Measures", Corps of Engineers, Ft. Belvoir, VA, November 1982.

<sup>2</sup> Civil Engineer and Chief, Planning Analysis Branch, The Hydrologic Engineering Center, Corps of Engineers, Davis, CA.

Lessons in the role of nonstructural measures presents observations related to the role nonstructural plays in the larger context of flood plain management. As part of the solution, what have we learned about these measures as a group or category? Lessons in creativity addresses those activities in nonstructural planning which are not quantitative analysis. They are more intuitive, more social, more cultural. Lessons in analysis summarizes experience gained in the use of computer programs in nonstructural planning. It is not the programs themselves but their use which is the subject. Lastly tools for analysis describe various computer programs and their application in nonstructural planning studies.

### Lessons in the Role of Nonstructural Measures

Large Scale Solutions. Large scale nonstructural solutions to problems of flooding of existing property have not been found in studies conducted at the HEC nor in most District offices. There are several reasons for this. First, formulation of plans to protect against the 100 year or SPF event in a populated flood plain creates a need which nonstructural measures alone cannot meet. The number of structures, the variety of types of property, their location, the severity of hazard, ownership ... all these factors and others make nonstructural solutions on a large scale improbable. Second, there are a limited number of measures that can be effective in reducing damage to existing structures. Conditions which make these measures attractive are unique: for example, structures located in frequently flooded areas where relocation becomes a viable option, or structures constructed such that they may be easily flood proofed or raised, or communities where the warning of a flood is sufficient to take meaningful action to prevent flooding. While nonstructural solutions may not exist on a large scale, there are opportunities for their use. Often nonstructural measures can be combined with structural measures to provide a composite plan. Such a plan should always be sought. It should look to the strengths of each type of measure and utilize them in a way which produces the most effective response to the hazard.

Local/Individual Nature. Traditional structural measures often had the important advantage of being back in the mountains or over by the river. Reservoirs, levees, flood walls, and channel modifications were, in general, constructed away from or on the fringes of the urban infrastructure. While relocation of existing property was often necessary, it was a relatively small percentage of what existed in the flood plain. Also, these traditional measures provided protection for large sectors of the community. A reservoir provides protection of developed and undeveloped land downstream. Levees, walls and channel work protects all property within their area of influence. A third feature of traditional measures is that they protect both existing and future development. Open space later occupied by damageable property is assured of protection because structural measures protect all the land not just that which is occupied at the time. Lastly, reservoirs, levees, walls, and modified channels are physical, concrete and steel, engineering works which we know how to plan, design, construct and operate, and equally important, which are reliable and certain within the bounds of our knowledge of hydrology, hydraulics, and structures. There is a sense of confidence which structural measures, by virtue of their long use, creates.

Nonstructural measures are uniquely different from structural. First, they include a variety of activities. Flood plain zoning and flood preparedness are significantly different from relocation or raising a structure. Secondly, some measures are designed for existing structures (relocation, flood proofing) while others only apply to future development (regulation). Still others, for example, flood preparedness and flood insurance are applicable to both existing and future development. With the exception of flood preparedness planning, flood plain regulation, and flood insurance, nonstructural measures when applied to existing flood problems are local and individual. As a consequence, the means of protection is not "over there" as in the case of structural measures, but in the midst of the flood plain infrastructure. Protection is not for a large sector of the community, but for individual properties ... primarily existing properties. And lastly, there is considerably more uncertainty, perhaps unjustifiably, in the protection provided by nonstructural measures. Part of this uncertainty is because many nonstructural measures require a personal involvement or response.

Degree of Protection. A nonstructural plan or a combined structural and nonstructural plan is most likely to provide variable degrees of protection. The concept of a uniform degree of protection is derived from and more applicable to structural measures than nonstructural. Relocation, for example, provides complete protection; flood insurance no protection; preparedness, unquantifiable protection; and raising, quantifiable protection. Even considering some single measures, for example raising existing structures, it is difficult for a uniform level to be achieved because of variations in topography, type of structures, and personal preference. When mixes of nonstructural measures are formulated, the task of providing uniform protection is near impossible. The difficulty lies in trying to maintain a concept (uniform protection) developed with one type of measure in mind and apply it to quite a different set of measures.

The question of certainty or confidence in the protection provided has already been raised in comparison with structural measures. Thus, not only will the degree of protection vary with nonstructural measures, but the confidence in that protection may also vary.

Flood Preparedness Planning. There is one nonstructural measure which should be part of every community's response to a flood hazard. This is a flood preparedness plan. Such a plan is designed to reduce the social disruption and losses caused by flooding to existing property and is an essential component of a community's disaster planning. It can serve in the absence of more permanent measures to reduce the threat to loss of life and can be part of both structural and nonstructural plans. In addition, it can include public facilities such as roads, bridges, drainage, and sewer systems which are not part of other nonstructural plans.

Flood Plain Regulation. For future development, flood plain regulation is a nonstructural measure which has been given nationwide impetus through the flood insurance program. At the root of nonstructural measures is the concern for and desire to prevent future flood losses. In measuring the effectiveness of nonstructural measures in reducing flood losses, there is much greater

potential in preventing future losses ... the new America being constructed in the next 30 years ... than in what now exists in the flood plains. The real flood loss reduction value of flood insurance is the requirement of flood plain regulation. The insurance itself does not reduce damage directly but provides indemnification for financial loss. It is ironic that, in Corps planning, flood plain regulations are taken as given and it is assumed a certifiable flood plain regulation will exist. Yet the Corps could play an important role through their planning in encouraging communities to adopt flood plain regulations.

Summary. While large scale nonstructural solutions are improbable, nonstructural opportunities should be sought and where they are found, specific information should be presented on how they can be implemented. This should be done for both existing and future development. Two of the most fruitful areas for research and application are preparedness planning and flood plain regulation. Considerable work needs to be done to make these more prominent aspects of Corps studies. Making them prominent includes both conducting research investigations which provide better technical information and the use of this information in planning studies.

#### Lessons in Creativity

Earnest Seeking. In light of the foregoing on the role of nonstructural measures, several observations can be made relative to the creative dimension of nonstructural planning. First, nonstructural opportunities must be earnestly sought. The variety of nonstructural measures, the lack of experience with their application, and the uncertainty surrounding their use makes a vigorous seeking of ways to apply them, a necessary prerequisite to any study. We must look for the opportunities. There must be a genuine desire to find nonstructural solutions or partial solutions.

Field Presence. Second, there is a necessity for a field presence during the planning study. The infrastructure, in which nonstructural measures are applicable, is a living community of people whose personality can best be captured through field work. Information on the types of structures, their use, their location in proximity to other property, and their ownership can best be assessed in the field. Community development: parks, bridges, recreation, historic features both existing and planned can be observed in the field. Access roads, terrain, vegetation, and wildlife are also important to observe. Discussions with people in the community can provide valuable insight to both the local flood problem and appropriate means of solution.

Appropriateness. A third observation is that every effort should be made to make any nonstructural plan compatible with and appropriate for the community: its infrastructure, its values, its plans. More than structural measures, nonstructural alternatives touch the lives of people and communities in a direct way. As a consequence the appropriateness of proposed actions must be carefully considered.

Cooperation. Other federal, state and local agencies have responsibility for the urban infrastructure including the flood plain. These agencies modify this infrastructure on a regular basis: inadequate bridges are replaced, land use is changed, new development is added, parks are planned, and structures removed. Many of these actions, when applied to the flood plain, may be termed implementation of nonstructural measures. Corps planning should recognize this ongoing activity and take account of it in the planning study. For example, on one study structures were removed from the flood plain through another agency's grant money. Other agencies are often working on the same flood problem with nonstructural means at their disposal. Such actions should be encouraged in a spirit of mutual cooperation.

In the search for appropriate nonstructural opportunities .. the earnest and vigorous search .. it must be recognized that none may be found; at least none of significance; or none which are appropriate. Often planners feel they have failed unless they develop a nonstructural plan. This could

lead to recommendations which are not appropriate for the community and are later rejected by the community. Flood insurance, flood plain regulation, and flood preparedness are exceptions. These are opportunities which should be seriously put forth and considered by all communities. They are nonstructural measures which have the potential for doing much good and may be confidently recommended. Other more local and individual measures must be examined in the context of each community and flood hazard.

#### Lessons in Analysis

In addition to the creative activities of nonstructural formulation there is also an analysis or analytical side. This is equally important. Analysis is generally of two types: flood hazard assessment and flood damage assessment. Hazard assessment includes hydrologic and hydraulic computations which describes where the flood waters go, how frequent they occur, and their depth, velocity and other characteristics. The level of protection provided by nonstructural measures can be determined as part of this analysis. Damage assessment includes estimating the economic damage to property at different levels of flooding, estimating the frequency of occurrence at each level, and computing the expected annual damage. Damage prevented by nonstructural measures is the damage with minus the damage without the measure. Both hazard and damage assessments provide quantitative information to the planner on the severity of the hazard and its economic consequences.

To provide the Corps with hazard and damage assessment capability for non-structural planning the Hydrologic Engineering Center developed several new computer programs as tools for analysis and has extended the capability of several existing programs. The new programs are described in the following section. Both new and extended programs are discussed more fully in published documents from the Center. The programs have been invaluable to the task of formulation. They have been used on projects ranging from several hundred structures to several thousand. In all applications they provide a very necessary tool for organizing, analyzing, and displaying large amounts of hazard and damage information. Coupled with the creative side of formulation they provide the planner with the necessary tools for formulation.

Level of Detail. An important question in nonstructural formulation is the level of detail at which the hazard and damage analysis should be performed. The options range from considering each structure individually (structure-by-structure analysis) to considering all structures within a reach as a single damageable property (reach-by-reach analysis). This latter approach is common in damage assessment for structural measures. The structure-by-structure analysis has the advantage of being able to analyze and consider alternatives for each structure in the flood plain: and the disadvantage of having to analyze and consider individually large numbers of structures if the number of structures is large. Reach-by-reach analysis aggregates all structures within a reach to one location which makes analysis more tractable, but in the process of aggregation the individual characteristics (hazard, damage, and structure) are lost to formulation. Experience has shown that either handling the damageable property individually or in groups of homogeneous units is best for nonstructural formulation unless a single measure is being applied to all structures in the same way. To insure accuracy when grouping structures it is necessary that they have similar damage potential (depth-damage relationship) and are subject to similar severity of hazard (frequency and depth of flooding). Such an approach (individual or groups of structures) preserves the individual characteristics of the property while at the same time providing the opportunity to reduce data handling. The tools for analysis described later handle both types of conditions.

Preliminary Estimate of Damage. One of the research findings from analysis of flood damage of individual residential structures is that expected annual damage decreases rapidly (exponentially) as structures are located further out of a flood plain. For example, a residential structure located at the 5 year flood event has significantly more damage potential than the same structure located at the 15 year flood line. This is illustrated in Figure 1. Total expected annual damage expressed as a percentage of the value of a structure is plotted against the frequency of the flood event at the first floor. The curve shown is for a one-story no basement structure, however, other types of structures show a similar relationship. The analysis uses 1974 FIA damage and frequency data. Figure 2 illustrates the significance of

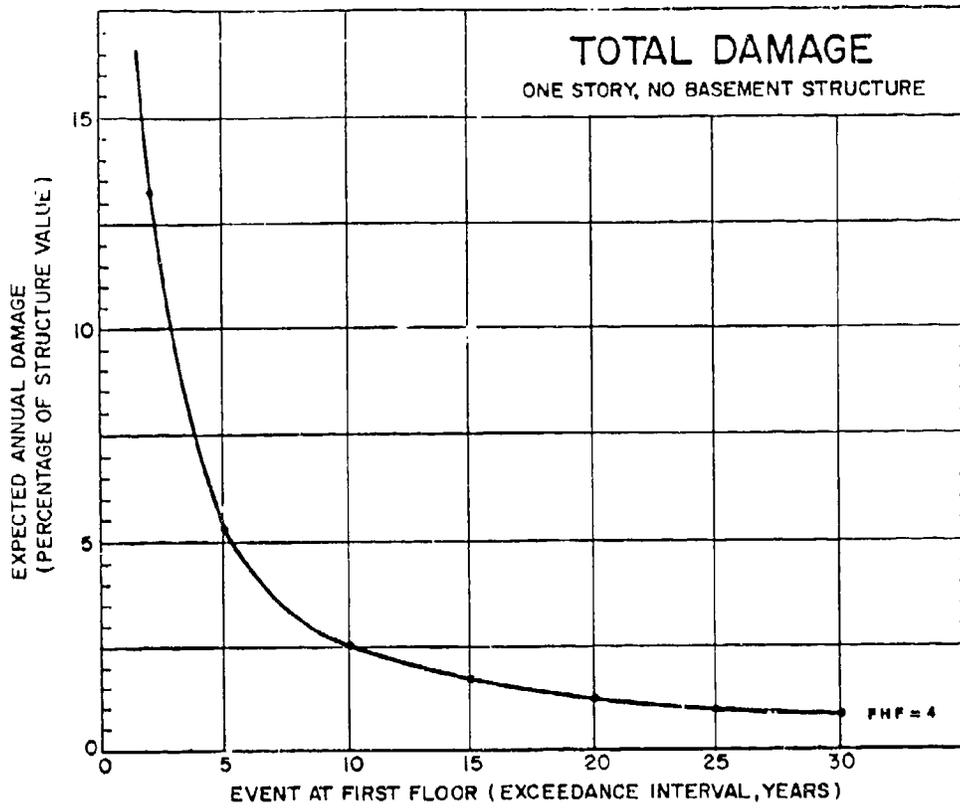


Figure 1

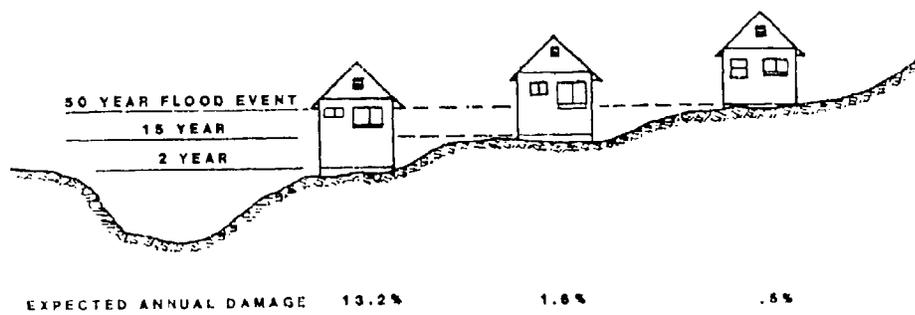


Figure 2

EXPECTED ANNUAL DAMAGE FOR ALTERNATE FLOODPLAIN LOCATIONS  
PHF=4.0 FEET ONE STORY, NO BASEMENT STRUCTURE

this relationship in another way. Expected annual damage is 13.2 percent of the structure value when located at the 2 year flood line. The same structure located with the 15 year event at the first floor has only 1.6 percent expected annual damage.

This relationship of expected annual damage and location in the flood plain is significant when it comes to understanding the economic feasibility of nonstructural measures. Figure 3 shows an estimate of costs of various nonstructural measures expressed as a percentage of structure value. These data show that the more costly nonstructural measures (relocation, raising, small walls or levees) are likely to have a narrow range of economic feasibility, generally within the 15 year flood plain. Other less costly measures are more applicable at most any location. Such knowledge is useful in preliminary formulation of nonstructural plans. A detailed description of this analysis may be found in Physical and Economic Feasibility of Nonstructural Flood Plain Management Measures, 1978 cited in the list of HEC publications.

Limits of Analysis. There are some nonstructural measures for which factual data and empirical relationships on performance is sparse or nonexistent. This is especially true for forecast, warning and evacuation; flood preparedness; and rearranging damageable property. As a consequence analysis is limited. Analytical tools will be of less value for estimating level of protection and damage reduced than for other measures. The way to make them more valuable and obtain better estimates of the performance of these measures is to conduct research and collect information on their nature and application. To be effective in plan formulation there must be a better understanding of what some of the more complex, human response measures, in fact, do. Better data and better understanding will most likely result in better analysis and plans.

#### Tools for Analysis

Each of the tools described below are designed to assist in analysis of the hazard and damage related to nonstructural plans. For details on each tool refer to the reference list of HEC publications.

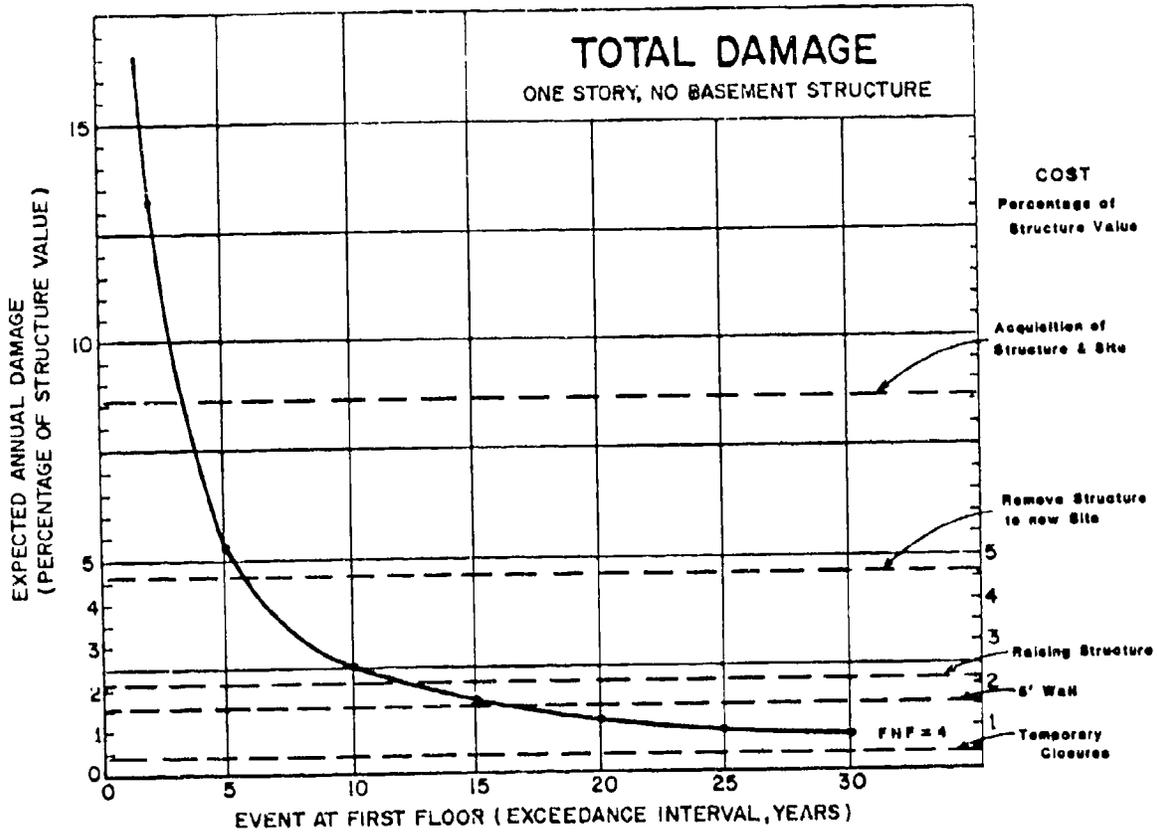


Figure 3

Interactive Nonstructural Analysis Package. This tool of analysis was first developed for and used on a study of nonstructural measures for the Santa Fe River, New Mexico and since that time has been used by other Corps offices on a variety of nonstructural studies. The program allows the user to assess the hazard and damage potential of individual or groups of structures in the flood plain interactively, that is, by sitting at a CRT or teletype computer terminal. A teletype terminal is about the size of a briefcase and in the Santa Fe study was taken to the field where it was connected to a previously developed data base at Boeing, Seattle via a telephone line. This allowed the planner to have access to important hazard and damage information in the field. The program is used by accessing the hazard/damage data base and giving commands which request various analyses. For each structure or group of structures selected some of the information which may be requested via commands includes:

- . depth of flooding for a range of flood events
- . frequency of the flood event at the first floor
- . level of protection
- . elevation of the ground, first floor, level of protection
- . value of the property
- . expected annual damage of structure and contents
- . x, y coordinates of the structure or group

In addition, the user may give commands to raise or protect a structure or group of structures. The program raises or protects the distance specified and all of the above information then becomes accessible, for example, new level of protection, new expected annual damage. The immediate interactive access to a data base with a variety of hazard and damage data, and the ability to select certain types of data for analysis make the interactive program a powerful tool in nonstructural formulation.

In the Santa Fe study nearly 500 structures were analyzed using the interactive program. The program was accessed both at the HEC and from a motel room in the field. This allowed the most effective use of both locations. Results from the program were used in the final report. This included a table of the number of

structures in the flood plain for different levels of hazard, level of protection for different measures, and expected annual flood damage.

The program is available to all Corps offices, and is compatible with most computer systems.

DAMCAL - Spatial Data Management System. This family of tools has evolved from the Corps experimental Expanded Flood Plain Information program. The series of programs comprising the spatial data management technology, referred to as HEC-SAM, was specifically designed to enable comprehensive, flood plain oriented studies to be undertaken in a systematic, land use focused style. The Damage Reach Stage-Damage Program (DAMCAL) is the central feature of the SAM system which focuses on nonstructural measure formulation and particularly examination of the quantitative consequences of alternative flood plain management policies.

Studies of this nature initially create a spatial data bank that contains gridded data (at say a scale of one acre covering perhaps only the flood plain but often the entire watershed) on topography, land use, transportation and other infrastructure, hydrologic basins and flood profiles, and any other relevant geographic data. The spatial data file can be accessed by DAMCAL - for nonstructural/flood damage focused studies, various graphics and boolean operation programs (such as the Resource Information and Analysis (RIA), to hydrologic programs etc. as may be appropriate for the study of concern. Publications are available from HEC on the SAM system and its flood control and nonstructural planning features.

Nearly fifty studies have been undertaken by the Corps that make substantial use of all or parts of the SAM system. A recent study performed with the Los Angeles District illustrates the type of utility a spatial/DAMCAL oriented study can contribute to nonstructural planning.

The study was the metropolitan Phoenix comprehensive study and the particular components relevant to nonstructural planning resulted in two reports: "Flood Preparedness Planning - Metropolitan Phoenix Area" listed at the end and available from HEC and "Nonstructural Measure Investigation - Metropolitan Phoenix Area" published as a draft report by the District. The former study focused on flood emergency preparedness and the latter on the full array of potential nonstructural measures.

A spatial data bank was constructed of just the flood plain area in the vicinity of Phoenix. The spatial resolution was 1.15 acres and comprising about 50,000 grid cells. Data included were existing and projected future land use, flood profiles and other geographic data. There are about 7,000 structures within the 500 year flood plain. Conventional flood damage analysis was performed using the spatial data by executing DAMCAL without exercising any of the nonstructural options and linking the results (automatically) to the Expected Annual Damage Program (as described in the SID structure-by-structure analysis).

DAMCAL has the capability to evaluate the following:

- . Flood proofing existing and/or future development - selective by land use categories and damage reaches
- . Relocation of existing development - selective as above
- . Managing future development to a target management flood level - selective as above
- . Temporary adjustments to contents during emergencies - selective as above.

The overall nonstructural evaluation was performed by analyzing the full array of measures for all applicable land use categories and damage reaches. General cost relationships were used and the result was screened zones of possible alternative structures for further more detailed individual structure analysis. Protection of up to 500 structures by perimeter barriers appeared to be marginally feasible. In addition 9 alternative flood plain management policies ranging from flood plain fill to various levels to

exclusion of development from lateral existing delineated floods were quantitatively analyzed thus providing local officials economic data heretofore unavailable on the likely impacts of management policies under consideration.

The flood emergency preparedness investigation made valuable use of the spatial data bank and nonstructural analysis features of DAMCAL. The high flood threat areas were graphically displayed by mapping flood depths and expected flood damage by automatic retrieval and mapping from the data bank. Also, flood threat area data were tabulated by area and type by clever use of the DAMCAL and RIA programs - - data such as number and types of structures (thus people and goods) that would be flooded by target flood events, and evacuation routes graphically located. Opportunities for meaningful emergency actions such as flood fighting were located by study of the damage potential map and topographic features . . which could be automatically superimposed using spatial data management techniques. Lastly, the value of certain emergency actions, such as contents removal, elevation, protection, etc. were evaluated and used in an approximate economic analysis of the value of a total flood emergency preparedness plan.

The HEC-SAM system of programs and documentation are distributed as a normal element of HEC's technology transfer actions. It should be noted that a course in Spatial Data Management will be held at HEC in February of 1983.

Structure Inventory for Damage (SID)/EAD Package. This tool was initially developed and used for the Walnut Creek pilot study conducted by the Ft. Worth District. The package consists of the basic structure inventory, project feature formulation program SID, and the companion Expected Annual Damage computation program EAD. The SID program is an individual structure-by-structure program that yields as an end product, elevation-damage relationships for each damage reach, flood damage category and nonstructural measure or flood plain management policy. These data are then linked (automatically) with hydraulic and hydrologic data and input to the EAD program for expected

annual damage computations. The SID program, the key nonstructural formulator/evaluation tool of the package, has been used for several large and small studies with nonstructural considerations. The most recent and largest scale study is that of the Passaic Basin investigation.

The SID program has the capability of analyzing structure-by-structure, then aggregating to an index location for a damage reach. The following array of nonstructural measures can be analyzed.

- . Flood proofing existing and future structures by raising and/or protecting
- . Relating existing structures
- . Managing future development to a target management flood level (flood plain regulations)
- . Temporary adjustments by emergency action (contents raise, removal, etc.)

Several types of measures may be implemented by reach and/or structure category and a log by structure of all actions taken is filed and may be printed.

The information that may be catalogued into a SID structure file can vary from a minimum of structure elevation, and damage function and reach assignment, to elaborate description for more detailed nonstructural analysis of geographic coordinates structure construction type, size, number of openings, etc. Thus SID may be used from preliminary screening studies through to detailed planning level final formulation of plans.

In the Passaic study, 65,000 structures were catalogued into the SID structure file, a special program named SIDEDT used to manipulate the file to the subset of structures subjected to detailed analysis, and SID (linked to EAD) run many times exploring the range of individual structure measures and flood plain management policies that would contribute to alleviating the flood problems in the Passaic. The full range of nonstructural measures analyzed by use of the SID (and other linked programs) were: flood proofing by barriers (structural and perimeter), structural relocation, flood plain

management policies, and alternative levels of temporary actions taken as part of a flood emergency preparedness plan. A reference set of lecture notes is available from HEC chronicling the use of the full array of HEC analytical tools in the Passaic Basin investigation.

The SID, EAD and other hydrologic engineering programs are available from HEC and have HEC standard documentation. In addition guidance is available as linking the program results automatically to enhance their overall user utility.

### Conclusions

It was never intended by the early advocates of nonstructural measures that these measures alone be the answer to our nation's flood problem. White (1945) called for a geographical approach to flooding; Hoyt and Langbein (1955) stressed unified flood management; House Document 465 (1966) recommended a broad and unified effort. These and other voices were calling out for a more comprehensive approach, an approach which seriously considered all possible means to reduce loss of life and damage to property. Subsequent federal legislation and policy guidance were designed to give impetus to these other, so called, nonstructural means which previously had been neglected or nonexistent: National Flood Insurance Act (1968), Flood Disaster Protection Act (1973), Water Resources Development Act (1974), Water Policy Initiatives (1978), Water Resources Council (1979).

Today, based upon experience in the field and knowledge from research, we can affirm that nonstructural measures alone will not do the job necessary for reducing present and future flood losses. A comprehensive approach is required. Flood plain regulation, flood preparedness, flood insurance, relocation, go hand in hand with structural control works. Formulation of comprehensive plans of this type is a complex and delicate task which requires creativity and analysis. The tools for analysis are available. Do we have the creativity?

HEC Publications on Nonstructural Planning

- Analytical Instruments for Formulating and Evaluating Nonstructural Measures, Training Document No. 16, January 1982.
- Flood Preparedness Planning: Metropolitan Phoenix Area, Research Document, January 1982.
- SID (Structure Inventory for Damage Analysis), Computer Program Users Manual, January 1982.
- Interactive Nonstructural Analysis Package, Computer Program Users Manual, July 1981.
- National Economic Development Benefits for Nonstructural Measures, Research Document, November 1980.
- Effects of Flood Plain Encroachments on Peak Flow, Research Document, September 1980.
- Flood Emergency Plans - Guidelines for Corps Dams, Research Document, June 1980.
- Interactive Nonstructural Flood - Control Planning, Technical Paper No. 68, June 1980.
- Flood Control for Santa Fe: Nonstructural Opportunities, Project Report, November 1979.
- DAMCAL (Damage Reach Stage - Damage Calculation), Computer Program Users Manual, February 1979.
- Physical and Economic Feasibility of Nonstructural Flood Plain Management Measures, Research Document, March 1978.
- Expected Annual Flood Damage Computation, Computer Program Users Manual, June 1977.
- Annotations of Selected Literature on Nonstructural Flood Plain Management Measures, Research Document, March 1977.
- Spatial Data Analysis of Nonstructural Measures, Technical Paper No. 46, August 1976.
- Nonstructural Flood Plain Management Measures, Seminar Proceedings, May 1976.
- Analysis of Structural and Nonstructural Flood Control Measures Using Computer Program HEC-5C, Training Document No. 7, November 1975.
- Estimating Costs and Benefits for Nonstructural Flood Control Measures, Research Document, October 1975.
- Costs of Placing Fill in a Flood Plain, Research Document, May 1975.

PANEL IX, FOLLOWING JOHNSON ADDRESS

MILBURN SMITH:

Historically, nonstructural measures were primarily considered in formulation for one reason: because it was required. And I see it as, realistically, the selection of structural measures for project recommendations often before the study was even actually begun.

I believe that opportunities for nonstructural measures implementation have not been actively sought because of either a lack of confidence in the concept or the degree of uncertainty about the protection provided by the non-structural measure.

I'd like to address most of the rest of my couple of minutes to the analysis that Bill talked about. With respect to these tools that are available through the HEC, Fort Worth District has utilized, I guess, every one of them. Hopefully we will get a residual on the SID program, since we funded that, if you sell some more of them.

As the project manager on two XFBI's and two pilot planning studies all using the system, I have observed the evolution of the HEC-SAM from its infancy all the way through to about 1980. I'm not aware of what you've done since 1980. But during this time, I have developed a high degree of confidence in the entire system. However, I must say, many of my views are not shared by some of the other district staff members, particularly the economists. But that's not unusual.

The economists are primarily concerned, as I see it, on the averaging of the economic data on a cell basis. But I believe that the flexibility of the system, the repeatability, and the ease with which you can answer the "what if" conditions far outweigh this averaging by cells. And I don't really see any problems with the HEC damage analysis tools, but rather I see there are more personnel problems in the districts with those who are afraid of trying anything new. And I'd like to remind those in our review and heirarchy that we won't ever trip and fall down unless we're up and moving and trying to accomplish something. And I have a little saying that I like. You can take a horse to water, but if you can teach him to swim, you've really got something. A lot of us are trying to learn to swim.

PAUL GAUDINI:

The Philadelphia District has been using HEC planning at least as far back as '73, and we've sort of evolved with the system. Our economists support the programs and have no problems with it. Of course, we don't use the cell system for economics, and they also have the problems with the spatial type of economics.

I don't think there's any other way to go except with automated systems if you're going to look at nonstructural solutions. The amount of data that we have to collect, both economic and physical data, to formulate nonstructural

programs, makes it almost unmanageable except with automated systems, not only for the initial screenings--say, through the first two cycles of planning--but even to the detail of formulation later on.

The data that are required have to be a higher level of detail than we did at structural because we're more exposed. We start looking at structures individually and in smaller groups rather than grouping a whole community behind a floodwall or levee system. And when we present these data, they are exposed to more scrutiny by both professionals and non-professionals, and we have to be able to back that up.

The problem that we had in the past is that a reasonable amount of data that is required for economic analysis and sometimes economics, let's say, doesn't compare with engineering data, the hydrologic and even the more traditional civil and cost estimating. Suppose we're dealing with 50 and 100-year horizons; and how much time should we spend in the details of the economics? As long as they are reasonable I feel that we're offering the kind of information to make decisions and that's where sometimes we get hung up on 100 years and BCRs. BCRs are a guidance for decision making and they're not exact. And I think this comes out greater in nonstructural.

Ironically, on some of the work that we're doing now, the opponents of structural projects who criticize us for stuffing benefits are now very critical of our nonstructural because we're not stuffing benefits. And as far as I know, the district has been doing the basic economics the same way for the structural and nonstructural philosophy.

One question has come up. Where do we stop the nonstructural formulation with the data? Do we just take it far enough to identify that we don't have or we do have a structural project? Don't have or do have a mixed project? Or do we have a nonstructural project? Coming out of a GI, unless we're willing to really fund these GIs, we can't get the kind of detail on the final solution for nonstructural for major communities that we could for levees and reservoirs, because it takes a lot more money. We're talking about going out in the field and interacting; it's very expensive.

We're talking about increased data, almost individual analysis, and that's very expensive. So do we want to develop the floodwall systems, the zoning ordinances, or whatever, once we've identified that they are a valid solution--and should it be done out of CG funds, should it be done out of special systems funds, or whatever. That's just a question, but I think the problem that we're having in the field with doing a complete nonstructural analysis is that it is expensive, and trying to get the money that you would need for the details on these kinds of systems is almost not practical under a GI program.

The need that I see is that even though the New York District and HEC have come a long way in managing with their D-edit program, managing the data for large study areas, I think we still need a lot of flexibility because it is a lot of data to move around--to change and to analyze--and maybe we need some more work there.

Also, more coordination of actual experience in flood damage has always been absent as far as I can tell. We don't have any single repository of actual flood damages compared to, say, the market value, the types of structures, the level of flooding. The people who accumulated the data are claims adjusters, and they've been lax or maybe they just don't have the mission to collect the additional data that we have to identify with that claim--the type of structure, the level of flooding, and the market value at the time of claim.

ROBERT PLOTT:

I want to emphasize something that Bill was saying. I won't mention the area. It's not a negative report but it's a combination report.

In the syllabus, two nonstructural plans are environmentally and economically feasible. An evacuation plan was justifiable with a 10-year level of protection and a similar plan at the 12-year level. In summary, we have determined, due to the limited scope and level of protection of the feasibility plan, that we have no further interest in the plan. The mode of study is terminated and that's that. We wrapped it up; as Frank said earlier, we stash it away in the files, and the people that work on it leave, and the value is gone.

Who else said in his presentation that we're professionals, and if we don't do a professional job when we look at these studies, we should nail their tails to the wall. I wonder how many of you in the district offices have been questioned because your reports did not fully address nonstructural alternatives. I wonder if our planning process is biased against nonstructural alternatives.

Do we have double standards in the benefit-cost analysis? Do we ignore the social coordination that is required to support nonstructural solutions? And as General Gay said, dealing in the real world, with the constraints on manpower and time that we have, what can we do now? Can we change? Do we have to go back and revamp the planning process to give nonstructural a fair shake?

I think it's clear we can't tag on nonstructural analysis and analyze nonstructural like we do structural problems. However, we're limited in funding, we're limited in time, we're limited in manpower. Who goes back and does the R&D to support that type of effort? How many people have used your analysis for nonstructural? How many districts at home?

Answer: Quite a few, probably over half.

The requests for R&D on nonstructural procedures and techniques, do they come from the field or do they come from OCE?

WILLIAM JOHNSON:

I think we try at HEC to be responsive to the needs of the field in the future; in other words, we try to anticipate the future and have the tool ready for the district or division offices for their use should they choose.

We have three tools in nonstructural analysis, and they were begun a number of years ago. Right now, in terms of the number of offices that are using them, I would say at least half are using one or the other tool. But they are available. They don't have to use them, certainly, but they are available should the district office find the value, the need for them. And we of course have the training program in nonstructural analysis that tells people they're available.

ROBERT PLOTT:

I'm a technical monitor for the SAM studies. And I've been working for about eight years now with SAM and on the Remote Sensing Demonstration Program, and I've found that it's very, very hard to get the field to undertake new techniques in planning. When I talked to Jerry Peterson earlier, he says the questions should be coming from the field. And if you have some questions, maybe we can get you some answers back.

DISCUSSION FOLLOWING JOHNSON ADDRESS

FRANK INCAPRERA:

I've heard it mentioned about five times in the last two days that the economists treat nonstructural measures differently than they do structural. I fail to see that. I work just as hard on the nonstructural as I do on the structural measures. I get the same detail of information -- in fact, more. It's more important to get that floor elevation exact, because you're going to eventually have to buy that structure. It's so critical to the value what the project's going to be. I think we spend more time on nonstructural matters. We use some sampling techniques, in our area, on the structural valuations.

Someone mentioned the externalities. The externalities that we use have been agreed upon with the board, the chief's office, and everybody else. The externalities are what's being paid through the insurance program and so forth, by everyone. Of course if you have to pay off so many claims throughout the project, in the end what you are actually duplicating are the average annual damages. If you did your average annual damages exercise correctly, then it's duplicating the actuarials that were being paid off by the government. So, they've agreed to let us use those average annual damages as part of the benefits.

But we've also included the externalized costs which is the premium aspect, the adjustor's costs, the insurance company's costs, the FIA cost. I don't know that we left any externalities out. If somebody has something they think we're missing, please raise the flag. We've had the question of residual values. We're talking about creating a green belt. We invariably think a green belt is the best thing to do because we make the environmentalists happy with our program.

Sometimes that's a good idea but sometimes I think we should realize what we're displacing. If we could sell land back to the private sector sometimes it might be worth \$60,000 an acre instead of \$2000. But that hasn't been the policy. Change the policy and we'll do that. That's a shortcoming in our present economic evaluation, but that's one of the few I can see. If somebody's got some other suggestions, I'll be glad to write them down.

WILLIAM JOHNSON:

The analysis tools that are available.... Computed expected annual damages, in a very accurate way, would not be different from those of your economists in your offices. Our program has been used for five, six, seven years. These other -- spatial, structure inventory of damages, and interactive are all wrapped around this basic expected annual damage program.

Let me make a couple of comments on their use. On spatial analysis we used a 1.15 acre resolution on the Phoenix study. You can use any size cell that you want. In terms of the number of structures, on Santa Fe we had about 500 structures within the floodplain. On Phoenix we had 7000 structures within the 500 year floodplain. On Passaic I'm not sure what the floodplain

limit was, but they incorporated data into the computer model for 65,000 structures. That's our range of experience with handling data and nonstructural analysis.

The other thing is the hazard and the damage. We do five things with the data that make the analysis a nonstructural one. We can raise the damage or frequency relationship. We can protect as if you had a wall. We can add or subtract structures, as for removal or future development. And we can modify the functions.

LAWRENCE FLANAGAN:

I certainly agree that most of the damages are in the five and 10 year floodplain. But when we deal with those floodplains, we end up with another problem -- the sponsorship of a project. Often those people are not the people originally interested in a project. The original people were interested in perhaps 100 year-protection.

Also, those in the five year floodplain often have flood insurance and are reasonably comfortable with their lot in life because they can look forward to new carpet and paint every five years. I've seen such houses become increasingly upgraded year after year because of flood insurance. Then there is very little incentive for sponsorship of a project in the five year floodplain.

JOHNSON:

That's a good point. I'm certainly not suggesting that we not do analysis out of the 10 or 15 or 20-year floodplain, at all. We have to do it for a variety of reasons. It helps to know the nature of the floodplain, where damages are, where property is likely to be damaged highly, and so on. The other point is that, regarding the tools of analysis at HEC, we feel that the problem to a large extent is solved. We've got the "go power" to go from 500 to 65,000 structures and analyze the data and do all kinds of things. That's on the creativity side as it characterized doing the good job, the professional job -- doing not just "nonstructural" but floodplain management.

DAVID C. HARRIS:

One problem I'd like to raise. You gave a simplistic approach on how to establish a level of protection for a nonstructural measure. We have a project coming up which is 250 houses in a subdivision and all located within the floodway boundary. The lowest house is at the eight-year flood level, the highest house at the 50-year flood level. So if we provide 10-year level protection we might provide protection to 20 houses and leave 230 unprotected. We tell one person we can buy the house. His neighbor is six inches higher so we can't buy that house. This presents a very serious problem. Any suggestions?

And I'd like to pose another question, as well. Public Law 91-646, the Real Property Acquisition Act, doesn't have its costs included in the nonstructural analysis. Are there any plans to change that policy?

JOHNSON:

In response to the last question, I know of no intention to change that cost exclusion policy.

On your first question regarding the problem of level of detail and the simplistic notion, the reason that I presented an abbreviated version is because it's a very hard problem. It's a site-specific problem. I have a hobby of looking in planning theory. Ninety-five percent of that is nonsense. But some people are saying now (in planning theory) that the practitioner is the theorist. What's being said is that the real theory comes out in the field on a site-specific, project-by-project basis.

So, in terms of level of detail, look at what they did in Baytown. You have that high damage over here. Yet you know you have to do something for the wider community, so you let that high damage (the two-year) carry some of what's happening elsewhere. Because we're just not going to go and say "Sorry, but the b/c ratio right here, for you, on one side of the street is okay," and say, "for you, on the other side of the street, it isn't okay." That's not an appropriate solution for the people. I think in Baytown they "carried" out to the 50-year line.

If you pose the problem that you don't have enough high damage to "carry" others, I didn't have any solution for that predicament.

INCAPRERA:

I think the reviewers have been liberal on that. They recognize that you may be "carrying" some areas. But you must have good reason and develop the case argument for it, for "carrying" a whole subdivision. There are externality costs involved, by the way. And we do take this into consideration because the utility companies and everybody else have to provide a service to that community. Once you cut half of it out, the utilities and other such services lose money. You raise their costs proportionate to the remaining base served, and you must look at such things in making a case. There are all sorts of such factors which add value if you protect the whole community. But every community is unique in these matters.

I think the chief's office, and the board, and everybody else has been fairly generous on this difficulty. I've been an advocate of always letting them know how things were really distributed. Where simple economic justification in damages was only up to the 50, I'd let them know it was because of specific other factors. And they've gone along with it.

JOHNSON:

I think that's an excellent illustration of the difficulty of nonstructural as compared to structural solutions. Because if it were structural, and assuming no destruction of environmental values, we'd just run a levee right along the front. We wouldn't have to go in and talk to the people, so to speak. We wouldn't have the anguish of, "Some of them want to

do this, some that." The latter is a tough chore. We're not sociologists or public relations people; we're engineers and it's tough for us. But we're going to do it, the very best job we can as professionals.

INCAPRERA:

Let me ask something more of David Harris, about being in the floodway. Did your people evaluate the damages that would be prevented upstream by removing structures from the floodway? That would have constituted more benefits.

HARRIS:

It's pretty wide in that upstream area. As a matter of fact, this is one place where the town, before the advent of flood insurance, denied permits. And the developer went to court and was granted a permit.

JOHN CUNICO:

I think the districts have taken a pretty good beating about not addressing nonstructural techniques to the degree they should. I think in our district we've attempted to address them. Santa Fe is an example.

But I think in the long run the district engineer, who ultimately makes decisions, is not judged on the basis of innovative planning. He is judged on the amount of construction that occurs in his district. That's a reality of life. Every one of the district engineers will tell you that. Quarterly, there is a publication the emphasis of which is, "How much construction placement have you got this year? Have you enough to sustain you for the future?" It's not a matter of how much innovative planning you've done. That criterion has to be changed before a district is really going to look at innovative planning that doesn't result in hard construction.

JOHNSON:

It seems to me when you have General Gay sitting in the back of this room, having brought this group together, it counts the other way. What more do we want for direction? President Reagan sitting back there? Yes, we're going to do nonstructural planning. And yes, there'll be some opposition to it. You're right, John. It's part of floodplain management. Ask General Gay.

BRIG. GEN. FORREST T. GAY, III:

I do want to make a comment. If measuring were based solely on construction, I wouldn't be a general. We had a very small district but we did a lot of innovative things. Certainly, it wasn't all just my doing; I had a great staff.

I think anyone in a supervisory position, such as a division engineer, director of civil works, or a chief, is going to be looking not only at how well a district Engineer manages his program and how well he accomplishes his objectives to reach 93-98 percent goals. They also look at the quality of what he's doing. That does not go unnoticed.

REMARKS  
ON  
NONSTRUCTURAL MEASURES RESEARCH

IWR NONSTRUCTURAL RESEARCH AND DEVELOPMENT

By  
James R. Danchev  
Director, Institute for Water Resources

Estimates of annual flood loss in the United States range from \$1 billion to \$5 billion. While the flood problem is growing, our resources to deal with it are becoming extremely limited. Although numerous flood control studies have been completed, Congress has not passed a water resource development act since 1976, and the prospect of any major construction authorization for flood control is not promising. Consequently, we face questions concerning the role of nonstructural measures in decreasing flood damage. Beyond the fact that Public Law 93-251 mandates that nonstructural solutions be given full consideration in the formulation of flood control alternatives, we need to insure that we are truly giving serious consideration to the full range of alternative flood damage reduction measures in view of this slow down in approval of structural measures.

We don't actually know how many nonstructural solutions have been adopted for Corps projects, but we suspect there are few. The major reasons seem to be that nonstructural measures are often difficult to justify economically using traditional Corps accounting procedures. Some nonstructural measures have a residual safety problem that often is exacerbated by floodplain residents' having a false sense of security. In many instances the Corps is reluctant to become involved in what has been traditionally a local government or individual responsibility, or in what may become a cooperative venture with other federal agencies.

These are serious, legitimate problems. Nevertheless, it is clear that the times and the economic conditions of the country demand simpler, less costly solutions. The budget constraints that we work under make it vital that we take advantage of promising opportunities for nonstructural work.

In a paper presented at the May 1976 Seminar on Nonstructural Floodplain Management Measures, Darryl Davis made a telling observation:

"The analytic needs for planning are probably not the critical needs related to planning nonstructural measures. The policy issues related to cost sharing, the federal planning role, and the federal implementation role are the significant issues. The adopted position on these issues will also have substantial bearing on the needed character of analytic tools. Nothing seems to have changed. Significant progress has been made in improving analytical tools, but the general issues of policy remain."

A telling observation of my own is that, despite my previous district experience and my years at IWR (where we have been deeply involved in planning research, training, and consulting), there are many people at this seminar

whom I have not met. I believe that the practice of isolating floodplain management from the mainstream of Corps planning has resulted in some of the problems that have come to light here. I now realize that we at IWR have not had any significant connection with our floodplain management people and that many of you may not know what IWR is and does.

IWR has been deeply involved in designing comprehensive methodology for floodplain development and management for well over 10-years. The initial study proposed a framework for developing and evaluating nonstructural alternatives in the context of multi-objective planning. This study laid out the entire scope of the planning process, from setting objectives to evaluating and selecting plans. Case examples for flood control projects in Reno and Tucson showed a range of alternatives. Later, John Scheaffer and colleagues from the University of Chicago developed another model for floodplain management which emphasized the use of community goals and management opportunities in the decision process. This study drew on case examples for Waterloo, Iowa; Lincoln, Nebraska; and Atlanta. A more detailed case study was done in 1975 for Pullman, Washington, where community goals and flood damage reduction determined floodplain management plans. The study suggested that a variety of measures could be used to achieve the goals. IWR recently published a study by Baltimore District that is a guide to determining the cost of nonstructural measures.

The Hydrologic Engineering Center (HEC) and IWR have developed a healthy array of analytic tools useful in nonstructural planning. IWR developed several computer models for projecting land use and location benefits. The most noteworthy of these is the land use allocation model, which identified future land use by grid cell, based on projected population, and balances physical and economic constraints with public acceptability.

Bill Johnson of HEC has prepared a method of evaluating the feasibility of nonstructural flood control. It is a useful guide, but leaves unanswered a number of questions; we still want more specific details on how to judge the benefits of individual measure. Part of the problem was addressed in James Owen's recent report on the effectiveness of flood warning and preparedness alternatives. That report provides specific guidance and case examples for evaluating flood warning alternatives. IWR has begun an assessment of relocation and evacuation evaluation procedures, but there are still no specific guidelines on how benefits of relocation should be measured. Questions like evaluation of alternative land uses and accounting procedures for costs and benefit remain very thorny issues.

IWR's work in urban studies has involved research on institutional analysis. While this research is not very specific to individual measures, it can serve as a good basis for future institutional work. Owen's review of implementation of flood warning and preparedness alternatives is an excellent survey of how public institutions can serve to implement this cost-effective measure.

Technical assistance offers a great opportunity for accomplishing and appreciable amount of work with limited federal dollars. IWR recently published Owen's Community Handbook on Emergency and Flood Warning

Preparedness Programs, a "cookbook" that outlines the necessary ingredients of flood warning and evacuation. A Guide to the George Palmiter River Restoration Techniques describes a community self-help method of reducing drainage and streambank erosion. We have also just completed a study of technical assistance which Corps districts have offered after finding no possibility of a Corps project. This study found a great reluctance to provide technical assistance, either from a lack of resources, insufficient guidance, or a reluctance to get involved in actions which appear to be primarily local in nature. Certainly, the Corps has a major role to play in offering technical assistance, and we need to find ways of expanding our work in floodplain management services.

The Tug Fork project provided a singular look at the human cost of flooding. We studied preferences for relocation and the potential impact of relocation. The human cost procedure was repeated recently for the Lake Elsinore project in Los Angeles District. We are also about to publish two studies by Dr. Annabelle Motz on the relocation process and on nonstructural measures from a social-psychological perspective.

Finally, as David Miller will be telling you, we have joined St. Paul District in a post-audit study of the Prairie du Chien relocation project. That study and others like it are badly needed to turn our presumptions of the effect of nonstructural projects into more reliable projections.

In considering the board issues that form the nonstructural concept, we need to look at mission, evaluation, and procedures.

If "federal engineer" indeed conceptualizes the Corps mission, then the Corps must represent the federal interest in the full range of nonstructural measures. Proper roles must be defined for federal, state, and local interests, and the Corps role must be properly defined--in planning and in implementation. Technical assistance is a special case: why do we continually reject it as part of our mission?

The major evaluation issue is the national economic development criterion. Its usefulness is limited. It simply does not incorporate the full range of federal interest in public programs, specifically in floodplain management, or the "wise use" of floodplain lands.

Our planning process is biased toward a preference for structural works, and not without justification. Structures are relatively permanent. They are certain; they do not require continuous individual action. They collectivize action by protecting all without regard to financial circumstances. They remove individual decisions from the agenda and validate generalizations. Nonstructural measures tend to be seen as a solution of last resort.

If our objective is a report, and not a solution, given minimum response in our planning studies, should we then simply quit when we find no economically justifiable structure solution and issue a negative report?

Is floodplain management an issue that can be managed effectively through a project rather than a program focus? The National Weather Service has a program. The Federal Emergency Management Agency has a program. The Corps of Engineers has projects.

It has been six years since IWR and HEC sponsored the last conference on nonstructural flood control measures. The hope is that we can meet six years from now and discuss progress that has been made. The hope is that there will be more Prairie du Chiens to review and discuss.

FLOODPROOFING

FLOOD PROOFING  
AN ALTERNATIVE FOR  
FLOOD DAMAGE REDUCTION

Lawrence N. Flanagan

Flood proofing can be defined as adjustments to structures and/or contents for the purpose of reducing flood damages. Flood proofing is not new, but has in the past few years been given increased attention because of the interest in nonstructural flood damage prevention. Although flood proofing is considered a nonstructural flood damage prevention alternative, in some cases the line between flood proofing and traditional structural measures is ill defined, particularly when levees and floodwalls are involved. Generally when only one or a few properties are involved in a limited effort, it's called flood proofing.

Ineffective attempts at flood proofing by both developers and individuals can be readily observed throughout this country. In fact, in a survey conducted by the Corps in 1979 and 1980, only about 50% of the observed flood proofing schemes were judged to be effective. This low percentage of success illustrates the complexities and difficulties involved in designing and maintaining effective flood proofing systems. Flood proofing measures can generally be categorized as follows:

- a. Elevating structure on Continuous Wall or Block Foundation
- b. Elevating structure on Piles or Columns
- c. Elevating structure on Fill
- d. Levees and Floodwalls
- e. Seals and Closures
- f. Wet Flood Proofing
- g. Other Miscellaneous Techniques

Any of the listed flood proofing techniques can be an effective flood damage prevention measure for both new and existing structures when properly utilized. Likewise, the same measure can be completely ineffective and if it fails, cause more damage than would have occurred had no attempt to protect the structure been made.

Selecting the best method of flood proofing for a given situation should be based on a knowledge of local soil conditions, topography, type of structure, availability of materials, local building requirements, and flood characteristics such as depth, velocity, duration, and warning time. Generally, the most common and often best way to flood proof is to raise the structure above the flood hazard. The second most common way is through the use of levees and floodwalls. Each of the listed flood proofing categories is discussed briefly below.

a. Elevating Structure on Continuous Wall or Block Foundation.

Continuous concrete wall foundations are used for many different applications. Above ground basement residential structures are often constructed in this manner, as are many industrial and commercial establishments where docking facilities are incorporated into the design. Also, it is fairly common to find structures raised on concrete block walls to various heights depending upon the depth of flooding. Great care must be taken in this technique to prevent differential water pressure from damaging the foundation. Either the foundation must be specifically designed to carry this loading or intentional flooding with either potable or floodwater should be used to balance internal and external pressures. Failure to vacate any raised structure during time of floods could result in cut-off of escape routes and create a very real safety hazard if the flood proofing design level is exceeded.

b. Elevating Structures on Piles or Columns. This method is frequently used where the dynamic forces of wave action or velocity of floodwater is severe or where the water surface can vary considerably. Structures built on piles are often found in coastal areas and along lakeshores. One advantage to this method is that floodwater impediment and impacts on flood storage capacity are minimized. Also, open areas under the structure can be used for parking or storage of materials that can be easily moved. Even though the best time to flood proof is obviously during initial construction, this method is often the most practical for flood proofing existing structures on conventional foundations.

c. Elevating Structures on Fill. This is a fairly common activity in subdivision development and in siting individual houses. Often the shaping of areas to be developed in such a manner as to fill the house sites in combination with use of a conventional foundation will raise the first floor level above the design flood level. Significant amounts of material hauled into a flood plain for this purpose may obstruct the natural flow of water or result in a loss in floodwater storage capacity. Either condition can cause higher and more frequent flooding. Before a structure is placed on fill, state and local land use regulations should be checked to determine if such action is allowed. The materials used for fill vary widely from one region to the next, but generally the material must be grassed or otherwise protected against erosion.

d. Levees and Floodwalls.

(1) Levees considered in this paper are those built around single homes, small subdivisions, and individual industrial complexes. These local levees, if adequately maintained, generally protect against more frequent lower level flood events but are often overtopped during higher floods if not adequately designed. Usually, floodgates and pumping stations are required for interior drainage and seepage. Both gates and levees require periodic maintenance. Local levees sometimes fail without being overtopped because of poor design, improper material and/or construction practices, inadequate pumping facilities, or other reasons. Therefore, it is strongly recommended that all levees and floodwalls be designed and constructed under the supervision of qualified professional engineers.

(2) Floodwalls are often added after a building or properties have experienced flooding one or more times and are generally used where space or other considerations preclude the use of levees. If designed properly, floodwalls are effective because they require little maintenance and can be easily inspected. Disadvantages of this method include initial cost, keeping closure materials accessible and training personnel to assure timely closure. Generally floodwalls are constructed from concrete or concrete blocks and have one or more passageways that are closed by gates. Occasionally, a structure will have a floodwall incorporated into the architectural design. The use of levees and floodwalls will usually require a sump pump system to evacuate internal drainage along with underseepage that might occur. Excessive underseepage from improper design is a common problem in the use of these alternatives. Also, a problem in this concept of protection is that failure of the system either structurally or by overtopping can result in damages as great or greater than if no protection was attempted.

e. Closures and Sealants. Plastic, marine paints, bentonite, and other waterproofing compounds and sealants can be applied to structures providing that the structure can withstand the hydrostatic and hydrodynamic pressures. Of the paint on type materials, research conducted at the Corps of Engineers Waterways Experiment Station indicate that those with cementitious bases are generally superior. With this method, the foundation must be designed to withstand uplift forces. A variety of closure designs are used ranging from single plywood sheets to expensive steel stoplogs. It is extremely difficult to make closures completely watertight and many systems using this technique allow for some leakage by employing pumps to evacuate the leakage. No attempts should be made to seal a structure against floods deeper than 1.5 to 2 feet until the structure has been examined by a qualified professional engineer to determine that it can withstand the increased loads. A disadvantage to this system is that human intervention is necessary to make it effective. Often warning time is not sufficient to allow implementation of the system.

f. Wet Flood Proofing. In this method, the structure is made of materials which will sustain minimum or no damage when flooded. Contents located in floodable areas are those which can be easily moved or minimally damaged. Contents that could become hazardous or create a pollution problem during a flood are not stored in floodable areas. An advantage to this method is that hydrostatic loading is neutralized avoiding over-stressing of the walls and foundation. Any amount of wet flood proofing can result in reduced damages; however, in this method the homeowner is still faced with after flood clean up, repairs, and other problems not associated with dry flood proofing.

g. Other Miscellaneous Techniques. A few other flood proofing techniques which do not fit the above categories have been developed. One unique technique is to build the structure on pontoons or a barge-type foundation so that the structure floats during the flood. In this case, all land-based supporting facilities, utilities, etc., have flexible line connections. Another technique is to wrap the house in plastic sheeting. The Corps of Engineers conducted some research in perfecting a quick method of wrapping houses with plastic sheeting. Although this method takes time to implement, it has been used successfully and offers an inexpensive alternative for the property owner, particularly for houses with slab on-grade foundations.

Often when properties are located in a flood plain it is done through ignorance or underestimation of the flood hazard; however, many times conscientious decisions are made to locate or allow the location of properties in the flood plain with the idea of flood proofing. Usually, these decisions are based on one or more of the following factors: (a) locational advantages, (b) unavailability of flood free building sites, (c) cost of flood free building sites, or (d) preservation of community tax base.

When property owners move into the flood plain unaware of the danger, flood proofing is usually attempted only after experiencing repeated flood losses. We see many, sometimes amateurish, examples of "after the fact" flood proofing. The property owner may not be able to afford relocation or the locational advantage is such as to justify an investment in flood proofing. Homeowners have repeatedly invested between \$10,000 and \$30,000 in raising individual houses either because they like the location of the property or they don't think they can get a satisfactory sale price. It is doubtful that these homeowners made a structured economic analysis in making their decision. On the other hand, industries after incurring heavy flood losses have made economic studies and found it more advantageous to make heavy flood proofing investments rather than move or sustain more flood damages and production time losses. Some water oriented industries, such as ship building and river transportation, locate in flood hazard zones out of necessity. Usually these decisions are made with a full knowledge of the flood hazard, and often costly flood proofing systems are utilized. It is simply one of the costs of doing business. Certainly in these situations flood proofing alternatives are evaluated and decisions made based on economic comparisons of alternate plans, but not in comparison with a flood free site.

New construction in flood hazard areas, if properly planned, can be flood proofed by raising at a small additional cost and sometimes with very large benefit cost ratios. In a study done by Sheaffer and Roland, Inc. for FEMA in 1979, a hypothetical case study of a new commercial facility flood proofed to 7 feet above existing ground was made and cost and benefits of various flood proofing alternatives were compared. In that particular case, all alternatives except wet flood proofing had favorable B.C. ratios with raising on fill having the most favorable of 3.46 to 1. Cost of the 22,500 square foot structure raised on fill was only \$26.61 per square foot compared to \$25.01 with no flood proofing. An interesting comparison is a warehouse in Greenville, Mississippi where the owners elected to wet flood proof. The estimated market value of the 28,000 square foot steel building is nearly \$1,000,000. The floor elevation is 2 feet below the Mississippi River 100-year flood level. The cost to raise the slab to the 100-year level would cost an extra \$20,000, so the owners elected to wet flood proof and raise damageable machinery and electrical circuits to above the 100-year flood level. In that case, infrequent low level flooding would do very little physical damage to the metal warehouse and flood prediction time would be long enough to allow removal of the contents. Other comparisons could also be made to show a wide diversity in flood proofing choices meeting site specific needs.

In summary, it can be stated that flood proofing is a wide spread flood damage reduction measure that will continue to be used throughout the United States. Again, it can be effective if properly used, and its misuse can

create more problems than it solves.

What has been the Corps role in flood proofing, and what does the future hold? The Corps has been involved in flood proofing in basically three different ways, (a) pursuit of nonstructural alternatives in project plan formulation, (b) technical information to property owners through the Flood Plain Management Services Program, and (c) research on effective flood proofing techniques. In plan formulation, since development of a primarily nonstructural plan is no longer required in the new planning guidance, there may well be less emphasis placed on flood proofing in the future. There is; however, a large void in well documented engineering data on various flood proofing techniques and a strong demand exists in the private sector for that type of information. The Corps has the opportunity to help fill that need by continuing its ongoing research on flood proofing, and through increased knowledge and experience improve and expand its technical services program in that area.

PANEL X, FOLLOWING FLANAGAN ADDRESS

BRIAN MOORE:

That certainly was a very good presentation; I just have two problems with it. One is you discussed that innovative technique that you're using at Allenville with the plastic sheeting. I just had one thing on Allenville. That was a small project that you got involved in in Los Angeles, and we took all the people, in effect, and moved them out of the floodplain, had new houses constructed on a relocation site, and there were some old houses kind of left over. Now most of those houses in Allenville weren't very good; they were pretty much what you might call shacks. But there were a few houses that were left there that were substantial. We're very happy to be able to offer them to do some tests and experiments on.

And hopefully we'll get some successful new technique out of this, and I think it's going to be pretty effective for a lot of people.

The other problem I was going to mention is that you talked about the Deutsch Corporation on San Luis Rey River and mentioned that it's a good, effective example of floodproofing. I'm sure it is, and we have an authorized project on San Luis Rey right now; the Deutsch Corporation has mounted an intensive campaign pretty much against our authorized project. And we've had a lot of discussion with that organization in going over their techniques and their claims on effectiveness for the floodproofing alternative they've come up with. And I think we have a little difference of opinion on just how effective it is. Maybe when you come out in December we can talk about that, too, because I really think it needs looking into.

One thing that I'd like to see in floodproofing that would certainly help me in the southwest and Los Angeles area -- we've been talking about floodproofing for floods, but floods aren't the only problem that we have in the LA area, in particular. A lot of our problem comes from mud slides, and that's a lot different situation. With flood waters, true, it's unfortunate when you get those in your house and it really makes quite a mess, but the flood water recedes eventually and goes away. And you can dry things out and hopefully restore it to what you had before. But with mud flows and mud slides, it doesn't go away. The mud comes down and maybe it gets three or four feet inside your house, and stays there. So when the rain part of the storm is gone, you're left with the unfortunate circumstances of having to remove all this material.

We've done a couple of studies to see if there's anything the Corps of Engineers can do project wise to prevent these kinds of mud slides and mud flows and really haven't come up with anything. It would sure help us in the LA area in particular if there was maybe some more research on that, maybe some attempts at developing some techniques for helping to solve these kinds of mud flow problems. I'd like to see more of that.

One thing about floodproofing. There's an awful lot that has been done now, on floodproofing techniques, and it's very helpful now in planning. You go back a while ago, like 10 years, there really wasn't that much done; now we

have a lot of experience, a lot of history, and a lot of data on these types of techniques. It's very helpful in planning, because you know what average costs are, what techniques are available.

I have a couple of comments, too, which I'd just like to make right now on planning for these types of facilities. What it really requires is the joint efforts of locals and the Corps to get these kinds of alternatives done. It's something that we really can't do ourselves. You really need the participation of locals because there are hard kinds of alternatives that require somebody to do. It's difficult sometimes to have people believe that they can be flooded, particularly in our area, where most of our streams are dry most of the time. It's only after floods that you get any flow at all in a lot of the streams, so most people don't believe that they're going to be flooded. And when you tell them that they need to do something to protect themselves, something for that particular home, it's a hard thing to believe. So you really need to work very closely with the locals through the homeowners in order to get the point across.

I think an effective thing that we can do in planning to get more of these types of projects built is in our small project program. I think that offers an excellent opportunity to do a lot of these kinds of techniques. On the 205 program, it is a small program, and the amount of money that we can allocate to projects isn't that significant, but it does offer an opportunity to help in a lot of these areas that people need help in.

But there are some problems with that. And I think one of the problems is that there's not that much money available for that kind of program, number one. Number two, to initiate that program you start a recon investigation and the amount of money that's available for that is very limited--very, very small. It is true you can ask for more funds to do the reconnaissance investigation, but still it would be helpful if more money were initially allocated in the reconnaissance phase so that we could do a better job of investigating these kinds of alternatives.

It's a lot more expensive to do studies on these nonstructural kinds of plans, because you have to look at individual buildings and facilities, than it is to do the investigation on the structural plans. We have a real good history on the structural, and it's easier and probably less expensive to examine those kinds of solutions initially in the reconnaissance level effort than it is to examine these nonstructural floodproofing types of alternatives. So I think, in our area, it would certainly be more helpful to have more funding allocated to the reconnaissance phase for that.

And the other thing again. On the small project program, which is an effective tool for us to use to implement these plans the thing we've come up against in LA is under that program, you have to solve the problem completely. And if you don't do that, we really can't participate in it. And we've found in floodproofing and nonstructural alternatives that oftentimes you can protect certain parts of the floodplain, but not the entire floodplain; so you're left with a possibility of ending up with a situation where maybe 50 percent or more of the development you could do floodproofing or some other

solution for, and the rest you can't. But because of the restrictions of the program you're not allowed to participate in it at all, so you really end up doing nothing at all.

Well, that doesn't solve anybody's problem. That really doesn't help, and I think if we can look at it from a policy standpoint, if there's something we can do in these nonstructural situations under the small projects program--if there's something we can do to change that policy--I think we really should look into that. It would be very helpful for us.

I can think of a number of studies we've done that have been turned down because they didn't completely solve the problem. To me it's very unfortunate to have to turn your back on somebody that has a problem when you have something that you can do but you just can't implement it because it's a policy requirement. So I hope perhaps we can get into that a little bit more in a general issues session.

LARRY LARSON:

This whole topic troubles me--floodproofing. There are two things that trouble me. The one thing that troubles me the most, I think, is the appropriateness of the federal role. It is a very site specific thing. I think as Brian just alluded to, it is the kind of thing where you may find incomplete solutions. Those solutions, if implemented, can lead to a perception of dissatisfaction with the Corps role, either in a technical assistance mode or if there were implementation. Take the case where the homeowners don't understand. Take the residential case, really what the flood problems are. They can't understand why, when floodproofing is only really effective at levels of up to two, maybe three, feet, their neighbor can get it because at their 3 1/2 feet it really doesn't apply to them. So look at the appropriateness of the federal role in other than a technical assistance sense. I think it is clear that the technical information is there.

I went back over the proceedings of the 1976 seminar, I went back over the St. Paul policy discussion; and we are really not saying anything much new. It seems that we know pretty much now what we knew then. There have been some minor improvements in techniques, but the same basic issues remain. Some of those basic issues relate to and are the same basic issues that have been running through, at least in my mind, this entire seminar. We need improved tools for economic analysis and perhaps even more important to this topic than to some of the others would be improved social analysis skills. This is a very site specific individual-by-individual perception and willingness to implement. You have to get into the community, I guess as Bill Johnson said, not only get into the community and understand your officials, your local government, but your people, not as groups, but as individuals and how likely they are to not only implement things that may be recommended, but to carry through. Are they willing to maintain their pumps? Are they willing to recoat their floodwalls every so often?

A minor point, I guess, is I didn't see one measure in any of the previous policy discussions, nor in this one. It seems to me to be appropriate to the

floodproofing topic, and I would like to get some discussion of this later--if not in this discussion, perhaps in the general discussion. What is the role of on-site detention in designing floodproof buildings? What I have in mind at Phoenix is the only model I can bring readily to mind where they have a sheet flow flooding situation, not a riverine flooding situation. In all the new developing areas they are excavating, they are building lots and using that material as fill to build the houses up. So they are getting them up out of the flood waters, but in addition they are creating on-site catchments to reduce flooding downstream or downslope. Where does that belong in this whole floodproofing discussion?

I see some of the underlying issues here in this topic that I've seen throughout the conference--more research in economic analysis, more research in social analysis. And when I say research, I don't mean untargeted research, or just nice-to-have information. I think we have got an awful lot. And Randy referred to some of our activities. We see that the techniques are there. What I am thinking is, to followup on Jim Owen and Don Duncan's suggestions earlier, that we need something that gets out into the procedural sense--procedural documents, guidelines, perhaps more training workshops to get ourselves in a better position both to provide technical assistance, where it is appropriate, and to do our job better.

DAVID BURROUGHS:

The federal role, or the nonfederal roles, or where we stand, or what we should do in floodproofing: I guess my view is a typical field view. We are out there on the ground. We're charged with solving a problem. To question whether we have a federal role or not--what are we trying to hide behind? We have been given a charge to help people help themselves on the FPMS program. And if we can give them some technical assistance within the bounds, frankly, by competing with the private AE profession, that's always in the back of our minds because if we were on the other side of the fence we wouldn't want a bunch of Corps of Engineers types doing work that we could charge people for.

But the tools of floodproofing are fairly well known. Then what should we be doing? As I see it, the FPMS people with their contact points in the industry and with local building authorities should be out there selling every day. Which leads me to the point of the validity of floodproofing for new construction. As Larry pointed out by his basic comparison, for new construction the cost of an additional foot or two feet of a foundation is infinitesimal considered with a one-time loss in a 50-year event. It is very much a false economy not to put another foot on the foundation or add another foot of ground to put a pad on.

In new construction, we should be working highly and very closely with local building groups, both regulatory and contracting, pointing out how they can help themselves. To the contractors, increase building costs a little bit. With local building groups, how can they preclude future problems, the regulatory people, by enforcing consistently floodplain regs about first-floor elevation.

Insofar as existing construction floodproofing, I have a real problem there. You can see from various of Larry's slides the false sense of security that is

created by floodproofing ill-conceived or too little too late. You get two feet in a house for any type of duration, or more than two feet, and you will lose your foundation and your walls.

And if you go in there and you encourage these people to do the floodproofing, then you have a large event, more than a nuisance flood, we as an agency and the local building authorities who have supported floodproofing are going to lose credibility. None of us wants that. Where does that leave us? It doesn't leave us in a very good situation.

If we encourage floodproofing, I think at the same time we had better be pushing for flood insurance. The two must go together--to insure against the infrequent loss and then to try to preclude the more nuisance variety. I am not convinced that you should try to protect above a foot of flooding, in a house, because I think the problems of overtopping and the false sense of security overcome any benefit that you can get.

Public utilities--water supply, sewage, and other utilities: I think to try to subject these things to traditional economic analysis is trying to use the benefit ratio as a crutch that is was not meant to be. Public facilities furnish the essentials of life, your sewage treatment system, your water supply, even your telephone system. To try to say that we can accurately identify all the economic benefits and put a price on them that we all would agree on is wrong. I think we should just go ahead and say, in effect, "It is worth whatever it costs." If you have an old system that you're considering protecting, what's the remaining life to that? You go ahead and just forget that remaining life and build a whole new one, or you go ahead and protect it. The benefit-cost analysis was meant as a guide, not as an infallible, inflexible rule. I think too many times we try to hide behind it as a reason not to do something, instead of looking at what we have done. There are all types of examples where everyone of us in this room knows that X project, whatever that project may be, with a BCR of .751 is a good project, but we just cannot find the rest of the benefits. We know in our heart that it is a good project, but yet we can't or don't recommend it. If there is a district in here that does not have a project like that, I would like to hear from it.

DISCUSSION FOLLOWING FLANAGAN ADDRESS

WILLIAM JOHNSON:

I'd like to make a little more specific what David was talking about -- existing structures. Let me pose it in a question to Larry and the panel. We're talking about some way of keeping the water out of existing structures, say, using polyethylene sheets. What can we say about the protection? We don't know the soil conditions. We don't know the quality of workmanship in the structure. We don't know anything about the design of the walls. We don't know if we put the reinforcement bars in. We don't know quality of concrete. We can only know by extensive testing.

Let me pose it this way, Larry. Should we in the Corps say, "We do not recommend any kind of protection for existing residential structures because we don't know the materials, quality, and workmanship which went into the structures?"

LAWRENCE FLANAGAN:

I think what we're going to have to do is be sure that we staff ultraconservatively low levels. We can probably floodproof nearly any structure up to a foot and a half.

This leads me to comment on what one of the panelists said: "Anything over a foot may be dangerous". What we must look at each time is the flood characteristics. We've got a lot of alluvial areas where we're picking up all these damages in the 10 year flood. We've got a foot and a half of flooding. We may have a situation where the 100-year flood is going to be 10 feet higher than that, and these people could really be in trouble if they tried to floodproof and stayed in that structure.

We've got just as many examples where we've got a 100-year flood level that's going to be one foot above that. What if it does overtop? They can wade out in that two feet of water and walk to high ground. You can't generally say that it's dangerous to floodproof. Lots of times the 100-year flood level or whatever flood level simply can't get much higher than a few feet. So we must look at the individual situation, and we can't make a valid generalization about all of them.

DONALD DUNCAN:

Could we find out when you're going to make this test in December or January so we could reconvene this seminar.

FLANAGAN:

If we don't have good results we hope you never find out about it.

PAUL GAUDINI:

I believe you named the Deutsch Corporation; you said it had a basement?

FLANAGAN:

Yes. It was used for plating.

GAUDINI:

Has it been flooded since they put in protection?

FLANAGAN:

Someone from Los Angeles would be better informed than I.

BRIAN MOORE:

No, it hasn't.

GAUDINI:

We have found in the East that most of our older structures have masonry basements. Our problems are that the threshold of protection is usually not the walls but the slabs. They go before the walls. And usually if the water was kept out during a flood they would have had severe damage. By their actually sealing the walls above grade (it depends on your soil conditions), they'd be precipitating damage.

We had trouble with types of flood waters. The oils and chemicals in the flood waters sometimes make it reasonable to pump fresh water into the basements to keep less desirable water out and to prevent structural damage.

FLANAGAN:

I agree. Foundation problems get to be severe. That's the time you must go to with floodproofing if you want to accomplish anything.

RELOCATION

MAJOR CONCEPTUAL AND EMPIRICAL DIFFICULTIES WITH RELOCATION  
AS A FLOOD DAMAGE REDUCTION MEASURE

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INTRODUCTION

Much that remains problematic about the formulation, design, and implementation of relocation as a nonstructural flood damage reduction measure is conceptual. Conceptual difficulties are those we have about the meanings and uses of words. Confusion and inability to act--and occasional conflict--result from word-meaning problems such as lack of precise definition, ambiguous definition, ill-chosen borrowing of terms from other contexts, and lack of consensus. The corollary of these is a corresponding situation in policies. In fact, the causal arrow can be interpreted in both directions between concepts and policies. Both need further development to effectively serve formulation and implementation.

The second genre of difficulties for relocation measures or plans is empirical. Empirical problems are those which arise from situational facts in the locale of a plan, from our methodologies, and from the intersection between these realities of the field and those of our agency procedures of measurement, analysis, and action.

There is also a third sort of difficulty--that of confusing conceptual and empirical problems. It is important to be accurate about the sources of a lack or an obstruction, because we rightly or wrongly cite either policy or planning methodology as the domain of remedial efforts--depending on where we perceive the origin of our working difficulty to be. Problems of policy specification and problems of method will, of course, almost always be intertwined in any given issue about plan formulation and implementation. In this way relocation is like any other measure or strategy for flood damage reduction. Or, indeed, any other agency mission.

Within the preceding introductory framework this paper will discuss the conceptual and empirical aspects of four major issues which currently constrain the development of relocation and other nonstructural measures for their routine use in "mixed" structural-nonstructural plans. These four issues are: (1) intervention in human social systems; (2) insufficient damages/benefits; (3) methodological dissensus; and (4) the proper objectives of nonstructural measures. Some relationships among these four issues, as well as several subordinate questions embedded in them, will receive some articulation as specific problems for near-future resolution. This needs to be done if the Corps is to move bravely into the new world of greater state and local partnership and financing.

INTERVENTION IN SOCIAL SYSTEMS

One of the fundamental statements of the St. Paul District's "Policy Discussion" of nonstructural alternatives was probably somewhat representative of many civil engineer planners' conceptualizations of implementing relocation as a flood damage reduction measure. Such intervention was thought to be

contrary to the value of individualism in American social and intellectual history, hence had an implicit ethical repugnance about it. The darkly questionable nonstructural measure was contrasted with structural measures, such as levees and dams, where we intervene in nature instead, to control water---not people. This value argument about technical options, consequential facts in nature and society, and ethics is a superb illustration of a problem created by the way we conceive of a matter. Therefore, it affects how we perceive the real phenomena and "facts" at issue in a planning situation. From a neutral investigative perspective toward the "relocation" or "dam" options, however, the "facts" and their moral consequences do not draw so simple a division between good and evil.

When we do structural civil engineering and the solution is a dam, we have a reservoir "take" area. Don't we intervene in the lives of those upstreamers (often in great numbers) from whom we take? This is a "relocation" too, except for the stigma some would affix to it if it were done at another spot as a nonstructural flood damage reduction measure. One suspects the stigma would fade if entailed construction. What is the difference? Since the issue was raised on moral ground it is legitimate to point out that the greatest difference of a moral kind about a reservoir "take" is its inferiority on the criterion of distributive justice.

When the technological action in answer to flood damages is structural, i.e., a dam, the government displaces and takes from those upon whom it does not confer any part of the collective good to be achieved by the dam. To parrot the old, and now quite shaky and contemptible phrase, "benefits to whomsoever they may accrue", does not lessen the injustice, unless we also use it to remove the onus of "interference" from relocation when it is the plan.

The law and the process of tangible compensation is the same in both actions. The truth about the "facts" is that we do intervene in both the social and natural systems of an area, whether we select a structural plan or a nonstructural plan. What is different about the two options is our evaluative interpretations of the facts. Controlling or interfering with people--and threatening American individualism is a "noble" reason against relocation. But it is a rhetorical, not an operational reason. And to applies equally to structural action.

The "real" reasons which shape interpretation and inspire noble rhetoric are more ordinary, antecedent factors. The social psychology of perception and interpretation in scientific research, for example, would lead us to expect this. These "real" reasons include such things as lack of construction opportunity, probable lower economic use of floodplain land (benefit/cost squeeze), risky one-to-one dealings with a large number of people, shared project management with locals, etc., etc. All these are, themselves, the working problems of nonstructural measures for engineers, economists, and planners, both by their discipline training and their traditional functions in the organization. For all these complicated facts and reasons, it is important to the adaptive capacity of the Corps that we cease vilifying one sort of relocation and wrapping the other sort of relocation in virtue. The near future must be cleared for genuine diagnosis and creativity, both technical and ethical.

## INSUFFICIENT BENEFITS---IS RELOCATION ECONOMICALLY EFFICIENT?

If the process of floodplain management strategy is singly focused on flood damages, relocation will seldom be economically justified. For relocation to be justified solely in terms of flood damages avoided, flood plain property values would have to be negative (unless there are significant costs, borne by others, with the current land use). Real property located in the flood plain having a market value of \$40K, of which \$10K results from various public subsidies, would justify no more than \$10K in relocation costs. Additional spending for relocation may be warranted if flooding costs of non-relocated individuals or of public services provided to the evacuated residents are reduced with relocation. In this simple example, paying the flood plain occupant \$40K for the property yields a 10/40 or .25 to 1.0 B/C ratio. And adding a 15K relocation allowance would make the ratio 10/55 or .18 to 1.0. The burden is to prove \$30K in additional benefits to make relocation an economically feasible alternative.

Reduced flood damages cannot possibly account for a sufficient amount of benefits to meet the B/C ratio requirement. The critical economic benefit is the value of the flood plain land with the new uses versus the residential use (or whatever the current activity which would be relocated off the flood plain). One should properly account for publicly borne costs and other external costs which could be avoided by relocation. Since relocation intentionally transforms land use, however, a fundamental change in the outlook of planners and decision makers is required. We should concentrate on the potential for flood plains to generate additional returns and shift away from focusing only on reducing flood losses.

Environmental interests often advocate the relocation alternative with careless abandon and push for "natural" uses of flood plain lands. We accept the possibility that natural uses may be exceptionally valuable (in an economic sense), but recall only one case where it is well proven---the natural impoundment areas on the Charles River. And we also note that this is not a relocation case but a strategy to block potential land use change. More often, EQ interests are satisfied with clearing flood plains (at huge economic costs) and doing nothing to advocate possible uses which may have net economic returns.

To repeat our thesis: economically effective flood plain relocation must depend on achieving higher net economic returns from flood plain lands. Relocation is a device for transforming flood plain land use. Although costs avoided with relocation must be accounted for, the focus of the planning and decision process must shift away from flood damages and toward the potential new uses of flood plain land.

Another aspect of the problem of insufficient benefits is that it often arises as a differentiation on the property damages between rich and poor citizens. We should especially give remedy by relocation, if sought, where we can achieve higher economic use, as discussed above, for formerly residential flood plain lands. But even where we can't, we must remember that the days of drawing levees or walls, or levels of protection, on the lines along which money flows rather than where the water flows are largely over. With the move toward greater state and local control, the principles of NED will yield

considerably to the facts of the political accountability of regional and local officials and community leaders. And relocation often does---despite its technical and administrative difficulties---cost less.

The mixed structural and nonstructural strategy will probably increasingly reflect this fact. By whatever means, equal treatment of income classes at similar hazard is a trend not likely to reverse in American society. The point is for the Corps to work out policies and procedures so that the agency retains control over formulation and selection criteria, rather than become reactive.

#### BUT IS RELOCATION POLITICALLY FEASIBLE?

The decision to buy, sell, and move is a stressful personal and/or household decision. Although the U.S. is characterized by restless, moving people, seldom is a move expressed by other than "I hope I never have to do this again." When the government is involved in this process, the hassle factors increase stress. Instead of the decision being made by the individual or household, the decision about when, and how, and less often, where, is made by a remote decision-maker generally not directly accountable to the people being moved. The interests of the persons to be relocated are reflected to some degree by their local political representatives. But it is seldom that local political representatives are not, also, reflecting the potential for increased revenues through higher valued land use, especially while the costs are underwritten by Federal resources. Flood plain relocation is different from reservoir relocation. In the reservoir case there is clearly an upstream-downstream dichotomy in costs and benefits. Not so in flood plain relocation.

While relocation is indeed stressful and a source of political conflict, the conflict may be transformed into a positive result. The local political representative must engage in the process of transferring some of the gains to the otherwise losers in relocation. Only if the net gain is equitably distributed can there also be a conclusion that relocation is politically feasible. If the Corps is involved, it must maintain a positive and low profile role in the process of distributing gains equitably. The accountability for equity cannot be ignored in the guise of objectivity.

#### METHODOLOGICAL DISSENSUS

One of the issues which the characteristics of the individual case and the fuzzy classificatory nature of some "nonstructural" benefits raises is that of whether to take benefits or offset costs. And do which with which ones? There is probably more befuddlement about this than conflict. The latter requires sufficient clarity---however erroneous---to support statements of disagreement. Our general position should be that cost offsets should be practiced only if the policy seems to facilitate good political decision making. Cost offsets are used in several areas of Corps benefit/cost analysis. Costs of betterments in road relocations are offset (removed from the denominator of the B/C ratio). This is a way to avoid the hard question--are there benefits from road betterments? There are other cases and other rationales for cost offsets. The primary problems with cost

offsets, of course, are (1) that the technique confuses true perception of outlays required to obtain claimed benefits; and (2) cost offsets generally avoid the discipline of articulating benefits.

In a deeper sense then, cost offset or exclusion may also sidestep indefinitely (and too long for the good of the Corps) hard questions about admissible real project purposes and civil works objectives. This matter was broached earlier in noting that the NED objective, unleavened by local and regional objectives, is likely to be less tolerated than in the past. This will be especially so if it seems to be blind to intangible "other social effects" or perceived distributive justice.

As is so often the case in both sciences and professions, what seems a methodological dispute is beneath the surface a substantive and ideological one. This is surely in part true regarding how to measure and do accounting of certain project actions and their effects which become de facto "purposes."

There is a second sort of methodological dissensus which contains the "purposes" problem implicitly, but is primarily a disagreement about the feasibility and the economic consequences of measuring an "intangible" harm or benefit. An exemplary case of this is the human impairment attributable to flood trauma and its monetary evaluation, which was done in the authors' Human Cost Assessment appendix to Huntington District's Tug Fork Study.

The study was actually somewhat conservatively designed, using (1) rather common psychological indicators of psychophysical trauma, (2) the degree of impairment classification of the American Medical Association, and (3) the compensation schedule of the Veterans' Administration. Yet, though most Corps people want "suffering" to weigh heavily -- even often overriding economic efficiency--some would rather just declare a remedy justified in extraordinary cases. They would not like human travail measured as a standard part of the benefit cost evaluation procedure.

The matter is crucial to the fair economic evaluation of relocation, because potential relocatees will often be unreachable by engineering or property-based economics. While the problem of insufficient damages/benefits may be partly solved by higher land use changes, it will not be so always. Nor, perhaps, more than half the time. Will we resort to a fiat that alleviation of misery outweighs costs in all others? Or abandon them in defeat? Or will we measure and monetize with the research methods of social psychology, the diagnostics of medicine, and the politically adjudicated compensation rates of the Veterans' Administration? This could be done cheaply and quickly in all projects, not just relocation plans.

Those who are troubled by "trauma damages," as they have come to be called, appear to be of three outlooks. There first are those who say that we who care about humane justification must follow the strategy of the environmentalists, who decided to not monetize EQ units because they feared losing, consistently, in the accounting against industrial goods. Second are those who reject the possibility of measurement because they don't know the contemporary methodological capabilities of psychology and sociology developed since 1960. And third are those with a vague but viscerally strong ideological angst about measuring things which "should be left mysterious." For the sake of the future of mixed plan strategies in Corps studies we must

arrange and work through a dialogue with the first two sets of colleagues. With the third, resort to reason is scarcely possible. Except, perhaps, to ask them why they are willing to intervene in the natural world for humane purposes in the first place.

#### IF THERE IS A CASE FOR RELOCATION, WHAT ARE ITS OBJECTIVES?

There are reasons which support relocation, even with the costs and the political complexity and risks that go with it. One, the flood plain can be converted into a resource which has greater net economic returns. This rationale is clearly the primary source for building good economic support of the policy. We need to expand the concept of improved returns to include the total community and regional economy in the same way that NED accounting attempts to characterize returns to the national economy. Antle has shown in Huntington's Tug Fork Study that flooding accounts for a part of the difference in coal mining productivity among 40 of the top coal producing counties in Appalachia. Control of flooding in Tug Fork could increase productivity in that valley by about \$25 million per year (which is greater than average annual flood damage).

In Tug Fork, there is also no local house building industry (nor any of the financing infrastructure necessary for a homebuyer to obtain a wide choice in housing). A relocation strategy here could be the way to get such an industry started. The strategy to develop a viable home building industry and improve coal mining productivity is a more profound reason for doing something about flooding in Tug Fork than reducing flood damages.

The "do nothing" option in the Tug Fork Valley continues the huge emergency and entitlement transfers that yield no net gain to the nation. These are continually paid out in the Federal Flood Insurance and Flood Disaster Recovery programs, in addition to the large human functional impairment and the conventional property damages.

IWR, in the Tug Fork Human Costs Assessment has published an evaluation of the human functional impairment costs of flooding due to psychophysical trauma during flooding and the post-flood recovery period. These costs are, like coal productivity losses, substantially large relative to other traditional costs in Tug Fork, and in two other places. Since they are, from a humane perspective, even worse for old, handicapped, young, or poor people than for active working adults. These human costs can help sort out appropriate long range flood plain management strategies. The AMA-VA based human impairment dollar costs resulting from flooding in Tug Fork was much greater than residential damages.

The best policy is to opt for minimizing nationally borne human costs when formulating and choosing among flood damage and flood plain management strategies.

It should be reiterated now that relocation may often be the wise strategy from a cost effective standpoint. In every Corps project there comes a point where the project is tied off, or where added flood storage is not effective. Homes and businesses are left outside the project as a result. Relocation, as a cost effective measure, may be the way to provide a socially and politically acceptable and reasonably efficient project. In just such a

situation on a very large scale, relocation of the housing which is scattered along 100 miles of the Tug Fork Valley, one or two homes deep, was discovered to be so much more cost effective than structural means that the nonstructural component stands as the best way to achieve a comprehensive closure on the Valley's problems.

MUST THE CORPS ALONE SOLVE "NONSTRUCTURAL DIFFICULTIES?"

The response is, "of course not," even though we have acted (or failed to act) as if we thought so for more than six years since the 1976 IWR-HEC Conference. There is no serious turf problem raised by the myriad facets of the topic of nonstructural planning and implementation which don't already exist for other or wider reasons. We would do well to explore what division of labor is needed among agencies, and to seek a system of joint planning authorizations in accordance with identified information, technical skills, and administrative capacities. We have a prototype for this in the "639" joint study authorization between the Corps and the Soil Conservation Service. We might readily devise less comprehensive joint agreements for cooperation with FEMA's Flood Insurance Administration, with the National Weather Service, with USGS, and several others, including perhaps HUD and some regional bodies such as the Appalachian Regional Commission. It will be good practice for learning to cooperate efficiently with state governments who are coming to expect a full partnership role. And it will help maintain Corps civil works and standards in an era of budget scarcity and enforced efficiency.

PANEL XI, FOLLOWING SIMPKINS ADDRESS

ART HARNISCH:

The topic is relocation, and, as Larry Larson said yesterday, when we are talking about relocation, we are talking about people--people relationships. First of all, in this business, we get and maintain our credibility in dealing with people. In most relocation projects that I have seen, problems develop where the Corps is dealing with rural people, and what the Corps does is send out urban-type real estate appraisers to deal with these people. Right from the beginning, you have got two different characteristics of background, experience, education, and knowledge of trying to solve the problem. Rather than solve the problem, many times the problem gets bigger because of the differences in the people who are doing the negotiating. So perhaps in this process of relocation, we should bring in more of the local people, more of the locally oriented people, to a relocation problem. There are social and psychological approaches we have to use rather than just putting together concrete and bricks as we do with a structural measure.

In view of the matter of relocation for the prevention of flood damages, I think that there is a great opportunity in there. On the arsenal of weapons that Colonel Galloway and Bill Donovan discussed that are in the laws and regulations, perhaps those laws and regulations were not written with relocation in mind. They were probably written with structural measures in mind and perhaps that is where we are having our difficulty: for example, the Uniform Relocation Assistance and Real Property Acquisition Policy Act, known as Public Law 91-646. It looks like the intent behind that is when the the "feds" have a project, they will not only buy the real estate, but they will help these people relocate. I wonder if we should look on the relocation of a community to prevent flood damages as a federal project to come under that law. When we look at the accounting laws, which Chuck has mentioned, we have, of course, the NED clause which is based on economic clarity, but then we have the financial clause which is based on high dollars that are going to come out of somebody's pocket. I wonder if federal assistance to that extent to people living near a floodplain is legitimate in calling this a federal project.

Now, in looking at that Public Law 91-646, seeing how other agencies are using it, I found that HUD has a program to help low-income families get dispersed around the community. You probably know that in the past, housing assistance was putting low-income people into high-rise buildings; now the thrust is to disperse the low-income people into other neighborhoods around the city. And what they are doing is advertising for people to volunteer their properties for this program.

In that case, when a property is volunteered, HUD pays cash for that property, there is no broker involved, and there are a lot of other expenses that are not involved. Essentially, HUD is paying less money for that property, but the owner is happy in that he is getting cash in hand (even though it might be a little bit less), but he doesn't have the sales problems here. And HUD tells me that that volunteering of property does not come under this PL 91-646.

So our organization thinks that perhaps HUD is doing something wrong, but it is in their regulations and they're doing it. And maybe that is an approach to the community, to have people volunteer their property to be relocated. There are many other aspects of relocation that have really not been addressed; I think that Randy is right, and we do need a lot more information on how to approach the relocation. It is a new experience for many of us.

LARRY ZINZINGER:

Benjamin Disraeli once said, and it was also attributed to Mark Twain, there are three kinds of lies: lies, damned lies, and statistics. So, maybe our economists have gotten us down that track of damned lies, or even into statistics. That is one of the problems we have.

I'm with FEMA, Federal Emergency Management Agency; most of you have probably heard about us. I am in the Office of Disaster Assistance Programs, and one of the programs that I am responsible for is a flooded property purchase program that FEMA operates as part of the National Flood Insurance Program. You may know it by its nickname, it's called Section 1362, and it's Section 1362 of the National Flood Insurance Act. I will tell you a little bit about the program, and I think as I am doing so I can illustrate, perhaps, some of the things that you might be interested in and that Chuck is hitting on.

When the program was initially formulated, it was added to the Flood Insurance Act. When it was passed in 1968 by Congress, Congress recognized that although the Flood Insurance Program would be a subsidized program, that something needed to be done about situations in which repetitive and substantial flood damage would create a continuing drain on the Flood Insurance Fund and a continuing subsidy cost to the Flood Insurance Program. The Congress realized at the time that there may be situations in which people might get tired of being flooded, and it may benefit the government at the same time to buy that property, get the person out of the floodplain, and solve our insurance payment problem forever.

We have been operating the program only for the last three years, because of various problems in getting appropriations for it. It is a very small program; we have an annual budget of about \$5 million. Properties to qualify have to be damaged by flooding while covered by flood insurance, and they have to meet one of a couple of statutory criteria in terms of repetitive damage or substantial damage. Over the past three years, we have acquired in excess of 200 properties nationwide. Most of these have been in various small projects, usually six to 12 properties involved. We are not constrained by benefit-cost analysis, although we do do an analysis of the anticipated savings in claims--in claims payments over the projected life of the property.

We are also not constrained by what the general was talking about before under Section 205. We don't need to solve the problem completely. We are able to go in and buy a couple of houses that are creating a severe problem and leave town. There may be some other people who are left. But the program is sort of an attempt to solve through acquisition and relocation. We have seen situations where we have bought a couple of properties, and two years later we are going to buy a couple more in the same community, in the same general neighborhood. To that effect, what we are doing is to create some serious damage reduction.

I would like to address a little bit later the question about solving the problem completely, because I have some problems with that. But I want to say a couple of things about our relationship to the Corps. We have had probably no case where we have done a 1362 acquisition where the area has not already been studied by the Corps of Engineers for some kind of a structural or nonstructural project. And, in almost every case, nothing has happened. The benefit-cost ratio was not considered to be favorable on the entire project or there was some other problem in terms of getting authorization on the proceeding. We have been criticized by the Corps because we buy the most flood-prone properties in an area, and we have been accused of reducing the cost-benefit ratios for larger projects because we have taken out essentially the cream of the crop. I can also say in response to that, that we are concerned about that and want to find a way of working with you on putting together larger projects, but our annual budget is \$5 million; I don't know what your annual budget for public works is, but I am sure that ours is a drop in the bucket, and I don't think that's a problem for you.

As far as solving problems to our program, I think something you need to keep in mind in looking at relocation is that relocation is rarely, if ever, the only strategy that you can undertake in a specific flooding problem to solve the problem. You almost always have to accompany it with some other actions. One of the things we recognize is the importance of not only the flood plan in those communities where we're moving properties, but watershed management in those communities. In the city of Mobile, we had more properties last year and we are going to buy some more properties this year. But only after we require the city of Mobile, as a condition of our buying the properties, to adopt a comprehensive watershed management program. So the problem is not going to get worse as the watersheds in the city develop. We feel that it would not be worth our investment to do anything unless this were happening.

One final note: I feel very enthusiastic with our program, and I think it is accomplishing good things, but we are fighting, I think, some of the same kinds of battles that you are fighting in the Corps, to make a relocation program effective. We have also, in the Office of Disaster Assistance Programs, our program of public assistance, where, after a flood occurs, if a person declares a disaster, we can go in and help rebuild the community public facilities including police stations, fire stations, libraries, public housing, and any kind of structures owned by the community. We pay for reconstructing these things on a 75-25 basis; we pay 75 percent. We have a provision in our law that allows us to provide money to the community instead of a new building, so they can take the money and build a new building someplace else outside the floodplain.

Now, this is feasible, but let me tell you what the restrictions are. If a community decides to rebuild outside the floodplain, we will only pay them 90 percent of the 75 percent that we would have paid, and, in addition, that does not include any compensation for the land. It is only the damaged structure. So, by the time you look at all the cost involved, we are really not offering much of an option of a relocation ourselves. And this is a problem we are dealing with as well.

WILLIAM HOLLIDAY:

We will follow the AOC planning. I hope that when you receive the proceedings of this seminar, the first thing you do is turn to Chuck Simpkins' presentation and reread it thoughtfully. I think the implications are that we need to completely reassess the way we approach flood problems. I think that our 1936 evaluation procedures aren't applicable to the 1980s. We have got to do something about it. I agree completely with everything Chuck said. I think you need to think more deeply about it and to understand what he is trying to say even better. Let's go down this listing of problems Chuck talked about--which he said he didn't want to talk about; but, in a way, it represents what I think is the tragedy of floodproofing.

The problem Chuck talks about is structuralism versus nonstructuralism and interfering with people as opposed to changing nature. It is easier to change nature than it is to become highly interrelated with people and try to interfere with people, to deal with people in their nonstructural problems. I think we have to help folks live with nature. I think sometimes it would be much easier to think of the structural solution; to visualize the dam over here. That is more easy to conceive of. The nonstructural plan requires a lot more intimate relationships with people and a lot of combinations of a whole lot of things coming together.

The other day, Larry Larson, I think, mentioned the difference in resources in his part of the country, I believe in Wisconsin, versus the far west. Let's think in terms of people differences, too. I think there is a vast difference in people in different regions of the country. I know the people in Appalachia are probably totally different from the people in Wisconsin. And they would relate to the kinds of programs that we would suggest totally differently from how the people in Wisconsin would. I think we have to keep that in mind. We have discovered, however, that the Appalachian people are willing to accept change and to do things to help their way of life and to help their situation. If they are given some help, they are willing to volunteer to do better.

Getting down to the problem with accounting, I think we have to find some way of allocating costs out of flood programs in today's real world. We just have to do that. I agree with everything Chuck said about the evaluation in that regard. We have to consider the financial implications of all of our economic evaluations. I think that is critical. We have to keep on doing it. The problem with insufficient flood damages. We have said that the benefit-cost ratio discriminates against the poor. There was a proposition I have heard batted around a couple times that may have some merit in an evaluation. When we are evaluating residential damages, maybe we should assume that each house we are looking at, regardless of its value, is really a HUD standard decent sanitary house as a certain value. It doesn't make a difference whether it is a \$4000 shack, we assume that is a HUD standard house and part of the damage relationship for that house is, if it were a standard house, that's what we would use for a damage. Otherwise, we are discriminating against poor people. It is ridiculous. And the only reason they are poor is because they had the flood problem in the first place. So, how are we helping them? "Well, folks, if you owned \$100,000 houses and didn't have a flood problem, we would

probably be able to help you." But if you look down on this low-lying valley community, the house isn't worth anything. There is nothing they can do for you. I think their whole thinking is upside down. When it gets into federal assumptions, in economic research, I can't resist saying this, if it hadn't already been said during the conference, but, to economists, the real world is a special case.

In a voluntary program, and we are speaking of voluntary relocation programs, you have to start thinking in terms of participational rates, and you would have had to do a good social analysis to determine and to project and anticipate exactly what kind of participation you will get and how fast--no matter what circumstances--are they willing to participate. All of those things are essential, and all of those things have been considered in some studies in the country; everyone here should be aware of that.

I don't know how many housing experts or how many community planners we have in here, but I don't think we have enough of them. The problem is there, in PL 91-646 in the Tug Fork area; there is no housing available. You have got to relocate 2000 families off of a floodplain, and there are not 20 houses available there. So then you get into the situation where, therefore, there is last resort housing. Last-resort housing is a mechanism for a guy who wants to undertake some federal project. He could use last-resort housing or forbid the 91-646 to pay for building his house, to build a new community, to do anything. We are talking involuntary program. Down there you can't just go out into some non-floodplain area and live, because there is no non-floodplain area, because it is 40 percent slope. So, you have to construct a place with a lot of development cost, a lot of subsidy. That makes the unit cost for each of these structures extremely high. Yet, we are saying we are going to do it under flood control and we are going to say we are flying high on 646 and that is how we're going about it, and we don't even include it in the economics. And it's only going to cost one-quarter of a million dollars a unit. But, after all, we aren't going to have to count a lot of this in the economics, so it doesn't make any difference. So you take the program over and propose it at the secretarial level, and they obviously are going to laugh you out of the office, because we are not dealing with the situation, we are not dealing with the problem. I think that everybody in the Corps, from the district, division, IWR, and the chief's office asked about it.

DALE KLEMME:

I have a different angle on this whole subject matter. Four years ago, I had no idea that the Corps really was involved in much of anything. I mean, it's just something that was there, but you're just not aware of it. I would guess that three years from now, hopefully, I will have that same attitude, because I will be ending the relocation project at Prairie du Chien shortly. I think we are getting into some interesting problems here.

We don't understand the process. We don't understand the solutions and, certainly--stemming from what we have been dealing with in the past, even though I have only been associated with the complete nonstructural acquisition relocation phase of the project--I feel quite uncomfortable with the matter at

times. I certainly don't understand the coalition fully enough to comfortably argue the merits of B/C analysis, economic analysis, structural and nonstructural, and that sort of stuff.

But I do have a feeling that there is something wrong here. I can't put my finger on it; I can't argue it. But I don't really think we attacked the problem. Perhaps the problem is too big for us to attack in such a small type program, anyway.

My personal background is not in engineering, it's not in the economy, it's not in the social field; it's in business administration and accounting. So I can't fully understand, in that respect. You give me a set of five numbers and you tell me what song you want me to play. No problem. And do I have another song? Rearrange the numbers some more. I am not going to change the numbers, per se; I am going to use the same digits. But I am going to make them speak a different tune. So I can understand the room for abuse, if you will, in dealing with our standards of economic analysis. So I guess I can understand that abuse to such an extent that there are many times that I question whether or not the project which is totally an acquisition relocation is economically feasible. I am not sure it is economically feasible. I have an even greater feeling, though, that the dam project, the \$60 million total structural project up the river, certainly was not feasible.

How to justify the benefit-cost system, I am not sure. That is not to say that we will see in the future that there were more benefits there than what we had initially figured and finalized. I think they are going to materialize, but they were too mushy up front to handle that. So the project itself is good, but four, five, or six years ago they don't know if we are in a position to actually say that positively. If you look at that from a purely business accounting type background, what I think we might have to do is take a look at an entirely new system here. And I am a bit reluctant to suggest the group of people that would devise that system, partly because of the fact that we are biased in our values; our knowledge is in one specific area. It is hard, then, after you've become attached to the system, to be able to objectively erase it completely from your mind and start off cold. But I think it certainly needs to be adjusted and proven that we need discipline, but we have to make sure that the people that are dealing with this matter have a very objective manner.

Two items I want to comment on that somebody earlier talked about. Structural projects are easier to deal with simply because they don't talk back, they don't throw public meetings on behalf of the environmental society. And the other thing that we had mentioned here earlier, also, is that, as Larry Larson has mentioned, problems in different parts of the country are different; likewise, people are different in different parts of the country. I don't think that's the case. I think people, when dealing with the types of things that we are dealing with here, are the same all over. They want to be dealt with in a manner that is respectful, fair, and sensitive, and they want you to show that you are attempting to understand their personal situation and problem. These are universal traits of people, and they need to be incorporated in any solution.

WILLIAM JOHNSON:

I think that is an excellent example of just the difficulty of nonstructural versus structural, because, if it were a structural and assuming no wiping out of environmental features, we just run a levee right along the front. Right? We don't have to go in and talk to the people, so to speak. We don't have to anguish that difficult problem of, "Some of them want to do this and some of them want to do that." That's a tough chore. We are not sociologists or public relations people; we are engineers, and it's tough for us. But we are going to do it. We are going to do the very best job we can.

THE ST. PAUL DISTRICT-IWR  
PRAIRIE DU CHIEN INTERIM  
EVALUATION STUDY

By:

David J. Miller  
Charles E. Simpkins  
Jody L. Rooney  
Vera L. Golenzer

## FOREWORD

This speech presents the results of the St. Paul District-IWR, "Prairie du Chien Interim Evaluation Study," which will be published in Spring, 1983. Because the substance of my presentation is based on the work of the entire study team, they are listed as co-authors of this paper. Dr. C. E. Simpkins of WRSC-IWR, is the study co-director. Ms. Rooney and Ms. Golenzer of the St. Paul District, performed the economic study and relocatees survey, respectively.

David J. Miller

## Introduction

This presentation varies from most given at the conference, since its' topic is a case study of a major relocations project. An evaluation of the partially completed Prairie du Chien project is being conducted by the St. Paul District and the Institute for Water Resources. This speech presents the preliminary results of that study. The study is scheduled for completion in the Spring of 1983 and may be updated following project completion.

The format I will use in this presentation involves a very brief background of the Prairie du Chien project, followed by a similarly brief description of the factors leading to our Interim Evaluation Study, and a description of the study design. The major focus of the presentation will be on the preliminary findings and conclusions of the study. The last section of the presentation will identify suggestions for future planning and research for nonstructural projects, in the form of "lessons learned" from our evaluation study.

## Project Background

Prairie du Chien is a community of 5,900 persons, located in southwestern Wisconsin, near the confluence of the Wisconsin and Mississippi Rivers. A portion of the city is located on a small island in the Mississippi River floodway, known as St. Feriole Island or, locally, as the 4th Ward. The 4th Ward and a narrow strip of land on the mainland lie within the 10 percent chance flood plain, suffering frequent and extensive flood damages. Major floods occurred in Prairie du Chien during 1952 and 1965, then continued at roughly 2-year intervals thereafter (1969, 1971, 1973, 1975, etc.).

After studying structural alternatives for several years, a nonstructural plan was recommended for authorization in 1976. The authorized plan consists of mandatory permanent evacuation of 130 residences and two businesses in the 4th Ward and low-lying areas of the mainland. The plan also includes providing technical assistance for optional floodproofing in the remainder of the 1 percent chance flood plain, and continued flood plain regulation and flood insurance for that area.

The project was cost-shared, 80 percent Federal and 20 percent local, with the city using HUD Community Development Block Grant (CDBG) funds to finance their local share. Implementation of the project began in 1979 and is scheduled for completion in early 1984. The project is approximately 80 percent complete at present.

## Study History and Design

In 1981, the St. Paul District Engineer, Colonel William Badger, decided to perform an evaluation of the Prairie du Chien project to determine whether the project had been successful to date. Since the project primarily involved permanent residential relocations, the evaluation study focused on this plan component. Four major areas of effect have been analyzed:

- o Social and psychological effects of flooding and relocation on project relocatees;

- o Social and economic effects on the community;
- o Benefit-cost reanalysis and procedures evaluation;
- o Evaluation of implementation methods.

The decision to perform an analysis at that time, rather than after the project was complete, was based on a desire to obtain the attitudes and perceptions of relocatees while they were still reliable. If the study were performed as a post-audit, perceptual and attitudinal information would have been collected on events occurring five or more years earlier. The possibility for accurate recall over this period would have been slight. Therefore, an interim report strategy was used, recognizing that a post-audit update could be prepared following project completion if desired.

Following the initial study design phase, the Institute for Water Resources (IWR) was contacted to determine whether they wished to participate in the study. IWR believed that the study might prove valuable to nonstructural planning throughout the Corps, and agreed to both jointly finance the study and provide expert technical assistance.

Primary data gathering activities occurred during a period from May 1981 until June 1982. For portions of the study requiring data of total project effects (e.g. benefit-costs reanalysis), remaining activities were estimated, based on what had occurred to date. Therefore, conclusions concerning total project effects should be considered preliminary and subject to revision.

The remainder of my presentation will focus on the preliminary findings and conclusions of the Prairie du Chien Study and the implications these may have for future nonstructural projects.

### Study Findings

The length of my presentation does not allow for a complete description of study findings. Therefore, the findings will be summarized and limited to areas in which significant interest has been expressed. The results of our investigations yielded six major categories of findings, including:

- o Project support and acceptability
- o Effect of the local flood plain ordinance
- o Financial effects upon relocatees
- o Impacts upon the local housing market, tax revenues and public services
- o Benefit-cost reanalysis
- o Effectiveness of implementation procedures

## Project Support and Acceptability

The first issue, related to project acceptability, involved confusion about whether project relocation was mandatory or voluntary. Additional comments made on the relocatees survey indicated that 30 percent of respondents felt they had no choice about moving. While correct, these comments indicate confusion concerning the project. The first relocations were conducted using HUD CDBG funds. These relocations were voluntary and may have led to a misunderstanding about whether relocations conducted under the Corps project were voluntary as well. This confusion may have been compounded by the policy that willing sellers would be moved first.

In any case, this misunderstanding led to a number of relocatees perceiving that policies were being arbitrarily changed "midstream." This finding is closely related to another response which indicated that 42 percent of the relocatees would not have moved at the time if given the choice (26 percent had voluntarily decided to move beforehand). This represents a significant minority of project relocatees who did not support the project at its outset. If the project had been voluntary, a number of properties would have remained in the floodway.

In marked contrast to pre-project attitudes, post-relocation support was very high. Ninety percent of the respondents indicated satisfaction with the relocation process, 86 percent satisfaction with the acquisition process, and 70 percent stated satisfaction with the actions of the local relocations office. Overall, 80 percent of the relocatees stated that "knowing what they know now, they would participate in the project again."

An investigation of the reasons for project popularity also yielded interesting results. Several other expected effects were mentioned as often as flood control as major project benefits. Eighty percent of community leaders and 70 percent of relocatees saw flooding as a serious problem, while 98 percent of the relocatees had experienced flooding of their properties at least once. However, when citing the "best things" that had occurred as a result of the project, housing quality increases were mentioned as often by relocatees as removal of flood threat (50 percent each). Community leaders cited expected benefits to housing stock, tax revenues and reuse potentials more often than removal of flood threat. This is not intended to suggest that a significant flood problem did not exist at Prairie du Chien, but instead, to highlight the fact that a variety of effects normally considered secondary in the Corps formulation process, can be major reasons for project satisfaction on the part of local beneficiaries.

The last area related to project success involved local cost sharing and financial support to relocatees. Most community leaders surveyed stated that the project would not have been implemented if significant local financing had been required. Reasons given for this perception included: (1) Expected political pressure from nonflood plain residents unwilling to "subsidize" increases in the housing status of relocatees; (2) strains placed upon municipal finances by the method of project financing employed; (3) lack of appreciation of the flood problems by the majority of the community (only 8 percent of city housing is affected by the project). In the case of the need for the financial support to relocatees (i.e. replacement housing payments) the majority of residents believed they could not have afforded to relocate

without the financial assistance provided by the project. Reasons given for this perceived inability included low equity in their existing homes, lack of interested buyers, and a combination of low savings and low and/or fixed incomes, resulting in an inability to qualify for and subsequently finance higher value nonflood plain homes.

Overall, community leaders perceived the project as extremely successful. The vast majority of relocatees believed that the project was well carried out though a minority still would rather not have moved.

#### Effects of Local Flood Plain Ordinance

The local flood plain ordinance has generated considerable controversy in Prairie du Chien, based on its perceived impact on housing values and quality in the 4th Ward. The city signed the local flood plain ordinance in 1971, under considerable pressure from the state. Since then, both relocatees and community leaders have perceived the ordinance to have the following effects on the 4th Ward properties: (1) Prohibition of necessary repairs following damaging floods; (2) depression of housing values through the discouragement of sales and imposition of tight financing; and (3) prohibition of improvements and additions to properties. These perceived effects of the flood plain ordinance were viewed locally as at least as destructive as the floods themselves, as well as providing the "last straw" which convinced the city that the properties had to be removed. The project was seen as providing the only means for residents to financially afford to relocate and was considered by some as a form of compensation for damages caused by the ordinance.

As part of the study, an independent review of the ordinance was conducted, supplemented by interviews with realtors, the local assessor, and financial institutions. The results of this review did not support the impressions gathered from local residents and leaders. First, the post-flood limitation on repairs did not prove to be significant. The ordinance only prohibits improvements and repairs to major structural elements of the properties (e.g. walls, foundations, additions) in excess of 50 percent of the property value. It does not apply to normal maintenance and typically damaged items (e.g. insulation, floors, electric, furnace, contents, etc.). A brief review of building permits showed few applications for the 4th Ward, and no more than two that might have been rejected because of the flood plain ordinance. An expectation of rejection may have resulted in lack of building permit applications, however, there appears to be little substantive basis for those perceptions.

The unavailability of home financing was also unsupported by the independent review. Local lenders still provided financing following imposition of the ordinance, as long as flood insurance was also purchased. The ordinance may have resulted in less housing demand and lower prices by increasing the awareness of flood risk. However, the frequent, major floods that were occurring simultaneously were a more likely cause of depression in housing values. Decreases in housing demand and values, in our opinion, merely reflected recognition of the actual risks of flood damages to 4th Ward properties.

In summary, the local flood plain ordinance, while indirectly supporting the need for a long-term solution, was generally misunderstood and inappropriately blamed for many of the islands' problems.

#### Financial Effects of Relocation

A major concern of residents prior to relocation involved their abilities to afford new housing and its associated expenses. This was of special concern at Prairie du Chien, since 40 percent were 65 years or older. Therefore, an analysis was conducted to determine how they had fared financially, following relocation.

The survey of relocatees provided the following information. Sixty-seven percent of respondents reported an increase in cost of living. Major reasons given for the increase included: (1) An average increase of 400 percent in property taxes; and (2) increased costs for sewer and water services (most were on well and septic previously). Overall, 32 percent reported they were worse off financially, and 10 percent expressed concern over their ability to afford to remain in their new homes. The majority, however, believed that although their living expenses were higher, their new investments would not suffer risk of damage and their home equity had increased. Seventy percent of respondents stated they would feel safer making improvements to their new homes.

The economic analysis also provided information on financial status of relocatees. Overall, the project has provided an economic gain for participants. However, this increase in "wealth" has also required shifts from discretionary to obligated income in order to maintain their new higher value property. These increased problems for some, especially those who, due to advanced age and fixed incomes, did not have the necessary capital to maintain their new investments. In most cases, however, the greater "wealth" resulting from increased home equity has been a benefit.

#### Impacts on Local Housing Market, Tax Revenues and Local Services

Community leaders expected that increases in housing stock and tax revenues resulting from replacement of lower-valued flood plain structures with higher-valued floodfree properties, would provide the major local benefits of the project. In addition, city service costs were expected to decrease due to relocation of the 4th Ward. Subsequent reuse of this area was also expected to generate substantial new income. These effects were also expected to benefit the entire community, rather than only the 8 percent of households involved directly in the project.

The results of our economic study show that these economic benefits have not materialized. Housing stock impacts have yielded a \$2,000 decrease in the community tax base to date. Although the new homes are worth significantly more on a structure by structure basis, only 14 have been built while 65 older homes were demolished. However, one possible source of benefits could not be calculated. It proved impossible to trace whether individuals who sold existing homes to relocatees in turn built new homes within the city. If this

occurred to a significant extent, net tax base increases could have resulted. In any case, housing stock increases resulting from the project would be proportionally minor since only eight percent of the community housing stock was affected. Because of the insignificant effect on the housing stock, tax revenue changes were also negligible.

At this point in project implementation, city service costs have actually increased slightly. Road maintenance costs have decreased annually by \$1,200, while grass cutting costs have increased \$5,190, since the city must maintain the acquired parcels. Vandalism damages have also increased by \$1,450 annually, but should return to near normal or below once the two 4th Ward taverns are relocated. Maintenance costs in general should decrease should the city eventually return 4th Ward properties to private ownership. Currently, the only revenue generated by the now publicly-owned properties is \$300 in annual rental income.

Eventual reuse of the 4th Ward was not capable of being assessed at this time. The city had just developed a reuse plan for the island at the time of our evaluation, but implementation of that plan is not yet assured. Should the plan be implemented, the island would be developed for recreation and tourism purposes. This would generate additional income to the city, either through direct revenues (if publicly owned) or tax revenues (if in private ownership). A post-audit update of the project, if conducted, should focus on reuse as a central issue.

Another topic of interest involved whether anticipation of the project would affect local housing prices and construction costs. A number of the relocatees reported inflated prices and lower quality construction as project complaints. They also believed that local realtors had driven prices up when project relocatees came on the market. Community leaders disagreed, however. They stated that attempts were made by the city to avoid artificial inflation of housing costs and that "price gouging" was avoided as a result.

Our economic evaluation tends to support the perceptions of the community leaders. Houses in the community did "turn over" 30 days sooner and at an asking price (rather than the normal 10-15 percent discount). However, this appears to be a fairly normal response of the market to increased demand, and not major enough to suspect speculative pricing. Relocatees' perceptions of escalated prices may also have resulted from not realizing how the presence of a flood hazard had already discounted the relative value of their former flood plain properties.

#### Benefit-Cost Reanalysis

This phase of the study was generated by considerable interest in the issue of whether nonstructural projects can meet National Economic Development (NED) criteria for economic efficiency. Controversy has existed in this area for some time, with primarily two schools of thought expressed. The first states that nonstructural projects are economically inefficient by their very nature. The second school asserts that nonstructural projects are good economic solutions, but suffer under traditional analytical procedures which were designed to evaluate only structural solutions. Our reevaluation has attempted to provide some substance to these contentions by recalculating the

benefit-cost ratio at Prairie du Chien, and also be presenting several suggestions for alternative methods of evaluating project costs and benefits.

At the time of the Phase I GDM, the benefit-cost ratio for the project was 1.12, using the authorized discount rate of 6-3/8 percent. Our reanalysis used the same discount rate, reanalyzing both costs and benefits. Before proceeding to the reanalysis, I would like to caution, however, that our reanalysis is preliminary and still contains estimates of remaining costs and benefits based on those observed to this point. Reanalysis data was gathered in late 1981 to early 1982, at which time the project was approximately 80 percent complete. The reanalysis is compared to the original analysis made in 1976 for the February 1977 Phase I General Design Memorandum (GDM).

Presented below is a comparison of project costs, followed by a reanalysis of benefits.

#### Cost Comparison

<u>Cost Categories</u>	<u>Phase I GDM</u>	<u>Reanalysis</u>	<u>Change</u>
Total 1st Costs	\$5.93 million	\$4.6 million	-\$1.3 million
PL91 Payments (Financial costs)	\$2.52 million	\$0.89 million	-\$1.63 million
Economic Costs	\$3.41 million	\$3.71 million	+\$0.3 million
Average Annual Costs	\$228,000	\$251,000	+23,000

The cost update shows some interesting changes from the Phase I GDM. Whereas total costs decreased the amount paid under PL 91-646 for replacement housing benefits (which are excluded from benefit cost computations), decreased even more. Therefore, both economic and average annual costs actually increased. Costs for the Phase I GDM were estimated from local assessments, while actual payments were made based upon appraisals conducted during project implementation. Since the assessment-based estimates were considerably lower than actual appraisals, the amounts paid under PL 91-646 for comparable safe, decent and sanitary housing were lower than originally estimated. This is why the costs used to compute the benefit-cost ratio increased, even though actual costs were less.

The next phase of the analysis was a reevaluation of benefits. Benefits, by category, were as follows:

#### Average Annual Benefits

<u>Category</u>	<u>Phase I GDM</u>	<u>Reevaluation</u>	<u>Difference</u>
Flood Control	\$123,750	\$177,450	+\$54,000
Residential	(\$115,750)	(\$169,450)	(+\$54,000)
Commercial	(\$ 8,000)	(\$ 8,000)	(0)
Public	(0)	(0)	(0)
Employment	\$100,000	\$ 29,100	-\$70,900
Recreation	\$ 15,750	\$ 15,200	-\$ 550
Floodproofing	\$ 15,000	\$ 1,600	-\$13,500
Flood Insurance	---	\$ 700	+\$ 700
Total	\$254,500	\$224,000	-\$30,250

Each of the benefit categories where major changes occurred will be discussed. First, residential benefits increased primarily due to increases in the appraised value of the floodprone structures. This increase in benefits, however, did not balance off the increased economic costs that also resulted.

The major changes in benefits occurred in the employment category. Employment benefits are the expected increases in output of goods and services from the use of unemployed or underemployed labor (in a Department of Labor designated "labor surplus area"). These benefits decreased for the following reasons. First, benefits decreased by \$22,000 annually, due to decreases in overall project costs. Since employment benefits are calculated based on project costs, this change would be expected.

The remaining \$49,000 change is not as easily explainable, but appears to result from two factors: (1) inability to trace some local employment effects; and (2) shortcomings in the estimating procedures used in the Phase I GDM. Our attempt to actually track project-caused employment proved quite difficult. Project-induced employment is relatively easy to verify, if it accrues to a small number of fairly large firms. If this were the case, changes could be determined by increases in employees, overtime, payroll, or a combination of these factors.

In fact, the majority of the observable employment benefits did come from one local employer, a factory-built home manufacturer. However, most of the project employed firms were small, one to five person companies. It proved very difficult to determine whether these firms would have been productively employed in the absence of the project. Also, as one of the small businessmen interviewed described, project implementation occurred just prior to a slowdown in local construction. This also made traceability of employment effects more difficult. In summary, for those projects which result in employment of small firms, verifying actual levels of employment will be difficult, and generally will yield lower levels than on projects using fewer and larger firms. This is a somewhat ironic conclusion, given the government's policy of employing small and disadvantaged firms.

The second factor resulting in lower observed employment benefits involves shortcomings in the procedures used for the initial estimate. Corps procedures for calculating employment benefits have been suspect for some time and were most recently highlighted as a problem area in the U.S. Army Audit Agency's "Advisory Report on Benefit-To-Cost-Ratios," 8 October 1982. Estimates of employment benefit can be highly inaccurate depending upon the quality of assumptions made concerning yearly distributions of construction costs; percent of construction labor from the local market; percent of local hires otherwise unemployed; and the mix of skilled, semi-skilled and unskilled labor. Inaccuracies in any of these assumptions can result in significant errors in overall benefit estimates.

Calculation of employment benefits for a relocations project requires that additional assumptions be made. Total project costs, and especially labor costs, are much more difficult to determine because you must also estimate post-project housing mix. Specifically, the amount of labor required by the project will vary, depending upon how many relocatees will: (a) build new homes, (b) buy existing non-flood plain homes, (c) move their old homes out of

the flood plain, or (d) leave the area completely. This adds a significant potential for error beyond that which exists for a structural project.

In the case of Prairie, more new home construction was anticipated than actually occurred. The availability of a factory-built home manufacturer in the community was expected to result in a high level of new construction. This did in fact occur in the first years of the project. However, after several years the price of these factory-built homes escalated beyond the reach of most project participants due to the "explosion" in new home construction costs occurring nationwide at that time. In addition, the percentage of participants relocating within the area was less than estimated, based at least partially on infirmity or death of the elderly participants.

In summary, employment benefits were significantly lower than anticipated, due to: (1) problems of traceability, (2) inaccuracies in the procedures used for estimating, and (3) difficulties in determining future housing choices. Recently, WRSC-IWR has developed new standardized procedures for calculating employment benefits which should partially alleviate this problem. However, nonstructural projects will still provide a special challenge for benefit calculation in this area.

Another major change in benefits happened in the floodproofing category. These were benefits anticipated from optional floodproofing of structures in the residual 1 percent chance flood plain. As mentioned in the introduction, our study focused almost exclusively on relocations. Therefore, we can only speculate as to the cause for disparities in anticipated and observed benefits. The reasons for the small amount of observed benefit is that only three properties have been floodproofed to date.

Since project implementation, the city and HUD have developed a much more financially attractive floodproofing program. However, even this program is not being taken advantage of by potential participants. At least two reasons can be postulated for the lack of success in "selling" the floodproofing option. First, no floods large enough to damage these residual flood plain properties have occurred in recent years. Therefore, perceptions of risk, as weighed against the financial and nuisance costs of floodproofing, have not been very great. Second, the floodproofing programs have required that all modifications be made to floodproof the home to a foot above the 1 percent chance level. Individuals who might wish to only partially floodproof their homes (e.g. relocate furnaces, electricity out of basements) cannot qualify. In many cases the costs of floodproofing to the administratively acceptable level can approach the total value of the homes. The debt burden to the property owner is often unacceptable, given his expected return on investment and perception of risk.

The last item of change in benefits is small, but since it is an item not claimed in the original analysis, we will describe it briefly. The \$700 annual benefit for flood insurance in the reanalysis reflects the decrease in cost to the Federal Government from the administration of flood insurance policies. While small, this represents a type of benefit which is often unaccounted for in benefit-cost analyses. Although some Federal flood relief costs are occasionally included in benefit-cost studies (e.g. foregone flood insurance administration, PL-99 activities), a realistic estimate of these "damages" is not currently being calculated. This issue will be discussed at greater length in the "Lessons-Learned" portion of my presentation.

In summary, based upon our reanalysis, the revised benefit-cost ratio for the project is 0.89. This represents a significant decrease from the Phase I GDM level of 1.12 and is due primarily to: (1) an increase in average annual costs, (2) a decrease in employment benefits, and (3) a decrease in flood insurance benefits. Again I would caution that our reanalysis, while primarily based on observable results, also includes an estimate for work not yet completed. However, it does reflect the best preliminary reassessment that could have been made at this time.

One additional activity that would have greatly helped our reanalysis would have been a small scale, ongoing monitoring process. A number of the economic effects that proved untraceable (e.g. small firm employment changes, secondary housing construction) would have been much easier to ascertain if monitored throughout project implementation. A modest (i.e. \$5,000-10,000/yr) construction phase monitoring activity could provide future planners with excellent data for formulating similar projects in the future.

### Effectiveness of Implementation Procedures

This is the last major category of findings and conclusions and involves a review of several management policies which guided planning and construction activities. Planners responsible for future nonstructural projects will be faced with similar decisions, and can presumably benefit from our experiences at Prairie du Chien. Although we cannot presume that our experiences are general enough to direct policy setting, still an assessment of how well these procedures worked may provide information to support those decisions.

We analyzed three implementation procedures which appeared in retrospect, to have been important causes of project successes or shortcomings. These included: (1) the method used for project financing during construction; (2) lack of development of a federally sponsored flood plain reuse plan; (3) local-based management and control of project implementation.

Prior to project initiation, a decision was made to finance construction activities by requiring the local sponsor (i.e. city) to pay all project expenses as they occurred. Subsequently, the Federal Government would refund their 80 percent share of the costs once each expense was approved. For those unfamiliar with how Corps projects are normally financed, I will provide a brief description. In the typical case, ongoing project financing is a Federal responsibility. The local share is normally required as a lump sum payment made at initiation of construction. In some cases the payment is made later when activities that are a local responsibility begin (e.g. lands, easements and rights-of-way acquisition). Occasionally local sponsors may pay 100 percent of a project feature and be reimbursed later (e.g. by a "215 agreement"). However, this is fairly unusual and generally never extends to the total costs of the project. Therefore, the financing method used for the Prairie du Chien project was, to my knowledge, unique.

The method used at Prairie du Chien can create several serious problems for a local sponsor, including: (1) lost opportunity for investment of funds now required for project operating capital; (2) potential for unreimbursed expenses if the Federal sponsor determines that expenditures are inappropriate; (3) delays in reimbursement while repayment requests are

reviewed and approved; (4) confusion over responsibility for and ownership of interest expenses and payments on loans and savings accounts; and (5) local political pressures resulting from the requirement to approve local financing on a yearly basis over the project construction period.

The Prairie du Chien project was not jeopardized by these shortcomings, primarily because their HUD CDBG funds provided the necessary operating capital. However, a number of problems have occurred which might have been avoided if a different method of financing had been used. But without the HUD CDBG funds, it is unlikely that a community with the limited financial resources of Prairie du Chien could have afforded the long-term financial commitments required by this method.

The second implementation matter to be discussed is the failure to develop a federally sponsored flood plain reuse plan during plan formulation. The reasons for not developing a reuse plan as part of the authorized project were at least partially due to reticence on the part of the local sponsor. But for whatever reasons, this failure resulted in several negative consequences. First, the potentially significant economic benefits resulting from reuse could not be determined because a specific plan was not established. Next, because the Corps did not participate in reuse planning, it is not possible to assure that the redevelopment will be compatible with project flood damage reduction goals.

The third area of implementation procedures to be discussed involves local-based management and local control. The first issue addresses whether it was a wise decision to manage the project from a base in the local community, or whether management from a remote location (e.g. Corps' District Office) would have been preferable. The results of our surveys of relocatees and community leaders indicate that locally based management has been one of the key determinants of project success. Reasons cited for this belief include: (1) greater ability of a manager located in the community to develop the trust and confidence of potential relocatees; (2) greater accessibility to relocatees requiring relocation services (e.g. new home search, information on relocation rights and requirements, etc), (3) greater ability to supervise and direct the work of construction contractors; and (4) increased accessibility to the local sponsor. The summary perceptions of the local community appeared to be that the relocations services provided were the most important factor in relocatees' satisfaction with the project, and that these services could not be provided as well from a remote location.

The second issue concerned whether field management of the project should be conducted by the local sponsor (as in Prairie) or by the Corps. Results in this area were more mixed. The majority of local respondents to our surveys again believed that management should be the responsibility of the local sponsor. Reasons given included a belief that local control would be more responsive to the needs and interests of the relocatees, in addition to the same reasons given for locally based management. However, when questioned whether a Corps employee who was permanently based in the community could do as well, most community leaders believed it was possible, provided that individual was trained in relocations assistance techniques. A concern remained, however, that a Corps employee, when faced with inevitable conflicts between relocatees needs or problems and agency interests, would support the agency perspective. They believed that the relocations director position

should serve as an ombudsman for the relocatees, not the government's interests.

Several considerations supported the opposite view, i.e., that Corps control (locally based) was preferable. The factors included: (1) a Corps employee could manage Federal funds directly, avoiding a number of the local financing problems; (2) a Corps employee would not be as vulnerable to local political pressures as a locally employed manager; (3) a Corps employee would have greater credibility with the Corps hierarchy when attempting to resolve implementation problems. Another concern expressed by one respondent was that while Prairie avoided a number of conflicts of interest and price escalation problems, these have a high likelihood of occurring with a project of this scale. The impression given was that a locally based Federal employee might provide a checks-and-balance function monitoring whether the local housing and construction market was artificially inflating prices to the detriment of project participants.

In summary, locally based management appears to have a number of benefits and few, if any, detriments. The superiority of local control is less apparent. However, should Federal control be used, the personnel employed should be carefully selected, based on their abilities and training in relocations assistance.

#### LESSONS LEARNED FROM THE INTERIM EVALUATION STUDY

Three areas of "lessons learned" will be discussed in this last section: (1) adequacy of benefit-cost analysis procedures; (2) relationship between reuse planning and project effectiveness; and (3) summary perceptions of project success.

The adequacy of current procedures for calculating the benefits and costs of nonstructural plans appears questionable. First, preauthorization cost estimates are based upon projections of residential market values in the future, for both flood plain and available nonflood plain housing. Estimating real estate acquisition costs (and PL 91 payments) had always been difficult, but normally overshadowed by more extensive materials and construction costs for structural projects. For nonstructural projects, where real estate requirements represent the majority of costs, the potential for significant deviations increase. Research into alternative methods of cost projections would greatly enhance future nonstructural planning.

The second major area of concern in the benefit-cost analysis is projection of employment benefits. As mentioned earlier, the procedures used to date vary greatly and yield benefit estimates of questionable accuracy. WRSC-IWR has recently developed a new procedure as a result of a nationwide "construction workers survey." We would suggest that post-audit investigations be performed on projects which use this new method in order to verify its accuracy and provide data to support "fine tuning" of the methodology.

The third major shortcoming observed in the benefit-cost analysis involves the method used to calculate damages. The primary focus of damage analysis has been on physical damages to structures and contents. Proportionally, little attention has been placed upon damages resulting from public sector

payments to floodprone properties. Although benefits are taken from foregone flood insurance administrative costs and PL 91 activities, the results of our study suggest that these costs only reflect a small portion of Federal payments to flood plain properties. Several attempts have been made on other projects to quantify public support payments to flood damaged areas, most notable by WRSC-IWR on the Tug Fork Valley and Lake Elsinore projects. These studies have shown significant levels of public support payments not previously accounted for in the economic analyses. We attempted to trace the amount of these payments in our study as well. However, the last major flood which resulted in a disaster declaration occurred in 1965, and public records are only kept for 7 years. Therefore, public support payments were not directly observable.

As a next step, we attempted to determine whether an indirect means was available to identify these payments. Presented below is a draft method we would recommend for further study. Briefly, the background for development of this method is as follows. As mentioned earlier in the benefit-cost reanalysis, one of the significant changes that occurred was the decrease in PL 91 costs which resulted in an increase in average annual costs (even though total costs decreased). The major cause of this change was a substantial increase in values paid for properties beyond original estimates. There are three possible explanations for this change in structure valuations: (1) the Phase 1 GDM estimates based on assessed value were incorrect; (2) the actual payments made based upon appraised values were incorrect; or (3) the previous two valuations were not considering the same variables. Our study tends to support the third conclusion. The initial Phase 1 estimate based on local assessments considered the level of potential flood damages in arriving at a valuation of the properties. This is one reason for why property taxes have risen 400 percent for relocatees, even though the proportion of PL 91 payments to purchase price is much less. The appraised values used to determine purchase price did not devalue the properties nearly as much.

The explanation for this apparent contradiction may be that the market place recognizes that a significant proportion of the flood risk is being borne by the government rather than the property owner. Government programs providing emergency relief to flooded areas transfer a significant amount of the potential risk from the property owner to the government. If this is the case, the market place, over time, will adjust housing prices to reflect only that proportion of the damages which the purchaser would bear. Thus, a significant portion of public damages is reflected in the appraised value which is used to determine the benefit-cost ratios.

It is not our intent to question whether government emergency assistance is a wise policy. However, we do question whether it is appropriate to reflect the costs of that program as project economic costs. If the nation has made a decision to provide those programs based on considerations other than economic (i.e. social welfare), then we would suggest that the costs of those programs be excluded from our economic analyses (like PL 91 costs which are currently excluded). Presented below is a preliminary methodology we have developed to identify the increase in market values resulting from Federal emergency assistance support.

## CAPITAL RELEASE BENEFITS

Benefit evaluations in the past have overlooked a significant benefit to be gained from proposed flood damage reduction plans. That benefit is the release of federally committed investment capital which is currently being used to rate subsidize flood plain developments for use in more attractive investments in the private sector. This benefit can be measured by quantifying amount of risk assumed by the Federal Government, i.e. their willingness to invest in maintaining unprotected flood plain occupancy and the difference between the rate of return expected by the government versus the rate of return required in the market place. The minimal rate of return is defined as being equal to the opportunity cost of capital in the respective sectors as determined in the current interest rates in the respective sectors. Any proposed flood damage reduction plan which would reduce the amount of risk assumed by the government would allow investment capital to move toward more profitable activities. The difference in the rate of return is the capital release benefit.

The amount of risk assumed by non-flood plain users is area specific. It can be quantified by analyzing the market values of flood plain structures. Expected annual damages to a unit are the quantifiable risks of being in the flood plain. The extent that these damages are reflected in the market value or purchase price of a structure indicates the extent to which the owner of that structure is assuming a risk. The difference in the actual market value of a structure and its full risk assuming market value is the subsidized risk, assuming market value, is the subsidized risk.

Assumption of this risk by the Federal Government in the form of subsidized flood insurance, disaster aid programs, etc., is a commitment to continued capital investment at a lower than market rate of interest. The risk investment assumed by the government at the amortized Federal interest rate subtracted from the total subsidized investment amortized at the market interest rate is the capital release benefit of Federal action.

We recognize that this methodology is still in the development stage. Questions which must be resolved prior to its application include what the appropriate discount rate is, and how to determine remaining economic life. However, we do believe that application of this method, once refined, would resolve a potentially major shortcoming in current methods. Therefore, we suggest that additional research be done on its development and potential policy implications.

The second "lesson learned" is in the area of reuse planning. While reuse potential can be a major project benefit, the question of whether reuse is consistent with flood damage reduction remains unanswered. Clearly, reuse of vacated lands, if wisely planned and executed, can result in a higher use of the property (and hence provide economic benefits). However, reuse may also result in additional flood damages. Even "if" the reuse plan adopted is in compliance with appropriate flood plain regulations, damages can still occur. This potential conflict between reuse and the flood damage reduction objective did not arise at Prairie du Chien because a reuse plan was not developed. However, a policy study on this issue might help to avoid potential conflicts on future nonstructural studies.

Our final area of "lessons learned" involves some summary perceptions of project success. As stated in the earlier section on study design, our evaluation study was structured to address four major concerns about Prairie and nonstructural planning in general. The first concern was related to social and psychological effects. Otherwise stated, was this relocation project socially acceptable? The answer to this question is clearly, yes. Perceptions of project success were quite high and would, no doubt, compare favorably with those of most structural projects. Some participants would have rather not moved, as would be expected. However, the majority of them still believed the project was managed well. Based on our case study, there is little support for the generalization made by many that nonstructural projects are socially unacceptable and therefore, do not deserve more than cursory treatment information.

The second major concern driving the study involved community social and economic effects, or whether a nonstructural project generated more local development and infrastructure benefits than a similar-sized structural solution. Clearly, our case study did not identify significant benefits in this area. Perhaps these anticipated benefits will occur once construction had been completed. However, no significant changes in the local housing stock, tax base, or service structure have occurred to date.

The third major concern involved the benefit-cost analysis and could be paraphrased as "Are nonstructural projects unfeasible, and if so, why?" A traditional recalculation using current data was conducted and yielded a benefit-cost ratio below unity. Cost and benefit breakdowns were provided and their accuracy assessed. Potentially major inaccuracies and/or omissions occurred in the areas of employment benefits, reuse benefits and public benefits. These were discussed, but not quantified. We would suggest that they be quantified if an update of this study is done following project completion. Otherwise, the research needs identified earlier will help to ascertain whether additional emphasis on these benefit categories would be fruitful.

The last study concern involved several implementation procedures which were evaluated for their potential application to future projects. We recommend that the financing method used for Prairie du Chien not be employed elsewhere, if possible. Locally-based management proved very important to project success. Local sponsor control of project implementation was less clear cut. However, if government control is chosen, our results suggest that employees be locally based and trained in provision of relocation assistance and counseling services.

It has been my personal pleasure to both work on this study and to provide its preliminary results to you. The final study report should be available in late spring 1983 and hopefully will prove useful to future nonstructural planning in the Corps of Engineers.

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References used to support the Prairie du Chien Interim Evaluation Study are available from the author, on request.

PANEL XII, FOLLOWING MILLER ADDRESS

DALE KLEMME:

I got carried away last time because there were so many areas I would like to talk about on this subject matter. So I think what I will do is keep it very brief and field questions.

I would like to just give you a feel as to what we have here, also, and that we probably have the oldest nonstructural projects this relocation project -- probably older than any structural project that we are aware of. Praire du Chien is a very historical place, first settled by the French as early as 1680. By 1800 there was a fort located on the island, on the site. That fort was occupied by the British during the War of 1812. After the War of 1812 it was burned to the ground and another fort was built in its place. In about 1829, Zachary Taylor was the commander at the fort. A fellow by the name of Jefferson Davis was serving under him and later married Zachary's daughter. It was on the society page there. Zachary Taylor decided at that time -- I understand that he was quite a builder -- that the low-lying area was no place for a fort. They had problems with the periodic flooding, they had problems with malaria and everything else. He decided that he was going to move the fort. So he picked higher ground up on the mainland to move the fort, and at the same time he made an offer to any of the residents on the island: "if you want to move with me to higher ground, the Army will pay for your cost." And it seemed at that time there were about 10 residents who took him up on it. And sure enough, he built them structures on the mainland. So this is probably the longest ongoing nonstructural project, or any type of project, that we have seen. Hopefully, we will be able to deal with the task that they started 150 years ago.

I was not local before this project. I am now. I don't know if someone who had lived in the community from day one would have been able to gain the confidence that I have, without being fearful of having the word spread around about this, that, and everybody's else's financial affairs. I assume that you don't talk about other people's information. But when I knocked on my third door (this was my first go-around), I didn't have to introduce myself. I didn't have to tell them what I was there for. The people up the road had already called and given the whole scoop as to what I was there for, and what I was going to say, and what I was looking for. So the word travels fast, and -- by the way -- if you get to understand most kinds of rumor in communities, it is probably a more effective way to communicate than a radio or the newspaper.

A few quick items on relocation acquisition. A lot of emphasis is on acquisition and, for the most part, that is what this organization is all about, rather than relocation. I think I got it backwards. Although acquisition normally comes first in an acquisition relocation process, people are very hesitant to even talk about acquisition unless they feel that you have a good fix on what they're going to be led into. They don't want to be left out. So you approach the community, you get a few things you might figure will fit into the price range without knowing what the appraisal is, and when they feel that there is something out there for them, the acquisition is sort of a false

alarm. The people that we are making offers to think that's a very low price, but they can see somehow that this whole picture is going to fall into place. So you have to be a little tactful in that matter, I guess.

Floodplain zoning ordinance is very much a concern of the local people. Whether or not it actually did devalue their properties makes no difference; it's what they thought happened. Perceptions, rather than realities, that's what you have to deal with. It looked very suspicious, when in '65 they had a flood which they thought didn't have to occur or they could have minimized some of the damages. Five years later the city adopts a floodplain zoning ordinance which in their mind lowers the property values. Six years after that, the project starts out, appraisals are based on fair market value, the appraiser takes into consideration the highest and best use which is restricted by the ordinance. You don't have to be a lawyer to put it all together and say this has been a scheme since day one. I could say "no," that they are really unrelated, but people are rather picky on that. So you have to be very tactful with that, also.

ROBERT F. POST:

To use some of the words that were said yesterday, I am not a sociologist, but I could probably be one. I think that deserves another bit of recognition. If you don't have sociologists on your staff now, hire them. If you have them, use them. We believe in the St. Paul District that we can take advantage of them for projects such as nonstructural alternatives. Certainly, it has been proven to be that the case in analyzing the after-effects of the project. They were not present at the time the project was conceived. Instead, the project was conceived back in a time when everything was right for nonstructural measures. Also, there was a project manager at the time, by the name of Bill Pearson, who happened to have enough foresight and ability to work with people and get along with them and understand their needs and problems. I believe that we have a lot of project managers out there today who are exactly the same way. All they need to do is to have your support.

I think we need an affirmative action for nonstructural measures, and that affirmative action has to start and continue with our project managers. They need to have the courage and ability to meet with the public and to express to them the different options that are available for reducing flood damages, not just structural measures but nonstructural measures as well -- to be able to point out to them the advantages. We heard some of the things that Dave Miller said, that most of the benefits were not just flood damage reduction, they were also benefits in being able to increase their housing, their standard of living. These things have to be communicated to local interests for them to understand, in order to give nonstructural measures a chance. We need affirmative action in economic evaluation. We need affirmative action when it comes to the review process at our division level. We need affirmative action when it comes to approval of the project when it gets to OCE and the board. So, I challenge each of you to take on that particular task and do something with it. Be imaginative and try to make it work.

One of the things that was of particular interest to the district was the fact that we believed, prior to the evacuation of the fourth ward, that many of the

residents, because they were of low income, would not be able to afford the standard of living that was going to be placed upon them after evacuation. We did find out (and Dave mentioned some of the statistics) that 67 percent of those people that were evacuated said that they had increased their cost of living. Only 32 percent of those indicated that, after the fact, they analyzed their cost of living with damage reduction and thought it was still an increase in cost of living. One of the statistics that I don't think Dave mentioned, but I happened to have an opportunity to see as part of the data that were gathered, was that, I believe, only 10 percent of those people really felt that, after having moved, the increase in their cost of living was something they were going to have trouble maintaining. So that particular impact I don't think really did materialize where we thought it would.

Who administers the project, and where? We had some difficulties in the district in how the project was administered, mainly because, I think, it was different from what we had managed in any other one. As far as who was best to manage it from a local level, as Dale did, I believe that it worked out fine. I also think that most of the difficulties were just in changing from our normal method of operation versus what really took place. The presence of the community block grant program presented, I think, a unique opportunity for the citizens to be able to take advantage of having the project being portable. I think it could have been smoother had we done a better job of early on coordinating more closely with HUD.

#### SAM SANDS:

I am one of about 10 fellows that are called project managers. We look at these reports when they come to the Washington level; we sort of play the devil's advocate role. We look at the reports to see if they are somewhat consistent and play by the rules and this sort of thing. Nowadays we find that rules are changing very quickly.

For your information, I don't have a lot of background on Prairie du Chien, so I am going to talk a little bit about a more recent evacuation and relocation project. The Corps did a report on Village Creek in Birmingham, Alabama, to the chief. It is now on its way, I understand, to the secretary's office. This is one of the largest evacuation plans recommended to date. Some 574 structures are to be completely evacuated. The cost of the overall plan is about \$24 million. This would include some small structural portion.

In the economic area, the BC ratio for the nonstructural part of the plan was less than unity. The overall plan was greater than unity when you put in the small structural portion, although the two could have been implemented completely independently of one another. There were no recreational benefits claimed, strictly flood control. In the area of social acceptability, a structural plan was definitely preferred by the local interests. However, it was just too costly -- many bridges, as you might expect in an urban area, a highly developed area, and low value structures. It has been pointed out many times that if it had been \$100,000 homes, you would have probably had no problem coming up with a structural solution. It is typical.

A referendum was held in the area to see how local people felt about being moved out of their homes. There were four areas under consideration at this time, and one area was completely eliminated from the plan after the referendum. In the three areas that were kept, it was approximately a 70 percent yes votes; there were still 30 percent that said they didn't want to move. That concerns me quite a bit. I think 30 percent in a particular area strikes me as a large number. I don't know how they are going to handle that. I understand from what one of the speakers said, that we had one point at the GDM stage where about 80 percent changed their mind on this thing.

DAVID MILLER:

Eighty percent that did not want to move at that stage. That's switched around now. Probably 80 percent of them were happy with moving.

SANDS:

We are still worried about that 20 percent. It's a large number. Now, for Praire du Chien and other projects coming along, I would suggest that we use people like St. Paul District folks and Praire du Chien folks as consultants. I would agree with Bob wholeheartedly that you should involve the social research people to a much greater extent in the planning effort, to take care of problems like this 30 percent.

I noticed that there are very few bad things that have been said about engineers here, in sessions that I have sat in on, and I think that's encouraging. You know, I am an engineer. I don't think that the engineering or the economics are nearly as important in this type of endeavor, particularly in light of the hidden subsidies that you are talking about. Once you have done the engineering analysis and you know that you are not going into a structural plan, I think that you are really into a social arena.

DISCUSSION FOLLOWING MILLER ADDRESS

TONY LANIER:

I haven't heard anyone say anything about impact on community cohesion. When you move an entire community, what impact does it have on them as a group? They have all lived together and suddenly they may be dispersed. No one mentioned this, and I just wondered what happened at Prairie.

DALE KLEMME:

Early in the planning process the city and the Corps had decided that we should buy a two or three block area and move all the relocaters there, thereby preserving their cohesion in at least the sense of spatial contiguity. That threw everyone into an uproar, their perception being, "See, they want to put us in a cornfield on the edge of town because we aren't good enough to live in town with everybody else."

However I recognized the problem of available lots, so what we did early in the project was to buy a half a block. We divided it into six lots and we said, "If you wish, you can buy one of these at cost". Needless to say, they went like hotcakes. If you don't tell people they have to move there, they'll move there. If you say they can't, they'll certainly try. That first half block sold out so fast that we went out and bought a two and one half block parcel, made improvements, and we have only two out of 18 lots left. So, we've made that available to people who want to stay together.

DONALD DUNCAN:

You had to be a relocater to buy a lot, didn't you? They weren't on the open market?

KLEMME:

Yes, you had to be displaced by our project in order to buy any lot the city had acquired.

DAVID DAY:

We have the situation of Brush Creek, in Kansas City, Missouri. We had more than a 100-year flood in 1977 so we started a flood control study. After the first stage we had identified two areas as potential relocation areas. One was in an old and rundown neighborhood of houses about 50 or 60 years old. The other was in a much higher income neighborhood of fairly new houses of medium high value.

Some of these houses, in both areas, were in the 10-year floodplain. We took some pains to talk to neighborhood organizations in both areas and explained PL91-646. We tried to enlist some support for nonstructural measures and to find out if they were interested in relocation. We felt that we had them well informed.

We held our first public meeting. Representatives of both neighborhoods came and unanimously criticized relocation and told the DE they didn't want it studied anymore. He acquiesced and that was the beginning of the end for relocation as an alternative.

Now I'm hearing that after a project is carried out, folks are generally in favor of it. How do you get from one point to the other point?

KLEMME:

After moving an older house into a neighborhood, we were accused of "lock busting," among other things. But after the house was fixed up and people realized that it would add to the attractiveness of the neighborhood, that kind of resentment subsided.

In addition, one must tactfully choose the people who are to participate early in the project. Of the first 10 people, we could tell who were proud of their yards and houses. You want to get those because they're going to continue that pride and good appearance in their new location. They will set the standards and perhaps induce the acceptance of the project by others.

It is a tricky process. There's a lot of psychology and "reverse psychology" working and it demands lots of patience.

DUNCAN:

There's a similarity between nonstructural flood control and nonstructural water supply, which is water conservation. I believe you may have been at one of the workshops on water conservation. I want to reinforce the statements that have been made about how to make use of sociologists and other behavioral disciplines, because you run a very high risk, early on, in these kinds of studies. They can "turn people off."

You can take certain options in water conservation in the early public meetings, and you'll never get the people "turned on" again toward viable, reasonable water conservation options. Certain things just give people an Intransigent mind set. You have to know what you're getting into. In water conservation we stress the analysis of peoples value's and interests. We do that before we set forth any proposals. We know we may only get one chance.

Some communities have voted their city councils out of office for proposing the "wrong" water conservation measures. That same city now has many water conservation measures, some of them of the same ilk as those originally proposed. I think you run the same risk in studies contemplating relocation, which is often a highly emotional issue.

CHARLES E. SIMPKINS:

That is a point I meant to stress in my talk. I don't think sociologists or other behavioral disciplines should act in lieu of engineers on grounds of the nature of the project. But in the spirit of interdisciplinary planning strategy they should often serve a strong adjunct function in designing and executing the study, as Don Duncan has implied.

What we sociologists are trained to do is to get into the community, to discover the patterns of human organization there, what values inhere that created those patterns in the historical process, what perceptions exist, and how those perceptions are distributed among people of varying characteristics.

As you begin to work with that adjunct discipline supporting you, what you can do as a "redesigner" of some aspects of the social system will become apparent to you in the process of social inquiry and analysis.

Don't feel that you have to abdicate from the engineering-planning role in these nonstructural plan situations where questions of values, perceptions, organization, preferences, and probable behaviors count heavily. Instead, learn to be confident in interdisciplinary partnership with sociologists conceptually and methodologically trained to study those aspects of reality and motivated to do teamwork with engineers and economists in delivering a public service.

KLEMME:

I came into a situation where the plan was already developed and approved. I wasn't involved in the planning process. My job is to implement. My job is to make the planners look good. You can make a good plan look bad with poor implementation. You can make a bad plan look good, too. But the odds on the latter aren't in your favor.

Allow some flexibility to implementers to adjust to peculiar things that might arise. Then let those responsible for implementing run with it.

ANNABELLE MOTZ:

I want to say that I'm very impressed by the report of David Miller on what has been going on at Prairie du Chien. I'd like to point out that I say an "Amen" to what Chuck said about involving social scientists' knowledge and approach to learn about a community.

I'm a sociologist who got into the Prairie du Chien planning process at the very beginning. There were a number of situations going on there that were interrelated. I think the Corps did a magnificent job working with the local administration. There was a receptive mayor at the start who was actively involved. I also think the Corps personnel took a sincere interest. As a matter of fact, one of the original people involved was a historian who knew a good deal about the social sciences.

Often, when you get a group of people together to announce a project study, you are bound to run into an opposition component. These initial meetings have to be held very carefully. If you meet repeatedly you'll find that after people have vented their anger they'll usually sit down and negotiate. Not always, but usually, their mode of dealing with their problems and you changes toward problem solving. When this happens you should already have a background knowledge of the community to help you respond with appropriate civil engineering solutions. I think Prairie du Chien is an excellent example of nonstructural workability.

I suspect, though, that an evaluation in five years will not be as positive because of the general economic situation throughout the country. Many of the Prairie people will probably find that they cannot support their new homes.

KLEMME:

That has come up on a number of occasions. I don't see that being the case. I'm not sure that we have properly taken into account the utilities costs to these people in their former locations. A lot of these homes were flooded. Insulation had settled to the bottom in the walls. Maybe six years ago they could have afforded to respond by just cranking up the thermostat, but no more.

Consider the entire cost of housing. As far as taxes go, Wisconsin has the homestead credit. Elderly fixed income people are reimbursed for taxes paid on property, based on income in the household. They aren't likely to be "squeezed" by their improved housing situation. The bottom line net effect is that probably no one is paying more than 10 percent for housing cost above what they were before. And they're able to keep warm and dry, besides.

EARL C. COSGROVE:

Your Prairie du Chien project was an evacuation relocation of properties and people not relocation of people alone. The structures that were relocated were "relocatable." They were liftable and movable, so weren't demolished.

KLEMME:

Ten to 20 percent were movable.

COSGROVE:

What is the chance that someone will accept the price you offer for their home, you relocate it, and they don't buy it back? They don't want that house, they want another one. You are stuck with that house and sell it on the open market. You place it where you want to, rather than the individual saying "I'll buy that lot over there," or, "I'll take that lot and you move the house to it." All of a sudden they don't sign papers, saying, "I want it back at the price it cost to build it up there."

DAVID MILLER:

The housing choices that were used in Prairie included people moving their existing houses people buying other existing houses on the market outside the floodplain, people building new houses and people buying other people's houses on the island and moving them out of the floodplain.

COSGROVE:

Is this part of a contract when the individual sells a house--signing that he is going to sell to the city, that he will buy his house back? Can you force someone to buy their house back?

MILLER:

No.

COSGROVE:

Do you give them this \$15,000 and they run?

KLEMME:

No. They have to own and occupy a replacement dwelling before they are eligible to receive the Real Property Acquisition Act money. I pay you \$23,000 for your house. You decide you want to move it. You give me a deed, I give you a check for \$23,000. You now say you want to move it, I'll give you a bill of sale, you own the house, you give me \$500 back. You own the house now, but you don't own the land on which it sits. You have \$22,500 plus whatever potential relocation assistance. You take your \$22,500, go out and buy a lot, build a basement, find someone to move the house. When you've used up that \$23,500, I'll begin to peel off part of the relocation money to help pay the difference.

COSGROVE:

Improvements up to a certain amount?

KLEMME:

Only improvements necessary to comply with "decent, safe, and sanitary" requirements and as we consider necessary to comply with state and local standards and to be energy efficient.

COSGROVE:

My concern was: "Is it implementable? Is the relocation implementable? You're accepting that person's property, buying it. When he goes somewhere else, the government or city owns that piece of property. Suppose you can't sell it?"

KLEMME:

Now I own the house. Is it movable or not? The city owns the house and it's a solid structure? Then I'd do one of two things. Either make it available to any member of the public at highest bid, which I'm reluctant to do or keep that as an "inventory" house. Someone else comes along whose house isn't movable and they may buy that house I have in inventory because its owner rejected it. That's a very good method to use when you have renters who want to become homeowners. You can usually move a house and set it up at lower cost than buying one on the market. Renters who haven't much cash will buy a lot for \$500 and move such a house.

PAPER  
CONTRIBUTED BY  
PENNING - ROWSELL

NONSTRUCTURAL APPROACHES TO FLOOD CONTROL: FLOOD  
PLAIN LAND USE REGULATION AND FLOOD WARNING  
SCHEMES IN ENGLAND AND WALES

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ABSTRACT

Nonstructural flood control schemes necessitate close liaison and cooperation between institutions concerned. The land use regulation system for flood plains in England and Wales is reviewed and factors which contribute to unwise urban development on flood plains are analysed. These include poor appreciation of areas of flood risk and circumstances which lead to local authority planning departments giving permission for flood plain development owing to economic pressures. Given the existing highly complex system of land use control, mandatory contributions towards flood control costs from developers would reduce the likelihood of further encroachment into flood risk areas. In addition, changes to the grant aid system for flood control schemes could be made such that flood proofing of buildings was eligible. Current flood proofing systems are rudimentary and despite efficient flood forecasting systems flood warnings show small benefits since response rates are low and damage savings are small. Nevertheless in England and Wales there are a number of sophisticated nonstructural flood control schemes, both existing and planned, from which other countries might usefully learn.

INTRODUCTION: THE ADMINISTRATIVE CONTEXT

It is sometimes erroneously concluded that flood control\* in Britain relies predominantly upon structural measures (Smith and Tobin 1979). In fact there are many instances of very sophisticated nonstructural measures to reduce flood damage and loss of life, yet these have received very little attention. In part this neglect is a function of transferring conclusions concerning flood policies direct from the United States, where it has been reported (White 1964) that nonstructural measures are uncommon.

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\*The term 'flood control' does not connote total elimination or control of floods or total immunity from the effects of floods, as that is rarely economical or practical. It is intended to be synonymous with 'flood alleviation' or the provision of a specific amount of flood protection.

This paper seeks to analyse policies for non-structural flood control in England and Wales and thereby identify lessons that may be applicable elsewhere. However, these policies will only be clearly understood within their administrative context, and this will be described first.

The administration of flood control in England and Wales is the responsibility of the Ministry of Agriculture, Fisheries and Food. This Ministry give grants to Water Authorities to construct flood control schemes which are planned and implemented by Regional and Local Land Drainage\*\* Committees. Grants are also paid to Internal Drainage Boards which are responsible for flood control and drainage of areas owned by their members. In nearly all cases both the Internal Drainage Boards and the Land Drainage Committees are dominated by farmers and other landowners, and their policies often reflect this domination. In addition, however, flood control on certain minor watercourses is the responsibility of local District Councils, which are elected local authorities with other duties such as education and transport. Furthermore, the Greater London Council has the major responsibility for flood control within its area. Highway and canal authorities also have responsibilities in this field. The administrative system is highly complex although of prime importance is the Ministry of Agriculture, Fisheries and Food so that policies and practices supported here are of particular significance.

Whereas flood control is clearly dominated by the Ministry of Agriculture, Fisheries and Food most land use control is in the hands of the District Councils. Strategic land use issues--such as the siting of major new developments--are the responsibility of County Councils but Districts implement the control of minor developments on a day-to-day basis. County Councils are also responsible for emergency services including flood relief and, in turn they are responsible to the Department of the Environment for most of their functions. Thus in England and Wales we have two government departments, 45 counties, 385 Districts, 10 Water Authorities, 310 Internal Drainage Boards and 29 Local Land Drainage Committees all with responsibilities in the flood control field. Given this complexity, the success with flood control in this country is commendable and a tribute to many years of concern to reduce flood damages and poor agricultural drainage (Burton 1961).

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\*\* In England and Wales the term 'land drainage' embraces flood alleviation.

## LAND USE CONTROL ON FLOOD PLAINS IN ENGLAND AND WALES

A major element in policies to reduce flood losses in England and Wales is the control of development in areas liable to flooding. For the purpose of such development control, development is defined as "the carrying out of building, engineering, mining or other operations in, on or over land, or the making of any material change in the use of any building or land" (Gilg 1978, 69). The major thrust of development control is certainly not aimed at flood control but at reducing the urbanisation of the countryside. Nevertheless flood control is an important side effect of these all-embracing powers (Sterland and Nixon 1972).

The land use development control system was initiated by the Town and Country Planning Act 1947 and essentially has two components: the development plan and the processing of development applications (this latter stage is often termed development control). The development plan is prepared by County and District Councils as a result of a survey of the land use of their area and a projection of land use trends and plans for the area. It is subject to central government scrutiny such that Ministers may modify development plans to accord with national rather than just local priorities. The development plans produced by local authority planning departments between 1947 and 1968 were highly detailed but since then the system has been modified to reduce central government involvement. Counties now produce general structure plans which are subject to scrutiny by the structure plan. In all cases the plans are intended to indicate which areas are to be left undeveloped, the areas already developed but unlikely to undergo further major change, and land likely to undergo major change (i.e., development) and thus needing the production of a special detailed plan.

When the development plan is accepted by central government it is implemented by the local authority. The main mechanism of implementation is the power of the local authority to refuse permission to develop land ('planning permission') which is not designated for development in the development plan. In addition, the local authority has the power to refuse planning permission if the development is not considered suitable for the area in question, irrespective of the development plan. Planning permission can be conditional upon certain design details for the buildings concerned, but the developer can appeal to the Secretary of State for the Environment against either refusal of planning permission or conditions imposed (Figure 1). The Secretary of State, therefore, has to decide whether to grant planning permission, and this decision is usually based on a public inquiry or written representations (Gilg 1978). In general the development control system has worked well since 1947 and has exerted a substantial influence on the development of the countryside in England and Wales.

With regard to flood control, the land use regulation operates with a system of designating areas liable to flooding and referring applications for development in these areas from the local planning authority to the Water Authority. Generally planning authorities have

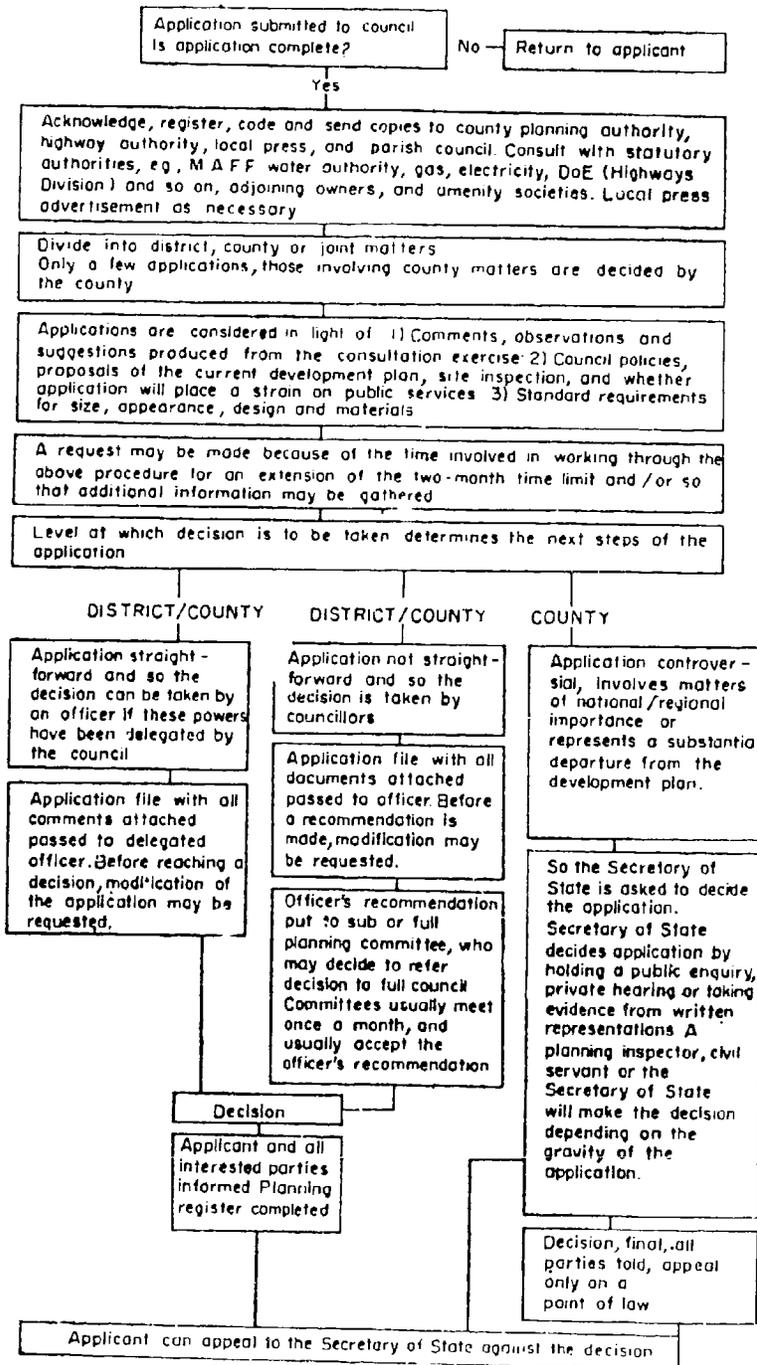


Figure 1: Stages in the progress of an application for permission for development in England and Wales (after Gilg 1978)

policies discouraging development in these locations and planning permissions are refused on the grounds of flood risk. For example, many development plans devised under the Town and Country Planning Act 1947 show the limits of known flooding; in south east England these are commonly the limits of the 1947 event (Surrey County Council 19; Collins et al 1970). The recent structure plan for Essex (Booth 1978) acknowledges the "significant risk of flooding in Essex" and that "it is impractical to expect to alleviate all risk of flooding and therefore more realistic to ensure that life and property is protected by locating development outside the areas of risk. Therefore proposals for development within flood plains of watercourses and coastal areas will not normally be permitted" (Booth 1978, 167).

Applications for development in flood risk areas should be referred to Water Authorities for comment and advice. The Water Authority can thereby judge the effect of the development on river flow, especially if land levels have been raised to prevent flood damage, and advise the planning authority whether the latter should give planning permission. Government Circulars 1947, 1962 and 1969 (Ministry of Housing and Local Government 1969) both clarified and emphasised the need for close liaison between the authorities concerned, to ensure careful regard to flooding problems when development decisions are made.

In general the system of land use regulation has worked reasonably well. The result is that there is relatively little post-1947 development on flood plains, although striking and spectacular exceptions have tended to mask the general picture (Hollis 1974). A familiar picture in flood plain locations is housing or industrial development stretching just to the edge of flood plains and thereby avoiding the main flood way. Nevertheless there have been problems. Principal amongst these have been the problem of ascertaining areas at risk from flooding and also the non-mandatory system whereby the Water Authority has power only to advise the planning authority but not itself to prohibit the development. These two problems will be considered in turn.

Until recently flood extent data has not been collected systematically. Maps of areas thought to involve flood risk were lodged with planning departments, to be used as a basis for referring planning applications to Water Authorities, but these maps were often based on sparse information and incomplete surveys. In addition these maps tend to show areas protected by flood control schemes as having no residual flood problems. For example, at Nottingham a scheme has been installed and development has subsequently been allowed in the area thereby protected (Penning-Rowse and Parker 1974).

Considerable improvements in the quality of flood extent data are under way. Section 24 (5) of the Water Act 1973 requires Water Authorities to undertake 'surveys of their areas in relation to their drainage (including flood protection) functions'. Guidance notes issued by the Ministry of Agriculture, Fisheries and Food (1974) indicated that these surveys are to be very comprehensive and record all known areas liable to flooding (Table I). Early opposition to the



survey programme (Penning-Rowse and Chatterton 1976) based on staffing problems has largely been overcome and Water Authorities are now presenting their survey results. These data should enable much more rational development control of flood plain areas since planning authorities will have full access to the survey results. There should be no reason that these departments do not have full information on flooding in their area (Wessex Water Authority 1979; Severn Trent Water Authority 1978).

As discussed above, nevertheless, Water Authorities do not have power over land use development. District Councils are free, as superior land use planning agencies, to ignore the advice from the Water Authority and to give planning permission for development in flood-prone locations. Two examples illustrate the problems here. Firstly, serious flooding occurred at the Meadows estate in Llandudno (Wales) in 1976 when some thirty recently constructed houses in a small flood basin were flooded to a depth of 1 metre. The estate had been developed with drainage works inadequate for the eventual storm runoff flows. The Welsh Water Authority could not prevent the development, only advise on the size of the drainage culvert. In the authority's opinion either permission for the development of the estate should have been refused, as had applications on previous occasions, or the developer should have been obliged as a condition of obtaining planning permission to contribute to the flood control costs. In any event, planning permission was given on less exacting terms than these, with the result that two years later serious flooding occurred. Now the Water Authority's Local Land Drainage Committee is having to install the necessary flood control works at a cost of £160,000 to rectify the situation and in effect thereby to subsidise the private development. Many Water Authorities feel, as a result of experiences such as these, that new legislation is needed to compel developers to make contributions toward flood control costs if development occurs in flood prone areas, and that more positive regulations are needed to ensure that planning departments heed advice given in these circumstances. There is some indication that new legislation is contemplated in the first of these two fields (Department of the Environment et al 1977; Cole and Penning-Rowse 1980).

The second example concerns development at East Molesey and is documented by Hollis (1974). Following a public inquiry in 1960 the Secretary of State for the Environment gave permission for development on areas flooded in 1947 on condition that the land was raised by 0.15m, despite objections from the Thames Conservancy (forerunner of the Thames Water Authority). Following 'exceptional' rainfalls in September 1968 most of this development and many other post-1947 buildings were flooded, affecting 10,000 properties, most of which were houses. A rough estimate of the damage was £1.3 million. The power of the Secretary of State for the Environment in the land use regulation field, influenced no doubt by economic pressures for urban development, had over-ruled the local planning department and the advice of the flood control agency.

## FLOOD WARNING SYSTEMS IN ENGLAND AND WALES

The development of flood warning systems in England and Wales in the last twenty five years has made a major contribution, along with land use regulation, to diversifying the approach taken by river and water authorities to flooding. Smith and Tobin (1979) argue that technical advances in warning systems have brought about this change. Of equal significance, however, must be certain significant flood events which attracted attention to the deficiencies in existing warning systems. The Lynton and Lynmouth flood disaster in 1952 (Ward 1978) and the East Coast floods of 1953, both causing considerable loss of life, initiated concern for more efficient warning systems. Continuing flood events in the 1960s, particularly in 1968, maintained momentum for research and development in the techniques of flood forecasting and warning systems. Meanwhile the most cost-effective flood control schemes for urban areas have, in general, been implemented. Attention, therefore, has turned to less expensive means of reducing flood damage, including flood warning schemes, where structural approaches to flood control fail to pass the cost-benefit test upon which the Ministry of Agriculture, Fisheries and Food insists. Such flood warning schemes, however, are required to be cost-effective such that the capital costs of installation and the revenue costs of operation and maintenance are outweighed by the benefits of the scheme in terms of damage reduced and lives saved as a result of warnings given. Only when warning schemes are economically viable as judged in this manner will the Ministry of Agriculture, Fisheries and Food give grant aid towards the costs.

As a consequence, therefore, of economic pressures, technical advances and concern over loss of life in particular flood events, river and Water Authorities have actively developed flood warning systems for their areas. By 1970 fifteen of the twenty nine river authorities had implemented some form of warning system (Porter 1970) and after the creation of the Water Authorities in 1974 further impetus was given to extending these systems to all areas. For example, the Severn Trent Water Authority has developed a regional flood forecasting system based on 100 interrogable rainfall and river level recorders (Chatterton, Pirt and Wood 1979). These recorders are interrogated by hydrologists during periods of heavy precipitation. Forecasts are produced of likely river levels based on rainfall/level and level/level equations, the latter giving downstream levels once upstream peaks are achieved.

A further extension of regional warning systems would be the proposed national flood warning network based on radar recording of actual precipitation. Such a system of radars would have benefits for weather forecasting as well as flood forecasting (Freeman 1979) and has been shown to be economically viable such that "the overall benefits would be very substantial, amounting to many times the cost of providing and running the network" (Bussell, Cole and Collier 1978). No decision has been made on the full network but further developments after the success of the Dee radar system (Smith and Tobin 1979) are being made by the North West Water Authority with an unmanned installation at Hameldon Hill in Lancashire. It is intended

to monitor the benefits of this installation, including those from flood warnings, to evaluate further the potential for a national system (Figure 2).

The essence of an effective flood warning system, however, is not simply its technical excellence but the efficiency of the arrangements for disseminating the warning to potential flood victims and the accuracy with which floods are forecast and false warnings are avoided. Here inter-institutional cooperation is essential. Given the relative rarity of flood events and the number of organisations involved there is considerable potential for confusion and breaks in the necessary lines of communication. First of all the Meteorological Office collects information on soil moisture deficit and with radar and satellites monitors rainstorm tracks. Information is passed to Water Authorities who monitor river levels and issues warnings of impending flooding to the police and local authorities. These in turn pass messages to industrialists and shopkeepers, those living in flood plain areas and to farmers. If the later stages in the warning process are deficient then the efficiency of the techniques for monitoring rainfall and river levels is to no avail; indeed, the most important link in the chain of communication is the last, whereby local policemen and neighbours ensure that all those potentially affected are properly informed.

The complexity of the warning process is illustrated by two examples. Firstly, Harding and Parker (1974, 1976) have recorded the complete warning system for Shrewsbury. The town has a long flood history and until recently has not warranted a structural flood alleviation scheme owing to insufficient benefits to justify the considerable cost. However, a warning system has evolved, assisted by the long lag time between rainfall observation and flooding in the town (24 to 36 hours) (Figure 3). The most notable features of the system are the panels of messengers which liaise with flood wardens in the event of breakdown of telephone communication, and a furniture removal system organised by the local authority to reduce flood losses. The removal system takes 2-3 hours and owing to the number of floods experienced in the town it operates with considerable efficiency and public support.

The second example of the complexity of flood warning systems concerns London where there is a serious risk of inundation from the sea when high tides and storm surges occur in combination (Horner 1978). A sophisticated warning system linked to the headquarters of the Meteorological Office at Bracknell is organised by the Greater London Council. The system involves a Flood Control Centre which monitors sea levels and storm conditions, regional centres which receive warnings and pass them on to neighbourhood flood wardens, and a series of flood emergency routines to alert public transport services--and particularly the underground railway system--the police, local authorities and voluntary relief organisations. In advance of the construction of a flood defence scheme including an estuarine barrage this warning system is of considerable importance and the Greater London Council has mounted a publicity campaign to increase public awareness of the system and has organised a number of trial

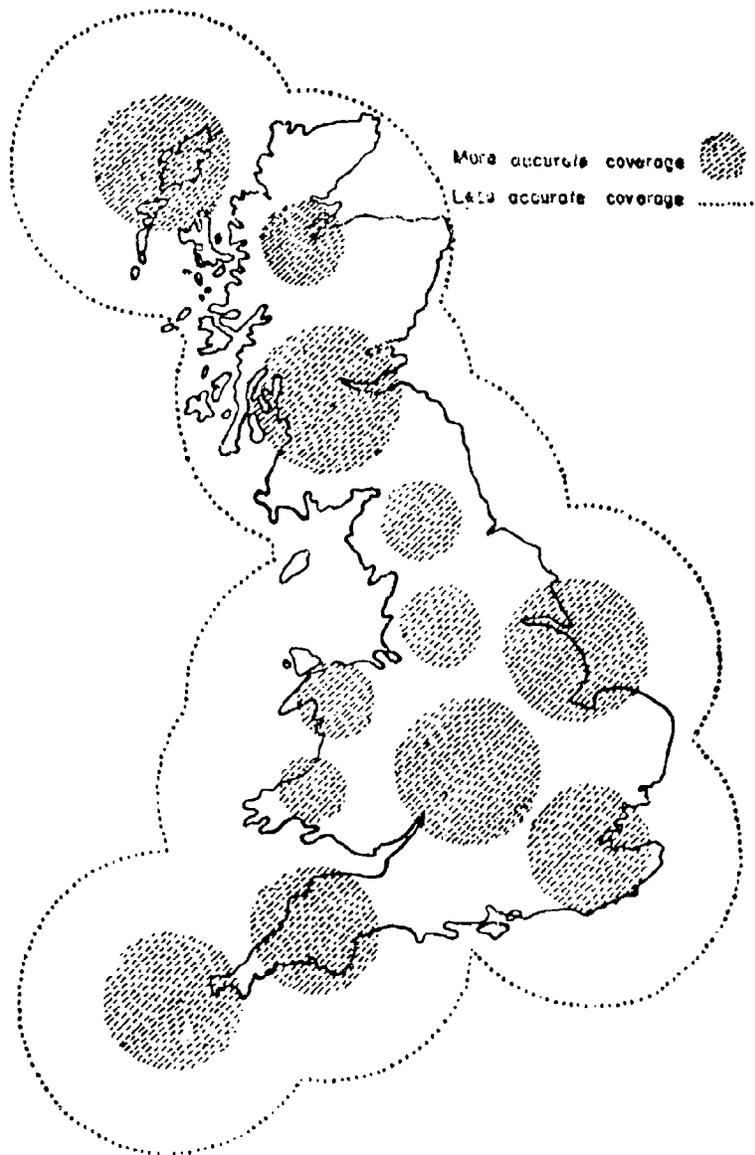


FIGURE 2: A possible future distribution of weather radar sites designed to cover Britain (after Dee Weather Radar Report 1974)

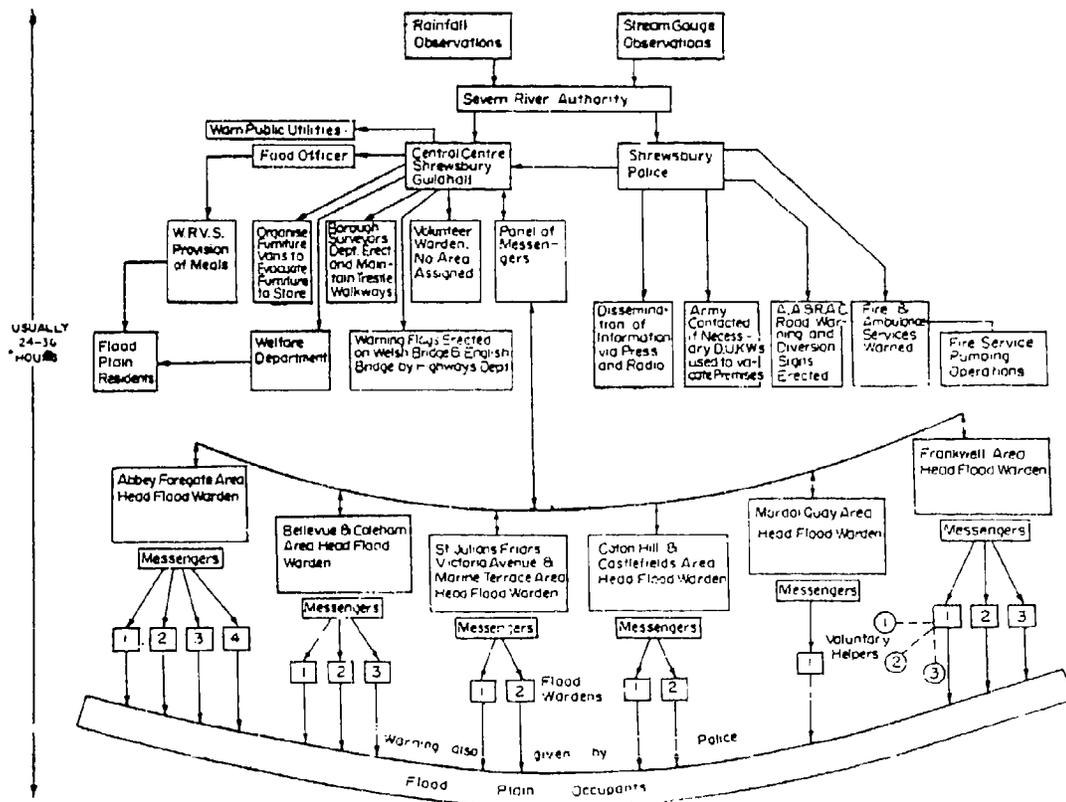


FIGURE 3: Schematic diagram of Shrewsbury flood warning and emergency plan (after Harding and Parker 1974)

operations of the system. The latter has only been of limited success since members of the public appear indifferent to such 'trial runs'.

#### FLOOD WARNINGS AND FLOOD DAMAGE REDUCTION

The Shrewsbury and London flood warning schemes are exceptional in England and Wales in so far as a long period is available for warning potential flood victims. In general the time available is much less than 24 hours, owing to the hydrologically 'flashy' nature of the catchments and the shortness of rivers. Therefore the lag between rainfall peak and flood peak is often less than 4 hours and such short lead times are liable to make warnings systems inefficient, or indeed ineffective, when measured in terms of damage reduced. Inefficiency may be compounded by both lack of awareness and breaks in communication links. For example, Smith and Tobin (1979) report that 44 percent of the householders in the flood prone area of Carlisle had moved there since the previous flood, and that therefore many of the potential flood victims were unaware of the warning system and how to react. Similarly they report that for an industrial estate in the same town eleven out of the eighteen industrial concerns had changed ownership or moved within a six-year period, including three establishments which were key links in the communication chain.

To obtain a clearer picture of the actual effectiveness of flood warning schemes in general an investigation was undertaken to interview those who had received warnings. The aim of the survey was to determine the type of reactions made by such people and to gauge how much damage, on average, was saved as a result of the flood warnings (Penning-Rowse et al 1978). In total, surveys were undertaken in thirteen locations in England and Wales, covering a wide range of flood circumstances. Thus, information was obtained from Shrewsbury, with its long warning lead time, as well as locations such as Appleby (Cumbria) where warnings are generally 7 to 8 hours. Some data are also available for floods which occur almost immediately after a warning is issued. The results of these surveys are aggregated for discussion here and reference made to the effect of warning lead time where appropriate.

The results of this survey (Tables II-VI) show that respondents fall into three broad categories: those who receive a warning but do not react; those who react by preventing water entering their property; and those who react by raising valuables and other household effects within their property to reduce damage. The last two categories overlap because some people try initially to prevent flood waters entering their property but, finding this unsuccessful, then concentrate on damage reduction through moving or removing house contents.

The number of people who are unable or otherwise fail to react to flood warnings is highly significant. Overall, 46 percent of those who did receive a warning did not react. The reasons for this inaction are various (Table III) but clearly skepticism owing to previous false warnings and old age or infirmity are important. This proportion not reacting may well be somewhat higher than would be

TABLE II

ANALYSIS OF RESPONSE TO FLOOD WARNINGS IN SURVEY OF NINE  
LOCATIONS IN ENGLAND AND WALES(1)

	Received flood warning		Miscellaneous
	Did not react with damage reducing actions	Did react with damage reducing actions	
Southwest England locations (2)	36	22	4
Cumbria(3)	1	7	1
Locations in the Midlands of England(4)	11	14	8
Totals	48	43	13
Percent	46.2	41.3	12.5

- (1) For more details see Penning-Rowse et al 1978 (Table 2).  
 (2) Weare Gifford; Barnstaple; Bideford; Coombe Martin; Braddiford.  
 (3) Appleby; Keswick.  
 (4) Attenborough; Newark.

TABLE III

REASONS FOR RESPONDENTS' INACTION UPON RECEIPT OF A FLOOD  
WARNING(1)

	Number	Percent
Ill/infirm/alone	12	24
Skeptical of flood warning/false warning	25	50
Existing protection assumed adequate	5	10
Other(2)	8	16

- (1) For more details see Penning-Rowse et al 1978 (Table 3).  
 (2) Includes "on standby"; "insured"; "away"; "no time".

TABLE IV  
 SOME INDICATIONS OF THE EFFECTIVENESS OF EMERGENCY FLOOD  
 PROOFING ACTIONS

	Received warning: took emergency flood proofing actions?		Took emergency actions; did they help to cut down or eliminate loss?		
	Yes	No	No flood	Yes	No
Cumbria: Appleby and Keswick	6	1	2	3	1
Midlands of England: Newark and Attenborough	25	-	8	3	14
Total	31	1	10	6	15

TABLE V

LIKELIHOOD OF COMMON HOUSEHOLD INVENTORY ITEMS BEING MOVED  
FOLLOWING A FLOOD WARNING TO REDUCE DAMAGE

	Household inventory item	Approximate average chance of being moved (%)
High	Electric toaster	80
	Vacuum cleaner	
	Colour television	
Medium	Record player/hi-fi	60
	Three piece suite	
	Carpets	
	Dining chair	
	Portable electric fire	
	Sewing machine	
	Personal effects (books)	
	Monochrome television	
	Dining table	
	Occasional chair	
Low	Electric kettle	40
	Kitchen chair	
	Electric cooker	
	Bookcase	
	Electric iron	
	Dining chair (carver)	
	Sideboard	
	Carpet sweeper	
	Spin drier	
	Food stock	
Very low	Freezer	12
	Washing machine	
	Refrigerator	
	Chest of drawers	
	Curtains	
	Kitchen utensils (cleaning)	
	Cupboard/cabinet	
	Clothing	
	Kitchen utensils (cooking)	
	Fitted electric fire	
Gas cooker		
Fitted gas fire		

(1) For more details see Penning-Rowse et al 1978 (Table 5).

(2) This list of items is somewhat arbitrary but was designed to fit with the flood damage data for these items in Penning-Rowse and Chatterton (1977).

TABLE VI

GENERALIZED DATA ON THE BENEFITS OF FLOOD WARNINGS TO THE  
AVERAGE RESIDENTIAL PROPERTY, MEASURED AS DAMAGE SAVED

Depth of flooding  (m)	Total potential damage(1)	Estimated average damage saving with flood warning			
		Up to 2 hours warning		2 to 4 hours warning	
		£	percent	£	percent
1.2(2)	2220	400	18	550	25
0.9(2)	2030	400	20	550	27
0.6(2)	1740	300	17	450	26
0.3(3)	908	450	50	500	55
0.1(3)	338	150	44	150	44

(1) From Penning-RowSELL and Chatterton (1977), Appendix 2.3.

(2) Assuming 70 percent response rate.

(3) Assuming 33 percent successful flood proofing, preventing water entering property, and 70 percent response rate (i.e. at lower flood depths more damage can be saved owing to the effectiveness of emergency flood proofing).

general for the whole of England and Wales since a number of the surveys were conducted in parts of south west England containing disproportionately large numbers of retired people. Nevertheless, the general conclusion from the survey as a whole was that the rate of response to flood warning is unlikely to be higher than 70 percent and could be much lower where populations are elderly or when residents are away (e.g. at holiday times). This figure of 70 per- cent is higher than that used by Chatterton, Pirt and Wood (1979) who concluded for Nottingham that response rates would be 80 percent.\*

Emergency flood proofing was analysed for 33 respondents. The indication (Table IV) is that the overwhelming majority of those receiving flood warnings took some flood proofing action but that this was only partially successful: 15 out of the 21 people eventually flooded said that the flood proofing actions did not "help to cut down or eliminate loss" (Penning-Rowse *et al* 1978, 11). Insufficient time or lack of materials for flood proofing, or again inability through age or illness, all contributed to this lack of success.

The effectiveness of emergency actions is also low in respect of moving or removing valuables within houses. Table V shows the items of household inventory moved by the 43 respondents who did react with damage reducing actions (Table II). As deduced by Chatterton, Pirt and Wood (1979) the most readily moved are small items of electrical equipment and valuable items such as colour televisions. However, many respondents reported that items moved were damaged by this moving and other items were moved above initial flood levels but were subsequently submerged. Often in the confused situation surrounding floods only a few items were saved from damage because residents waited after the warning had been officially issued by the police before reacting to reduce damage. Commonly such respondents felt the need to confirm for themselves the impending flood before investing effort in removing valuables, often because warnings had been issued previously when no flood water appeared.

To judge the effectiveness of flood warnings, and provide data with which to evaluate the cost-effectiveness of flood warning systems, requires the damage saving from flood warnings to be costed. These costs then form the benefits of the cost-benefit equation. Costing such damage saving, and deriving generalised figures on the benefits of flood warnings, is not easy. However, the survey of household goods moved as a result of flood warning (Table V) was designed to be compatible with the generalised data on flood damage presented by Penning-Rowse and Chatterton (1977) and this facilitated deriving average damage-saving figures for different lengths of warning and for different eventual flood depths (Table VI). This use of different depths recognises that for major floods where properties are flooded to 1.2 metres or more the potential for damage saving with flood warnings is less a proportion of total damage.

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\* Many previous studies (e.g. Day and Lee 1976) have assumed 100 per- cent public response to warnings which must overemphasise the benefits of flood warning systems.

Table VI shows that for minor floods the damage-saving approximates to half the total potential damage\*. However, for more serious flooding the combined effect of the response rate of only 70 percent and the inability of many householders to move much of their house contents means that damage saving is unlikely to exceed £550 per property, or some 20 percent of total potential damage (1977 prices). This low proportion accords with information on the effectiveness of flood warnings from other parts of England and Wales reported by Penning-Rowse et al (1978) derived from surveys of Builth Wells and Aberdare (Wales) and Bristol, Gloucester, Tewkesbury and Northwich (England). The figure in Table VI could be used to appraise the economic viability of flood warning schemes, but the relatively low damage saving--due in part to the general lack of response to flood warnings--to some extent counters the argument that flood warning systems are a substitute for structural flood alleviation schemes.

#### SUMMARY AND CONCLUSIONS

As discussed in more detail elsewhere (Parker and Penning-Rowse 1981) the system of grant-aiding flood control works by the Ministry of Agriculture, Fisheries and Food has favoured structural approaches to flood control. Nevertheless nonstructural approaches have not been neglected. Two such approaches are reviewed in this paper: flood plainland use regulation and flood warning systems.

In England and Wales there is a relatively long history of land use control, dating from the Town and Country Planning Act 1947. Local authorities have the power to refuse permission for urban developments in areas liable to flooding. These authorities are encouraged by central government to consult with Water Authorities concerning such developments and for these purposes Water Authorities provide maps of flood prone areas based on historical records.

In general this system of land use control has worked moderately well, although there are significant exceptions. Problems occur when information on flood-prone areas is incomplete and where the local authority planning department chooses to ignore the advice of the Water Authority. To provide more information on areas liable to flooding Water Authorities are now conducting surveys of flooding problems of their areas (Table I). To discourage development on flood plains where planning departments give planning permission unwisely, the government is contemplating mandatory contributions from developers towards land drainage and flood control costs (Department of Environment et al 1977). Both these measures should improve the control of development of flood plains and reduce future damage costs.

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\* For more details of the techniques in this costing see Penning-Rowse et al 1978.

Flood warning systems are developing in Britain in response to public pressure following loss of life in past floods, economic pressure since most cost-effective structural schemes have been implemented, and in response to technical developments which have permitted more reliable flood forecasts.

However, the effectiveness of flood warnings is relatively low, partly because warning lead times are small since many rivers in England and Wales are 'flashy' and short. In addition many of those suffering flooding are unable to respond because of old age, illness and other reasons. Survey results show response rates to be 70 percent or less and that damage savings resulting from warnings of serious flooding can be only 20 percent of total flood damage. Emergency flood proofing appears relatively inefficient owing to lack of time during warning periods and to inadequate preparedness.

Nonstructural measures for flood control require efficient inter-institutional cooperation. In the two examples examined this applies to cooperation between planning authorities and water authorities for the regulation of flood plain land use and between water authorities and emergency services in the case of flood warnings. Complex liaison systems have developed in both fields in England and Wales, but their continued efficiency is essential for optimal flood control. In addition, minor changes to legislation controlling the grant aid system would encourage more effective flood proofing schemes and help further to control unwise flood plain development.

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# Second General Issues Forum





## SECOND GENERAL ISSUES FORUM

Helen Ingram, Moderator

HELEN INGRAM:

What makes the Corps different? Why does the Corps, as an organization, succeed? The Corps is a successful agency in the long perspective. When I worked for the National Water Commission, David Allee, Al Smith (visiting scholars in ASA Civil Works, at the chief's office), and I, and others, used to get together and talk about that.

David would say, "The Corps is able to change its mission to meet the times." Even though in its basic image it says, "We are the builders of America; we're a construction agency, the construction arm of the Congress," they have nonetheless been able to change that mission as people's ideas of what they want to build change.

The Corps was once a transportation agency. Then it discovered flood control. After it discovered flood control it discovered multi-objective planning. In more recent years, the Corps has moved into such things as urban studies. They spent some time with pollution and waste treatment. The Corps adds new roles and missions as it goes along, so it never works itself out of a job.

For a contrasting agency example, the Bureau of Reclamation has for some reason been unable to do that. In its "soul" it's an irrigation agency and as an irrigation agriculture has become less important in the west, the bureau hasn't thought up any new jobs it could convince itself it wanted to do.

While I'm away from the University of Arizona these three days, I've asked my students to read a manuscript by Jean Nienumber, another of those visiting scholars in the chief's office. She says, "The recent history of the agency -- from 1950 to the present -- shows the same pattern of behavior. The Corps rarely turns down an opportunity to expand its areas of responsibility. It even (as we previously mentioned) takes challenges to its developmental orientation as opportunities to demonstrate its responsiveness to changing public values."

The Corps' response to the environmental movement in the late 1960s and early 1970s is further demonstration of the agency's flexibility, even its innovative style. Several analysts of the Corps' response to NEPA generally reached the same conclusion. The Corps' response was sincere, swift, and impressive. It incorporated the environmental issue in a manner which forced the grudging respect of even its most strident critics. Its response record was often better than that of federal agencies that were more overtly conservationist in their orientation. That's high praise, coming from people who prefer to be critics of things rather than supporters.

That leads me to a question about nonstructural alternatives. If the Corps is good at changing its mission to meet the times, are nonstructural actions a good new direction for the Corps? Or aren't they? Over the past

few days you've said very different kinds of things: Dan Mauldin said on the first day, "The future of nonstructural alternatives is only in combination with structural measures. They are kind of an added bonus. The real stuff is still concrete." Robert Plott said, "Plans that show environmental or economic benefits for nonstructural measures alone sit on the shelf." He talked about projects being terminated that have only that kind of thing to offer. Michael Burnham said the Corps "has information useful to emergency planning, but that information sits on the shelf if there is no useful structural project recommended by the plan." Another quotation: "If a locality implements a flood preparedness plan, will it take away from the benefits of structural and nonstructural measures and nonstructural cream off the benefits for the structural measures?" somebody asked. Kyle Schilling said today that he was troubled by the federal role in a particular nonstructural measure; in this case, I think it was floodproofing. It is an incomplete solution; it leaves the Corps vulnerable. If they have solved the problem, then comes a 100-year flood, they are vulnerable to having misled people into believing that they were safe, when they are not safe.

Well, that is one side of the argument. It is at least possible, it seems to me, that nonstructural alternatives are very far from what Bill Donovan and Beverly Getzen called the identity of the Corps, which is an engineering kind of identity. This agency never will be all that comfortable with this kind of measure as something other than an add-on to what it basically does.

On the other hand, you have said some other things. There is Bill Donovan's button that says, "The Corps Cares." We are not out to build things, we are out to solve problems; we will solve them by whatever kinds of tools we have, and those tools, in fact, may not be concrete tools. Then Chuck Simpkins really enthralled me today with a beautiful story about the role of a civil engineer. I would be proud to be that kind of civil engineer. So my question to you is, "What do you want me to tell my students about nonstructural alternatives, and are they part of the Corps mission?" Will they one day be the heart of the Corps mission? Where does this stuff sit with you? In a period, especially, of budget constraints, where you have to push off extra added things, is this one of the things that is going to go, along with the other things you can no longer afford to do? I don't know how you all afford the IWR. In talking with David Allee, he says that proves the Corps is different. You know, they hire gadflies that make their lives utterly miserable, and they pay them for it even in bad budgetary times. Well, that is what I want to know. I guess, because you are panelists, you get to tell me first, but I hope we're not just going to take these people's word for it.

L. H. BLAKEY:

First of all, I have to thank Bill Donovan for letting me follow Helen. You said a number of really thought-provoking things. I am trying to be relevant, myself. It is hard to be relevant when you pointed out and made some observations on things people have already said that put it in such a good context. But I will try, anyway.

In a conference like this, which is oriented toward a specialized part of a large business, you necessarily have to get very technical and talk about

that specialized complement. When you do, you tend to get a little off track sometimes from really why we are all in the business we are in. Bill Donovan said it very well: that is, we're problem solvers. That is what the Corps is all about. We are all rushing, usually to answers. That is a part of the problem the Corps might have gotten itself into a long time ago in rushing to answers--traditional answers. Those of us in this room now are focused on rushing, perhaps, to unconventional answers. But the truth of the matter is that all of us constantly--not from time to time, but as a background "given"--have to go back to basics. That is, we're problem solvers. So the first thing we are doing is identifying what problems are. Then, we control what alternatives there are. The world is sort of our oyster, in the sense that we are not barred from any legitimate things to look at, which we "scope" as being alternatives, especially nonstructural, where we almost have a blank check by the Congress and president in Section 73. It doesn't really constrain us in what nonstructural alternatives we might consider. But, in the sense that we can identify the solutions, we also identify the alternatives, one of which becomes the solution.

But, in speaking of nonstructural, I think that Dan Mauldin is probably not correct in saying that it is going to be an add-on or bolt-on or something done in connection with something else. I don't think that is really quite true. If you take the broad range of what planning is about today, in the Corps of Engineers, you can sort of look at the way we are organized in a district office and get an idea of what we are about.

We have a planning division reporting to the district engineer. The planning division, then, is responsible for concepts and a number of things, but essentially for recommending solutions. One of the ways of doing this is called technical services, which, for the most part, floodplain management-type people are brought up into. That is where you find these people. Then you will find plan formulation people, then some technical disciplines such as economics, environmental, and some others. But the programs we work on can also be categorized the same way, such as technical services, answering phones, giving advice, flood insurance studies--things of this nature. Then you have got, if you move along to what some of the other people have talked about, the small projects program, Section 205, smaller, the ongoing survey program that results in large scale recommendations for things. If you look at all those and try to decide what's the future or what's the application, the potential of nonstructural, you have got to realize that it is really across the board but that the answer might be a little different in each of these.

One of the problems in management (and I wish I saw more chiefs of planning out here so they could hear this, but I will repeat this again when I have the opportunity), one of the functions of the chiefs of planning, is to organize through the job. In so doing, if you are good at what you do, you will organize in a very precisely defined way in that you group this group of people one place to do one thing, another group of people somewhere else to do something else, and you drive this wedge between them so that each knows exactly what they are doing, so they do it well. That is only part of the answer in organizing to get the job done. Because then, the second thing you must do is to integrate and differentiate these various disciplines or

techniques or missions. Then, you have to integrate it all back together. Some managers do the first very well and neglect the second. If you properly integrate things back together, then you will find the technical people, who mostly are concerned with nonstructural things which can be done, have a good bit to say about what might be done in an ongoing survey program. You'll find, then, that these people can be very helpful in a small project. In a Section 205, if you left the survey program to its own devices, it might come upon a problem for which they can't find the solution because of some environmental or economic constraint, what have you. Terminate the effort, go on to the remainder of the survey program, where there might be an opportunity to do whatever it is we are supposed to be doing to solve problems. What is left over from the menu of those in the survey program, then, might well have its answer in a small project formulated with a large measure of nonstructural alternatives.

To summarize, in part, what I am saying, Helen, is that Bill Donovan is right. We are in a business of problem solving, identifying problems, proposing alternatives almost without limit in the sense that we can study and recommend. You feel constrained sometimes. And we have heard people say, "The economists have done us in right from the beginning, because they have set up ground rules that we can't comply with and we often have exceptions to those." Well, that is an interesting and certainly a debatable point. Is it true that we have, perhaps?

But, if we don't like the rules, then we can work to change them. And if you don't like the rule, you have to ask yourself, "Why is it that I have decided--based on some standard that I have, or objective, or some constraint--that what it is I am trying to do is correct and the economist is wrong?" You can say the same thing about the hydrologist, and so on down the line. I think you can judge success in nonstructural not so much on whether a federal project results, is built, and so forth. Maybe another criterion of success is how, with a few federal dollars, a great amount of nonfederal dollars could be spent to produce a substantial benefit where the problem has occurred--that is, with the local people, cost avoidance measures, and things of that nature.

Before I spend too much time, I would like to point out one other thing that I would like to respond to that I have heard here. Some people said that we need more guidance on nonstructural. We need more guidance so we know what we can do and what we can't do and so forth. I would really not want to agree with that--and we could debate that point, too. I feel if you look at the planning guidance notebook--which, of course, is our Bible now for plan formulation--and some of the other things that we have got, I think you have got all the guidance you need. In fact, what it amounts to is that you have got all the constraints that you need. I think that from that point on you have an awful lot of flexibility to do a large number of things. Whether or not these things are technically feasible or not, and we have heard a lot said about that, is another issue.

The heart of the planning process is an interdisciplinary effort. Regardless of how we are organized or what programs we are pursuing, we need to make sure that the people whose predisposition is to construct something

and build something are influenced by those of us who really come from first principles and say we want to solve the problem. The means by which we solve the problem is only relevant as we solve it. But we don't come from a point of view where we say that we are going to solve this problem by building something structural or where we start out by saying we are going to do something nonstructural. What we are really up to is trying to solve problems.

INGRAM:

It occurs to me that you said you want to be ambidextrous; that is what I heard you say. All of these things are part of the tools that the Corps has. But I am still troubled because of the things I have heard which make it sound as if nonstructural measures are going to be difficult for the Corps to pursue. Most of us are not ambidextrous. We are left handed or right handed, because it is easier to do something really well if you concentrate on those things that you are really good at.

I have heard, for example, that nonstructural measures will require much more money in planning because analysis is much more site specific. You have to collect a lot more information. Not only do you have to collect a lot more information, but that information is of a different kind. Instead of physical information, you have got to collect social information. People don't ever stand still, they change their minds. They are against something, but you do it and then they like it. You know the story from Great Britain: a lot of information was given out which seemed to clear it up, and then you asked the people what they're supposed to do in case of emergency; 95 percent of them would do the wrong thing.

Those things are where it is really hard to know that, if you do something, you are going to get the result that is predicted. That is something that the Corps is not really used to. I guess my question is how committed is the Corps to changing hands, to being ambidextrous in this way. Is this something you really want to do? How do you feel about it? I hear what you are saying, which is in some sense, "Yes, we do." But what do the rest of you think?

ROBERT D. WOLFF:

To re-enforce what Lou Blakey was saying about the various programs: When you say, "Are we committed to doing it or can we do it . . ."

INGRAM:

Do you want to do it?

WOLFF:

What do you mean, though, by "Do we want to do it?" Do we want to do it as a federal project? I would say the answer is not necessarily "yes," because we have programs where we solve problems through other than federal projects. We have technical assistance, or maybe a small project. So the

answer is, "Yes, we want to solve problems." Then, if nonstructural makes sense, that is the solution. I think very much so, yes. If we want to make sure that we have Prairie du Chiens and formalized large-scale undertakings, don't call them projects. But nonstructural plans or any kind of plan that require a large federal investment, I am not so sure that is success.

In other words, if the objective is to solve problems, we have to look at how much technical assistance is solving problems through local instrumentalities and how much is being solved through small projects or through federal projects. Then take the sum of federal and nonfederal investments to achieve the benefits of solving flood damage problems, rather than saying how many projects do we have coming through the Board of Engineers that recommend nonstructural solutions. So, if you have your sight set on the right objective, I think, again, it is an ambidextrous type of situation, where you have to look at what the results are across the board and not just as far as how many federal projects we are recommending.

INGRAM:

Do you see technical services coming to be a much larger concern for the Corps?

WOLFE:

I am not a technical expert, but after listening to the technical presentations, it appears to me that technical services are a large part of the flood damage reduction solution. These would be nonstructural kinds of measures, or I would call them cost avoidance measures. You don't have large capital investments; instead, you have some other kind of measure that you institute that doesn't require federal appropriations. They're transferring the cost someplace else.

INGRAM:

Well, maybe there is going to be lots less money for federal structural solutions and much more initiative is going to come from the local and the state level; and certainly that is what Larry sees. Much of what the Corps has which is special is that kind of technical expertise or background that it can make available. When Randy and I were talking, we talked about technical services and what the Corps has in terms of technical background that other agencies don't have. It is as you phrased it, "practical engineering experience of having done things." Then the question was, if the Corps doesn't mainly concentrate on real physical projects, is it going to have that special leg up in terms of technical background that makes it a special kind of agency with particular things to sell. Am I stating you correctly?

RANDY HANCHEY:

I think I said those words. Whether I used them to make that point, I am not quite sure. The thing that has concerned me here during the two days, and has concerned me even longer than that in other areas, is our program and our mission. We have heard some talk earlier today, from Bob Harrison, about the

goals of our program, and we keep talking about what the objectives are--whether they are federal projects, whether they are solutions, and these types of things.

Frequently, when people start talking about goals and objectives and missions, a lot of other people get turned off and say, "That is such high-level generalization, we don't really need to worry about that. We know what our missions are, we know what our goals are." I don't think that is necessarily true. I find a real paradox in the way we approach our flood control planning. Some of the earlier speakers who tended to talk more in global terms about floodplain management and what the real objectives of unified floodplain management programs were, and were intended to be, and so on, talked about a program objective, a national objective that is really various as to why use the floodplain lands and these types of things, which go well beyond flood control or flood damage reduction.

Yet we find ourselves in the Corps with, essentially, what I consider to be two orientations. We have got a project by project orientation where we go in and do flood control studies that are oriented towards flood damage reduction. By the sheer of volume of our history and the number of projects that we study, you might argue that we do that comprehensively, certain that we may have some influence on which areas we study.

But it is not really a program orientation. We never perceive ourselves as having a mission to solve the nation's flood problem. It is only indirect through what we can do with our projects. Other agencies that we interface with--the National Weather Service, FEMA, really have a program orientation, are really only concerned with the bigger issue. Certainly they have limitations to their mandate, but they have a program orientation as opposed to a project orientation.

Now we in the Corps do have, through the technical services program, a program orientation. I said something this morning and Bill Donovan, perhaps quite properly, corrected me at lunch and said that I was completely wrong, that I was getting on the floodplain services people, talking about their influence, and getting involved in formulation. That is not their mission. I understand that and I guess what I was trying to say is, "Why isn't it their mission?" Why don't we find some way to blend these two programs? Can we continue to have a project-by-project orientation on one side of the house building projects, and then can we have a program orientation and some other people that are somewhat isolated in the organization in some districts, maybe much better integrated in others. But we are really in a more narrow field, and that is technical services.

We keep talking about technical assistance. As I indicated earlier, we keep backing away from technical assistance in an area of water conservation supply. We have talked about technical assistance in the small hydro field when we were doing the national hydropower study. People recognized that we had an expertise in hydropower, that there were local communities that wanted to build them and perhaps we could provide technical assistance. Even legislation was introduced at various times (and never passed) to allow the Corps to get involved in this technical assistance role. There are reasons why it is probably controversial.

But I also sense an awful lot of reluctance on the part of the Corps of Engineers to get involved in this because the Corps somewhat reluctantly approaches being an organization that begins to look like it has a more continuous programmatic planning responsibility for the nation. We feel much more comfortable when we can put our planning in the context of a project. It's much easier to define the federal interest in those kinds of things. I would argue that someone in this country, if we're ever going to deal with the floodplain management issue comprehensively, has got to have a programmatic responsibility.

And I guess what I was telling Helen earlier was that it seemed to me that some of the other agencies -- the U.S. Geological survey, for instance -- could lay claim to having some expertise in the area of floodplain management. There are a lot of scientists, hydrologists, and so on there that do a lot of planned research. FEMA certainly has some responsibilities. The National Weather Service has some responsibilities.

What the Corps has that none of these other organizations have, with the possible exception of the Soil Conservation Service, is an applied engineering practical capability. We in fact have been practicing civil engineers -- designing, constructing, managing, operating, and planning -- and that's a fairly unique responsibility for someone that has the geographic and I think the legal mandate to do some of the things that we at the Corps can do. I think it's simply a matter of our getting more comfortable ourselves with these perhaps modified roles and then beginning to try to develop the support, not only with the states and the local people but also with the congressmen and administration to try to make some of these things happen. I really believe that we in the Corps don't feel comfortable enough with it yet. We're almost like the Bureau, Helen, in my judgment, that we haven't really convinced ourselves yet that we want to do that.

INGRAM:

That ought to stir some comment from you people. There's a proposal. Go ahead, please.

DAVID MILLER:

I would like to touch on a few things. First, is nonstructural a good mission? I don't know from a policy standpoint. I'm a district representative. From my standpoint -- from our district's, it's a necessary mission whether it's a good one or not. We don't have any more nonstructural projects on the books in St. Paul. However, we have a number of structural projects where it's very clear we're not going to be able to sell those projects without nonstructural components. I think that the future for nonstructural may be much more in the area of mixed strategy plans than it is in pure nonstructural plans. And I think, because it's becoming more difficult to sell the big engineering solutions, it's going to be necessary that we design a mix of more modest engineering solutions combined with nonstructural solutions.

Are we rushing to nonstructural answers? No; we're being dragged. Is the economist wrong? No, I don't think so. The economist at least in one sense

is applying in a very good way the rules the economist has to apply. I think if the civil engineer and the sociologist and the biologist do not work with the economist to help him see that he doesn't define the total reality, then we're as wrong as he is.

And, finally, is technical assistance good or bad? Again, from a practical standpoint, I like to keep busy; so does my district. We have technical assistance projects now that are an expanding portion of our work load even though our traditional planning work load is shrinking. I think we're doing something worthwhile there. We're doing pilot water supply projects for the state of Wisconsin. We're doing studies to determine the effectiveness of wetland preservation programs for the state of Minnesota; We're helping the state of Minnesota to determine how to keep urban wetlands from being developed. I think those are all worthwhile things. Some might not think those are things we're supposed to be doing, but they are things we have an ability to do, they're things people want us to do, they're things that keep us busy; and we're going to continue to do them to the extent that there is a need and there are resources available.

WILLIAM J. DONOVAN:

I would like to respond just briefly to Randy, not to disagree with him but to open up at least in an objective way. He mentioned the idea of why the technical services or the FPMS function is separate from the regular project planning formulation activities within the Corp system; and he's questioning whether it's correct or not. I don't want to address whether it is or not. I happen to manage the Flood Plain Management Services program for Dr. Blakey as one of his program area responsibilities, and there are people in the room -- certainly my predecessor, George Phippen -- who might want to pick up on this comment. He has a lot better background from an earlier time than I do. I've more or less seen things from the formulation point of view, and I've been happy to move into this other area of work. It's certainly not unrelated to planning -- quite the contrary.

It's too bad Jim Goddard has left the room, because he was brought into the Corp in the early days to help establish the Flood Plain Management Services Program -- a technical services program, if you will -- based on his long experience at the Tennessee Valley Authority. But the essential concern, as I understand it (and George might want to amend this or extend my comment), was that if that program (the technical services program, which is nonstructural in orientation) in those early days was not set up separate and apart from the larger planning project structure orientation of the Corp, it would have been absorbed into that in the sense that it would not have been able to develop its skills and provide the services that are directed by Congress.

It may be that at this stage in the game you're raising the question (and, Randy, it is a valid question to raise) should it be separate at this time? "We're getting it started"--that was a way to look at it. In fact, it was originally proposed and I think originally established (but for a short period of time) in the office of policy rather than under the chief of planning. I don't know if George wants to amend or extend my comments in that regard.

GEORGE PHIPPEN:

I'll see first, Bill, who among your present staff wants to say something.

DONOVAN:

Okay. They can speak up if they wish to.

JOHN BREADEN:

Two observations. One is that I noticed that in the '70s it was open season on the environmentalists; in the '80s, it seems to be open season on the economists.

INGRAM:

That's all right. They'll be okay.

BREADEN:

The second thing is, if we're really serious about floodplain management and nonstructural measures (we have about 10 to 15 unfavorable reports at the board at the present time), then we should have no such thing as an unfavorable report or a negative report in those terms. Every report would be a positive report with positive recommendations that Congress can see and act upon. That would encourage a wave of turning the corner on our thinking in nonstructural measures.

INGRAM:

It does seem to me you've identified, in this last couple of exchanges, some key elements about what is really the mission of an agency. A mission has got to be more than what they say it is. It also has to be one where all the incentives are to do that thing. And it seems to me, Bill, that there is a point at which technical services are protected, isolated so that they're not absorbed by other people, so that they can go off and do their own thing. Then there is a point at which they are isolated so that they don't contaminate the rest of the business. And you've got to know at what point they are being isolated for their own good or for the good of the agency.

I think back about the analysis done about environmental impact statements. In many agencies those people who wrote environmental impact statements were put in separate offices away from the main business; the impact statements went to them, they worked on them, they left the agency, and really the whole agency never got involved in that kind of business. In such circumstances--and that was not true of the Corp--one could say that environment really wasn't and never became a part of that agency's mission.

So when you tell me that being dragged into nonstructural, technical services is good to do because you've got to do some business and there's some business there, that is answering my question. I don't know if that's what you particularly wanted me to hear, and it certainly doesn't sound much like

Randy sounds when he talks about this business, so I'm still getting two messages.

KYLE SCHILLING:

I think the cutting edge of this issue is where you match up the GI program to technical services. You've got GI studies because there's a problem there. Like you said, we're problem solvers. But the GI program is designed on specific authorizations and funding over a set period of time for a study. Originally they were supposed to be projects; now we're saying maybe they won't have to be. Yet we're running them the same way. We end up with a report. John even said, "Maybe we shouldn't have negative reports." But, the end product is still a report that way, and what the locals are left with is a problem that we've written a report on, told them what to do about, and then said, "Sorry, our money is gone. You guys will have to do something." There's no continuity in the exchange of information, the dialogue, the helpful assistance in getting something implemented.

There's a parallel to this--the Urban Studies Program. Many people view the Urban Studies Program as a failure because it didn't produce many traditional projects. But in some studies I did a number of years back, where I went out and interviewed local people who were involved in the Urban Studies Program, they viewed it as a success because of the dynamics of the people interactions. What they regretted was a termination of the studies with a report and then no continuing contact for interpretation of those data to work with them to implement solutions to their problems. They needed technical assistance, a follow-up match-up program. We've got GI studies that terminate in reports and we've got a technical assistance program that somehow are not matched. I think that's the crux of the issue.

INGRAM:

Is there any money to circulate negative reports that have in them useful information for other communities?

BREADEN:

I just wanted to make a response. I wasn't trying to say that we should do just anything that pays us. If I understand the Corp correctly, we're a water resources planning, management, construction agency. I work in the planning division. I work on water resources planning. I think the examples I gave in technical assistance all can be interpreted by everyone here as water resources planning. They're not the traditional kinds of water resources planning we used to do in St. Paul when we had a lot of big structural projects--big structural flood control projects--and that was appropriate because those were the most pressing problems. I would submit that we resolve maybe most of those large pressing problems, and we're getting into the business of exploring those other areas of water resources management that we're particularly competent to assist our constituents in.

TONY LANIER:

I think as a planner in the district that I see the Corp spending money to solve problems from a planning standpoint. One of these badges that we have as an organization is that we see the solutions and we can carry out the construction work necessary to solve the problem. Technical assistance is valuable if it is used. The problem I see at times is that great amounts of money are spent gathering data and saying here is a solution to a problem, and the local agencies do not have the funds to solve the problem without federal assistance; that at times is a waste of money.

BREADEN:

It seems to me that we want decisions at the lowest possible level, where in fact state and local governments can solve problems; of course, they're going to have to be willing to do it and spend the money. But that's what we ought to do. The idea that every report coming to Washington go to Congress recommending some solution doesn't make sense to me. Basically we're talking about the federal government handling its role as a part of a larger equation of state and local governments, who are predominately in the water resources business to begin with. Statistically, the federal government only has a small share of what's spent in this country on the infrastructure and water resources pollution control across the board.

So, basically, in terms of looking at negative reports, I guess I reject this notion that negative reports from our standpoint in Washington represent a negative attitude at the district level of not communicating with local interests and not transferring information. We just happen to have an institutional process for favorable reports to go to Congress and get specific authorization. But that's not to say, if you don't have anything to recommend for congress to do, that the transfer of information and keeping decisions and implementation at the lower levels of governments isn't important. Whether it's new federalism or old federalism, it's a decentralized approach to water resources.

The other point I wanted to bring up is technical assistance versus point of formulation, I guess to take a little philosophical approach to where do you sow the seeds of programs. How do programs grow? And, as Helen brought out, how did the Corps of Engineers' program grow over the years? Did we write language up and put it in a 1936 flood control act and generate a flood control program? No, there was a national need there. The Corp of Engineers was put in the business because of these large floods and a national need.

It just seems to me that while technical assistance may be looked upon at any particular time as being not really what the Corp is mainly about, how are we going to become a future water agency in the areas where the country needs assistance? Perhaps by having districts do things that right now are off line but 20 years from now may be in the mainstream. It seems to me that while, to some people we failed in the Urban Studies Program in doing software planning and never came up with a major program, those are the risks we're going to take. And we ought to continue to take those risks at the district level to do things that develop.

But it just seems to me you've got to work it both ways. There may be something Congress will say we need to do, like the dam inspection program, and we'll all run out and inspect dams. Other times it seems to me you have to go both ways. You've got to at the grassroots level do your job and do it well for whatever there is locally, and maybe that will develop into some kind of national program. I think we can't reject either course of action.

GRANT KELLY:

I guess I'm harkening back to Bill Donovan's parting words of the morning session. They seem to be constraining us. The constraint was that we are working within the framework of the plan formulation process, and FPMS is there but it's kind of over here, and the issues today are plan formulation. I suspect that we may be ruling out a possible problem-solving tool by taking that position. And Bob just finished saying that by making that statement, making that constraint, and trying to force the problem solving of nonstructural alternatives through the plan formulation process, you are arbitrarily ruling out the technical assistance in floodplain management as an avenue for effecting those solutions.

Second observation: I would be very interested in hearing whether anyone on the panel this afternoon sees a clear distinction in policy that may be necessary between nonstructural solutions to residential problems on the floodplain versus those on the commercial-industrial plains. I see that distinction. I see it becoming clearer and clearer. There are total distinctions in public safety issues; there are distinctions in available capital; there are distinctions in the ability of those two parts of the private sector to effectively make rational decisions and implement those decisions with their own investment capital. I'd be interested in hearing whether anyone sees that growing distinction or need for different policies.

DONOVAN:

May I respond to the first part, Helen. I'm glad you brought that up. So there's no misperception of what I said, I was focusing on the attention--predominant attention--of the seminar on the project formulation process; this is not fundamentally an FPMS meeting. This is not withdrawing from a concern that we have to have a focus on FPMS services. Obviously, I manage that program for Dr. Blakey. And also I might say, going on beyond that, that we're talking about technical services, and FPMS is part of that so-called Section 22 authority, which is a much broader type of technical assistance authority that can relate to the Corp when it has sufficient funds. Of course, it's not a highly funded program. There's a cap of \$4 million on it which it never even got to begin with. There's about \$2.2 million now where the Corp through its districts can assist any state within the framework of a state comprehensive plan.

I would say a possible future--something I've been pondering for some time, and Larry Larson may disagree with me--is that we come into what I would call a state ascendancy. The state ascendancy and water resources planning--whether that is going to be very real or not remains to be seen; that is, in the laws. I notice some states are highly competent; they are a

handful. Then there's a mid level of mixed skills, and there's a lower level that has very few skills in the larger planning. They have some skills, but I think they'll need technical assistance, and I can see it as an expanded area of Corps assistance within the floodplain management context as well as other situations.

My focus was on the formulation process for, say, Corp projects in the ordinary sense. But feasibility studies you can take in that context--fine. FPMS people are not assigned to work in that context. They have information, knowledge, skills, and ability that could be used that way, but I was trying to separate the FPMS thrust as such, as a program, from ordinary Corps project formulation. Maybe I didn't make that clear and maybe I still haven't made it clear.

INGRAM:

How about the other distinction? The policy distinction -- residential, commercial?

HACHEY:

I've got the real answer to this one, and that is to ask Don Duncan, who's from the office of policy, if he won't say something about the difference between the residential and commercial policy in the floodplain.

DONALD DUNCAN:

I'd like to hear some more about what factors you're talking about. Obviously there's some choke factor on limited benefits to limited beneficiaries. If that's what you're referring to, that's one thing.

BREADEN:

I guess what I'm referring to is my perception of the ability to a great extent of the industrial-commercial marketplace to look after itself in the area of reducing its own flood losses. It has the investment capital, it has the tax structure that allows it to spend its money and retrieve on investment. It has the capability of evaluating rational decisions on returns on its investments. It has got the wherewithal to return some capital to put into it. It has the ability to make these decisions on its own and implement them unconstrained for study process in a study time frame within any regulations as to what level of protection we must advise or must recommend.

I see, on the other hand, a vast residential marketplace in the private sector that has none of those capabilities and probably can use some sort of service. And what I'm suggesting here is the possibility of developing a policy that recognizes those distinctions and possibly reacts differently to a floodplain problem, a flooding problem that involves commercial-industrial structures versus another one that involves primarily residential structures.

JEROME PETERSON:

I'm with the FPMS branch at OCE. I've been there since 1969, and I guess I'm a little bit frustrated by some of the conversation. Let me give you my perspective. When the Flood Plain Management Service Program first started, it was a new program in that it had a very broad law to go by so we were pretty flexible in what we could provide. And out of that activity came a very strong concentration of nonstructural measures. We became the center of expertise within the Corps on non structural measures. But all the way through it was recognized that a structural measure could also be a solution for a local organization. And it was the law and the program which provided a direct response. In other words, a community, a state that had a need for technical information could come directly into the Corps, have the answer provided, and go directly out. It would not have to weave its way through the bureaucracy and was a quick response. And because of that responsiveness it was always very important to keep it as a readily identifiable organization so it would not be tied into a lot of other programs.

In the current situation, however, we're all aware of the decreasing funding and decreasing manpower. I'm afraid that in many offices we no longer have that isolated capability. For your benefit, the Flood Plain Management Program was set up with an identifiable feature at OCE at the division and at the district level. But now, with the restrictions in funding and manpower, there have been many of the organizations that have been combined with other planning elements within the district offices. So I think we're not out of the mainstream anymore; in some cases we're very much into the mainstream to the point where the identification of the program responsiveness is being hampered, and my concern is that perhaps in some offices it might be lost. This would be a loss of a responsiveness to the public which I think the Corp has been very successful with in the past. Whether it continues to suffer the same problem, future budget situations can only dictate.

In getting back to the responsiveness under the Flood Plain Management Services Program, right now it's obvious to me that a great portion of all our questions on technical assistance are being generated by the national flood insurance program. So there is a direct relationship between both programs. I think again, if I may restate--the key thing in FPMS is not necessarily to completely combine them with other activities but to utilize the expertise that's there to the maximum extent possible without destroying the program. But keep the FPMS as a readily identifiable feature so we can maintain this relationship with states and local people that we've been so successful with.

INGRAM:

Very helpful set of comments. Randy, do you have a reaction to this?

HANCHEY:

No.

BLAKEY:

What Jerry is saying is exactly right; it's said a little bit differently than what I said, but I hope it reinforces what I said. And he's speaking from the standpoint of a manager. If you're going to manage something, you've got to differentiate and you've got to integrate, and those are the two things you must do. So you decide what your jobs are--your various tasks--and you, the manager, have almost total flexibility to decide that. And once you've grouped everything you do with labels and identified, then you go about the process of carving things up and separating in a permanent way such things as technical services, FPMS, plan formulation.

But that's half the job; having done that, then you have to integrate it back together again. If you do neither, you wind up with a mess, you wind up with something that does nothing; you wind up with an organization unable to respond to its different missions as you just articulated them and unable to provide anything. So you've got to have a differentiation, and then the biggest challenge becomes how do you integrate it.

I guess that's sort of what everybody's saying here. How do we integrate nonstructural in the plan formulation? That seems to be a big problem in Corp districts. Jerry's pointing out that there's also a problem where we've lost our identity in terms of tech services, FPMS, in some of the smaller districts because that organizational element doesn't exist and therefore we're not very good anymore at FPMS. Although we may well have some things integrated, we don't have that differentiation that allows us to execute that part of the program well. What I perceive as hearing--and you're right--is this problem of integrating things back together, getting the people who might consider themselves dam builders to consider nonstructural or getting those people who have lost sight of what we're all doing (which is solving problems) to consider this just one more tool. But that's, I think, what you're saying.

ROBERT POST:

I guess I'd like to be able to make the last comment on this discussion with respect to whether or not we're integrating the floodplain people or what you said, Lou, is working. The St. Paul District, for example, having formed a planning division, has brought its floodplain management people into the planning division where, of course, they belong, and they are combined with small projects and a few other types of services. Those people are communicating back and forth, and it's working. I think it will work even better in the future as we get used to each other. So I really think we're spending a lot of time and energy on a problem that has recently been taken care of with respect to forming many of the planning divisions, and I'd like to see us move on to other topics.

INGRAM:

Did that foreclose the question? Do you still want us to go ahead?

LAWRENCE FLANAGAN:

I disagree about taking all the floodplain management units and putting them back in other areas. I think the units have quite a lot to offer. I think that from what I've heard here these past few days that many of the nonstructural solutions can best be handled through FPMS. I would like to say to Dr. Blakey and General Gay that with the level of funding we're at right now, we might not have floodplain management units in even some of our bigger districts by the end of the year. We are hurting for funds desparately.

ART HARNISCH:

Back in the late '60s, early '70s, Gilbert White stopped in at Seattle. We got into a bull session with him and he said, "Boy, you guys (meaning the Corps) are really shakers and movers. If somebody wants to get something done, get the Corps in." He said, "I think the future of the Corps is really in being a catalyst in getting everybody together, going in one direction." And I think that's becoming more and more apparent today, with a lot of federal agencies into water resources. A lot of state agencies are in water resources, counties are into it, cities are into it. I can see where the Corps can get in there, be a catalyst, help put things together, and use its technical expertise; rather than build up construction and design expertise, maybe concentrate on people-to-people expertise, working with people in how to get people moving, rather than the construction part of it.

INGRAM:

What you're just saying relates to the whole question of scarce resources. Going back to my academic storytelling, you know that the literature says that one of the reasons why the Corp is successful is because it's a redundant organization. There are tables that show budgets, personnel of the Corps versus other natural resources agencies like the Bureau of Reclamation, the Soil Conservation Service, other agencies - and clearly the Corp does better. One of the papers is entitled "The Rich get Richer." Well, rich agencies simply are able to experiment with new possibilities to allocate some of their resources somewhere else because they still have resources to do their core mission -- you know, the main thing. And I guess one of the questions raised here by some remarks is whether or not decremental budgeting, the decrease in resources, doesn't mean that those possibilities of being innovative aren't becoming constrained. I don't know whether or not scarcity of resources prompts innovation. I have a feeling that it's at least as likely that the new interesting things get dropped.

CHARLES EDWARD SIMPKINS:

Just a little piece of organizational theory that has been bugging me for a few minutes. Several people have already picked back up on what Bob Wolff said and what Jerry Peterson said. If we're in a bind as an organization because of scarce resources. I don't know if FPMS is one of the sensors, so to speak, for scanning the environment for the purposes of opportunity detection, and that sort of thing. I won't go into the full jargon of organizational contextual theory. But, if you're cutting you had better be

careful that if FPMS is important as one of those scanning, boundary kind of devices in your organization, if you're lopping those off systematically, you'd better be sure that something else does what Bob Wolff says FPMS possibly does, or the Urban Studies Program did, or you won't have any money to worry about in a decade or so.

So it seems smart now to dump a non-mainstream, non-decision making part of the organization which isn't as vital or powerful or glamorous as plan formulation. But if you knock off everything with that function in terms of sensing opportunity and discovering it, elaborating it, teaching the societal environment about your capabilities, you're dead.

INGRAM:

Very well stated. The only trouble is it's sometimes pretty difficult to distinguish between what's a sensing part of the organization that's out there doing something different, and what's something which is dispensable.

SIMPKINS:

You have to know. You can't be wrong.

INGPAM:

You have to think hard about that question. All right, there were some other comments.

BEVERLY GETZEN:

One of the things that seems to me to be an advantage of trying to integrate floodplain management people into the mainstream of planning is that quite often I've found a dramatic difference between the types of non-structural measures that the FPMS people might tell locals were implementable and good plans and the ones that stood up against rigorous Corp review if they were part of the mainstream activity -- if they were going to be incorporated into the GI programs. And I think that the FPMS people purposely or accidentally were in some way left out of the ongoing rigorous standards to which everything else was subjected, and they needed to learn that process so the nonstructural measures they deal with could then become recommendable if we could find a local sponsor. A lot of them fail to stand up once you subject them to an economic and technical review. Any reaction?

INGRAM:

Well, it seems my next agenda item was to move on to your rigorous standards and to quote some people that say the rigorous standards are not rigorous, they're biased, and biased against nonstructural kinds of solutions. Do the solutions have to adjust to the rigor? Or do the rules have to change? And I think we might join that issue a little bit here. Chuck has made an eloquent plea that we shouldn't be slaves to the rules, that the rules were set up to facilitate the job we're doing. At the point at which they get in the way, then you have to change the measurement apparatus some.

All right, I don't know about these hopeful comments. Someone a little while ago said, "We have to help the economists see!" You know, I spent two years at Resources for the Future. I'm now happy that economists let me be. You really don't change economist's minds, so if you are expecting somehow to make them accept a benefit-cost ratio in their economic rigor that will reflect your point of view, that's probably quite frankly an empty kind of hope. Economists are very eclectic in the sense that they do believe their pardon covers everything. And if you have a non-quantifiable something or other, that's simply because they haven't gotten around to doing it yet. But they can figure out a bidding game, you know.

SIMPKINS:

If they don't know it, it must not exist.

INGRAM:

That's right. You either made it up or that's going to be their next kind of job. If you decide they serve you, you have to decide you can't ever convince them that we are not all in the service of efficiency and effectiveness as measured by economists. Well, clearly, in truth, I wouldn't be proud to be an economist. I spent two years at Resources for the Future. I have a right to say these things. All right, I didn't work with economists, but we worked with each other. I think we have separate chapters.

But let me throw that question open to you, please. Is it true that the analytics are biased against the process? Brian Moore early on said, "The reason why more things aren't coming out is that we don't have the same sort of infrastructure support to these things." We haven't got the logic behind it. The wonderful thing a BC ratio does for a structural project is it puts that stamp of approval on it. We don't have a similar kind of mechanism to put stamps of approval on different kinds of projects. Have you thought about this for a couple of days and come up with any ideas about it?

GETZEN:

Some of the nonstructural plans which did come into existence--and in our division Allenville would be a prime example--turned out to be situations in which new rules were created, or old rules were modified, or rules were bent a bit. I don't think we violated any rules. It's a very creative process and I suspect that if we go back and review the history of Indian Bend Wash and perhaps Prairie du Chien and others, in many of those cases they were somehow going around the process a little bit. They were not, as you said, part of the standard, traditional, rigorous process that would have happened in the structural projects. So some of them kind of got forced on us or we forced them on the system using a little bit of ingenuity. I don't know if other people had that feeling.

INGRAM:

Well, we're back to OMB, aren't we. If it takes those kind of analytics to get through....

UNIDENTIFIED:

It was interesting that Frank Thomas brought up that infamous interagency memorandum on nonstructural measures which in large part sort of resembled a regulation that policy planning worked on for several years which no longer could see the light of day -- under wrap, I guess, because it was too detailed and too much guidance. But OMB never signed that memorandum. Secretary of the Army adopted it for the Army because it represented sort of a state of the art or consistency with what many perceived to be the notions of how we would go about implementing nonstructural measures. But OMB refused to even go that far to lend its signature to a document espoused under the rules of nonstructural measures. So I think to answer the question--the extent to which rules can be bent or used, or innovative applications to rules, depends on the level of reviewing to which you're going to subject the innovation, and obviously if you subject it to OMB you'll probably result in crashing failure.

If you subject it to a division and district level, to the chief, if it's an innovative application of the rules, and the objective of that Army memorandum was to encourage nonstructural planning, I think you're home free. So, again, I think it's keeping decisions down to the lowest possible level.

BLAKEY:

I can make one observation. When we come up against these rules, or these economist's guidelines or techniques or so forth don't seem to serve to push ahead nonstructural, you've got to decide once again what your objective is. Is our objective to push nonstructural or to solve a problem? Of course we've got to all say our objective is to solve problems, with nonstructural simply being one technique.

Without making too big a case of it, I'm sure everybody would agree there's always safety in numbers. That's the reason the dam is a lot more successful sometimes than an evacuation. The evacuation is a specific that applies to a single case and has a single cost isolated with that single case.

There are some economies of scale there, but the dam starts off with a better case for it in the sense that the alternative is the levee whereas the dam is a small thing somewhere that serves a large number. So you've got a lot out of something small, such as a dam, no matter how big it might be, whereas in the nonstructural it's a very specific thing. Floodproofing may cost, floodproofing may benefit for specific residents or industrial sites as you might see so. I think we start off behind, a little bit. It doesn't mean that there are not other factors that make it far better than the dam, and in many cases, the dam falls of its own weight economically.

One other observation I noticed about OMB: from time to time, you have got to remember that they have a point of view, too. We may be looking for nonstructural, but they are looking for less expenditures, rational or irrational, so, if I work for OMB, I have a different perspective. They have only one perspective, and that is spend less money -- at optimum, spend no money whatsoever. So don't ever look for anything rational from OMB. Their point of view is different from our point of view. Their point of view is to not spend money. On the other hand, I noticed that a couple of us have talked about budgets going down and losing capability.

You can talk about the times today and the world change and all that business, but there was never enough money. There was never enough money for anything, no matter how we were operating. The challenge to us is to not only endure and survive, but to prosper in a climate where there is not enough money. Even our personal lives don't have enough money. So, just sighting in saying that we don't have enough money, you are implying that the answer is more money. I agree that is helpful, but it is not even most likely, so we just have to do the best we can with what we have. It is also true that, in rule changing, if you are talking about changing some economic rules to make nonstructural more viable, it is sort of like the tide that raises all boats. Because I think that you will also assist the structural solutions, too, in any innovative (as Peverly pointed out) changes you might make to rule twisting or bending. If you are willing to do that for nonstructural, it probably raises the boat of the structural solution just as well.

So maybe the answer is not necessarily in the rule changing either. I think that the big answer is what General Gay said in the first hour of this conference, that we are all here to learn, to make sure that we really understand what it is we are trying to do, that we understand where we are at the forefront of this technology of the nonstructural; that is the biggest answer: knowledge. I think the idea is a good idea, and it won't go away, and it doesn't need rule changing, I think, to help it. Because where it applies, I think it will be applied by people who are knowledgeable.

HANCHEY:

Lou carried us well beyond this simple evaluation issue to more global issues. But let me just come back for a minute in partial defense of the economists. We have really been beating them over the head the last couple of days. I think the root of our problem in evaluation is that we, as a nation, or the Congress, somehow have to accept national economic development as the objective of water resources planning. If you accept that as the objective, as what the Corps of Engineers is all about, then you ask the economist to develop the decision rules to help you measure whether or not you are contributing to national economic development.

They, in fact, have done a good job. I don't think that anybody who sits down and knows economics would argue they are wrong. They are, in fact, doing about as good a job of measuring our contribution toward national economic development as I think can be done given the state of the art. The real problem we run into is that some people argue, and they don't always explicitly state it this way, that there are other objectives besides national economic development; there are other reasons why we ought to be developing resources. We know what they are in general terms: environmental quality, social well-being, regional economic development. The economists have argued us back away from those kinds of concepts. They deal with it in terms of federal interest. What is the federal interest in water resources? It is national economic development. If we want to do regional development or social well-being, that is a job for the locals. If we can't deal with that issue in those kinds of terms, we are never going to convince the economists to change the rule. I think that it is the national objective, the reason why we invest, what we are trying to do, that is causing the hang-ups in our evaluation today.

SIMPKINS:

I took the economists to task from the point of view of philosophy of science where they are authoritarian without any real basis for it. I know better. I did not say that they weren't doing their job. I tried to characterize them as victims of some of their own lack of knowledge and methods with which they are trying to deal as technicians. They presume too much. That gets them into trouble. It is their way of going about it.

I said the other day that we have to take into account the institutional factors that make those people in that discipline, in this organization, behave in the particular ways that they do -- in dialogue, in decision making processes, and in the analysis process. There is no good and evil here. Those concepts are really silly. I use them in sort of an "ordinary language" characterization of another discipline that sometimes annoys me. It should annoy engineers more, actually. I am not beating on this issue you're talking about, and I don't mean to encourage that, I simply mean to caution people who have overstepped, perhaps, and are in part victims -- because of the abdication of engineers, in part.

But now, having said that, I do not agree that they do a completely good job according to the wider tenets of economics in any whole sense of the body of knowledge that exists today. And, as Mr. Harrison put it, the full historical scope of economics is political economy, which in any applied context of economics in the public sector, it ought to be still. National economic development is not served by the narrow bookkeeping that he was talking about, which has replaced wider responsibility in agency water resources economics. We have circumscribed Corps economists to a very narrow set of bookkeeping. Or they have done it to themselves. I don't know which. This is part of what needs to be unraveled after this is over. It is a problem that we all recognize.

National economic development: if you are not counting the transfer costs of some of the open-ended drains on the wealth of the nation, to help people, in a charity fashion, who are unable to help themselves -- if that does not go into the BC ratio, I am saying that is not rational, economic efficiency in the NED sense. I don't believe you can sell that to a seminar of thinking people anywhere in the country regardless of educational level after you define basic economic terms from the blackboard and tell them what empirically is going on.

INGRAM:

Well, if one looks at the real world, I guess that is a special case. But if one looks at the real world, you know that regardless of the benefit-cost ratio, it is only projects and programs with support that get by; and even with wonderful benefit-cost ratios, if you have substantial opposition, they don't. Very often, the analytics that economists perform don't measure that at all. The decision maker, thank God, knows that he has to listen to other things besides those analytics. John, I was going to ask you, don't you want to say something about risk assessment?

JOHN BELSHE':

Well, not so much that, though you could bring it back to that. Randy sets me on the path which may be parallel -- it is certainly not sequential -- to the one Chuck takes. I might have sympathies there. My mind is probably following up things that I have talked about earlier. Let me make a couple of points.

I think you may find that you see ambiguities here because some of the audience perceive the agency very differently than you do. I think the agency is quite willing to sell services anywhere there is a clear buyer for them. They are not sure where that buyer is, perhaps, on some of the nonstructurals. The Corps has been very "floodproof" for a long time. We have two parts, a military and a civil. In the days of the last couple years of civil austerity, we have certainly seen relaxations on the military. One of the hardest sells I ever had for a nonstructural flood program was on a military base where we were brought in to solve the problem of flooding, and we had both the structural and nonstructural; that was a very hard sell. But, it is an organization which is quite willing to sell services, for example, to EPA, as we are now doing on the hazardous waste cleanup and as we have done on the construction grants programs, helping the sewage treatment.

So the Corps is many things. I think one of the biggest problems here has been knowing what it can get in the way of reimbursement, particularly, worrying about the reimbursements in the years to come when we seem to be getting into even more formula grant type activities or cost sharing activities with locals. We are just not sure where those monies are going to come from.

The point that I wanted to make particularly was that we are a different agency, though, too. I would raise a question that is almost teleological with what Dr. Blakey says. When he says we are problem solvers, I would sort of ask the question, "If the solver is a part of the solution, can he any longer be just the problem solver?" I am saying this with perhaps a little levity, to point out to you that this is the very year where our operational budget has for the first time exceeded our construction. The Corps not only completes projects, which some might say solves problems, but it many times retains a vested interest. I would suggest that it has really not solved the problem, but turned it into management problem.

I think, of course, of us very much as a natural resources agency. I think that we are custodians already to 12 million acres of land and 430-some projects. In many of our projects, in solving the problems, we are extending that managerial stewardship responsibility. On that point I would say, for those who have been observing, that I have been probably here sitting at times with a bowed head, wondering a little about what it is we are trying to approach in the way of management. Perhaps the dark and troubled waters of flood stage have not permitted me to grasp that well enough, so I have been sitting here contemplating those clearer, colder streams of wildlife management laws.

That is a prestigious law that goes back for about 600 years. It has, essentially, four goals in wildlife management law. I think these four goals

are reflected to some extent in floodplain management, or should be. Perhaps they are not now, but they could be. These goals are (1) to have essentially maximum sustained yield, a good management program for a renewable resource; (2) to give special benefit to certain sectors of society, such as was the case of a lot of game laws in Europe, to which a lot of colonial areas rebelled, and to which some of our noncolonial areas have seceded. You find, today, game laws that do favor the few in some areas, in some states. (3) There are also game laws which are brought in, essentially, to be there for the good of the animals, to do something protective for the resource. They are trying to take not an anthropomorphic view of it, but something that is truly from that standpoint. Finally, the one that I think that we have, perhaps, spent a disproportionate amount on, is (4) the goal of trying to force some social pattern of behavior. These are the sorts of game laws where you say you don't use a cannon, you don't throw a bomb, you don't use a net to get the game. You limit certain ways of taking. I think all of these strategies have some potential in floodplain management type of resource problems, etc.

I don't see anyone really articulating the community standpoint; that is, the community has a viable value. We have only gotten to the point of species-by-species elaborations of that in the endangered species. Nobody has yet come forward, I think, with community protection type things, though I do hear it being mumbled about occasionally. But, so far, it is not moving.

The other two, where I think we have spent most of our time, are that of self-serving certain sectors of the populace. We are very self-serving. We are serving very narrow interests frequently. I would suggest, in fact, that that is maybe one of the hang-ups we have. Even when I hear about Prairie du Chien, I am wondering if we are not trying to give subsidy there. I think a lot of people are worried about undue subsidy to the beneficiaries there. It ended up, in retrospect, with the benefit-cost ratio, a low unit. It is one that I think as an organization we have reason to ponder.

When I hear about the emergency warning systems, I am wondering if the middle class -- who are able, often, to call us in to ask for problems to be solved -- not using emergency protection measures as a way of broadening the base, of getting, perhaps, lower income people in whereby, with removal of their real property, they are increasing the benefits in helping make the viability of that project even more, perhaps, apparent.

We speak of problem solving. But what do we really mean by problem solving? I think that the meeting here has skirted around, a couple of times, that duality problem that we have in defining what is the solution. Is it the here and now? Is it the immediate thing that Johnson was talking about in his probabilities and benefits for the flood protection you can give now? Or is it the opportunities we are trying to create for future developments -- which have been bleak years in the 1970s -- which are traditionally a lot of flood control benefits, and which traditionally are what have given you structural solutions.

Then I would raise the question if we are indeed moving between this area of trying to do something for favored sectors of the populace, as opposed to,

say, trying to force some behavior pattern, which might be what the executive order was trying to do. It perhaps followed up and implemented the executive order on floodplains. It was trying to make some behavioral pattern on society.

These two solutions, still, have not attached the very first one I have made by analogy to wildlife management. That is, what is really good management of that resource? We have not in any way tried to effect well a policy that is wise in its management vis-a-vis crops that are appropriate for floodplain areas. Too often our policies give some major protection. Perhaps one of the most favored sectors of society has been the agricultural one. We give very favored protection for them to come in and do upland-type farming in floodplains, rather than trying to have a policy to force them to do a type of agriculture that is appropriate to the floodplain. We encourage them to bring in one that is alien to the floodplain and thereby forever change that very floodplain.

We have not a happy mix between our uses, needed uses. We do not have a happy policy of blending these rural versus urban, industrial versus private dwelling, type uses of the floodplains. There is little attempt there. We are spending almost all of our time in that other area of either trying to be sure that we are not unduly favoring some sector or trying to force the behavior in some behavioral pattern.

INGRAM:

What a sobering set of remarks! I thought we were beginning with, "Are we solving problems or are we building projects?" Now I am even more discouraged about knowing success when I see it, because you are telling me, sort of, what I tell my students. That is that you never solve problems, you just create new problems, and the only question is whether you like the new problems any better than you liked the old problems. What you are sort of saying is that we are creating a lot of distributive problems and a lot of ecological problems and management problems, and we haven't looked hard at what is falling out. Are they going to create a situation we like any better as we work to solve some of these problems?

BELSHE':

Perhaps, even adding to that, I am trying to suggest that some of these solutions may be rather temporary ones, and rather unstable ones without getting to what Don Duncan was talking about -- trying to get full value for what is there, but at the same time, preventing mistakes being repeated in society's future. We may be forcing a certain temporariness and an instability in our solution which is undesirable. We have got to get to a broader resource management view if we want to get to something permanent.

INGRAM:

This may be a poor time to bring this up, because to some extent what you have raised are problems for at least a couple more seminars. It's not anything that we are going to come to closure on today, but some very helpful,

provocative comments for me. Thank you. While we are on this question of evaluation -- and we have gone much broader than that simple kind of fix that I was talking about earlier -- are there more comments about that, or shall I move on to the third group of things I thought we might talk about?

SIMPKINS:

Just a very short comment. The Corps is probably one of the best agencies in the nation as a sort of hybrid between environmentalism and developmentalism because of the environmental mandates it got dropped on it by Congress. We are a prime agency to solve it, because we have it within ourselves. I think that this nonstructural thing brings us right abreast of that one more time. If we don't get the integrated synthesis of those two things into these situations, the alternative land uses problem won't be solved and the benefit problem will be less well solved. We, more urgently, have to solve it more than anybody else.

INGRAM:

John reminds me of a wonderful paper I read once about the ecological benefits of flooding -- the extent to which flooding is absolutely essential for the river ecosystem further downstream because of the kind of nutrients it picks up for fish and the kinds of jobs it does. Those benefits need to be taken account of, whether or not they are measured in an NED account.

SIMPKINS:

We can't have the internal adversary relationship between those two points of view any longer. We have got to integrate them. We once again have the catholic mission that can do that. And we'd better do it.

INGRAM:

You are more optimistic than I. I live with conflict. I didn't expect you to straighten me out on this. I really didn't think you were going to be able to speak with one voice in a way that I could go back and tell my students, "This is what the Corps thinks." Indeed, I think you do think many things, and that is probably very good. The other kinds of things that we were going to talk about is a question of building support for projects. Especially early on, there was an enormous amount of discontent about the ungrateful public that didn't like the things that were carefully crafted and delivered to it.

Dan Mauldin talked about Peachtree Creek in Atlanta, where they included too many people without a clear interest and they killed the bond issue. Other people said that if there is a feasible structural alternative, the locals will lose interest. Somebody said we need a crash program with PR. I guess that nonstructural alternatives present the Corps with new kinds of chores and tasks in terms of how to relate to state and local people. I thought we might talk about that a little bit. Larry, you might begin with some of your thoughts that you have not had an opportunity to articulate.

LARRY LARSON:

This has been a real interesting experience the last three days. It is amazing. I don't know if there is anybody in the Corps of Engineers who does not support nonstructural. Surely, they are not here. At least if they are, they have been very quiet in the past three days. We have all sat around and talked and supported nonstructural highly. As I told General Gay once, at a previous meeting he and I were at, I fear that nonstructural suffers from the Charlie Brown syndrome. As Charlie Brown said as he stood on the mound, "I don't understand how we can lose so many ball games when we are all so sincere." Chuck gave us, today, some excellent insights into some of the things, some of the personality and attitude things that may cause impediments to implementing nonstructural measures or toward helping locals implement nonstructural measures. I would like to share, from the perspective of a state and local position, the way we kind of hear what you say. It may not be what you say, but it is what we hear you say. I might suggest some of these to you in that light so that you can consider them. Think about how you sound.

We have talked about the need for bottom-up planning, that we must get away from top-down planning. I don't believe we have broken that yet. I think we give lip service to "their plan," meaning the locals. Let me feed back to you some of the quotes I heard in the past few days. Someone said, "Locals prefer structural." I mentioned briefly yesterday that a lot of that may have to do with how you talk and present that to the locals. We have talked about the cost which may discriminate. How are the alternative solutions approached or sold or discussed or brought forth to the community? It is a PR job. How do you sell the alternatives? We have had some bad examples in the past that have killed nonstructural, and some of you have shared with us some of the problems you have had in trying to even talk about them; they have gotten killed in the beginning.

When you do it, do you make it clear that structural projects carry a long term cost for operational maintenance forever? Do you point out the adverse impacts -- the fact that levees in fact may encroach and cause increases on other people, or do we get the right bank, left bank situation we have heard about? I hope some of the horror stories of trying to sell your solutions aren't happening much anymore. We all heard about those 10 or 20 years ago. I hope they are decreasing.

You have to be very careful, of course, what you talk about to locals, because what they hear is the good part -- what they want to hear. So you have to say the good part once and the bad part 10 times. Have you clearly pointed out what all the local costs are and what all the local benefits are in nonstructural, even if they aren't accountable in your BC?

Are you selling a social solution and not an engineering solution? I thought -- and Chuck made an excellent point that you really are, first of all, civil engineers, which means you really are selling social solutions. You have some expertise that you can evaluate them or design them in an engineering sense, but you are really dealing with social solutions in nonstructural. There are a number of factors that encourage that. Are you

bringing those out? The 65-35, I think, will help encourage more careful evaluation of these kinds of things.

Whose floodplain is it? I am going to feed back to you some more quotes that I have. I quote: "We gained approval of nonstructural." We gained approval, meaning we, the Corps, from the locals. "As we change cost sharing, we should expect more input locally." Someone said, "We did a local study and told them what to do. Here is how you can solve your problem." Someone from NWS said, "Local warning plans are better if there is some local involvement." I would hope so. My point is that you probably need to change your lingo, your language and thinking, a little bit. It is like saying we need more "manpower." I am sure your intent, when you say that is simply to say that we need more staffing and that is what you are thinking. But I can assure you that some of your female colleagues get turned off by that particular language. You may think that is stupid, but it is fact. When locals hear you say, "We're going to solve your problem," or "Here is your solution," they get turned off. So I would encourage you not to think of it as your floodplain. It is their floodplain, it is their problem and you are there to assist.

How can you assist? Should the Corps try to shape and implement nonstructural? There are some interesting questions Helen brought up. Or is there, in fact, some better way, some better agency -- I don't know at what level -- to assist the locals and when they need your particular types of technical assistance, come in and ask for them. Chuck suggested that the Corps be the lead agency in technical assistance. I am not sure that I am comfortable with that. More importantly, I am not sure you are comfortable with that. If local problems are a mix of local needs and require a mix of nonstructural and structural solutions, and that mix is really social solutions, here again, is the Corps the best agency to help package that together?

Frank Incaprera and others have suggested that perhaps memorandums of understanding between the agencies will help to split the pie. I encourage that. I wouldn't worry about using technical assistance that cannot be implemented. I agree with Bob Wolff. I think if you develop the solutions locally and if you cannot implement them, it will come to a point where others will either implement them, including those locally by themselves, or there will be a groundswell that will bring forth the need that will create a program that will help to implement them.

INGRAM:

Do we have some reactions, or are you going to let him get away with that?

UNIDENTIFIED:

Someone brought up the federal interest on the first or second day. Several of the field people have been questioning the federal role in nonstructural measures. In terms of traditional federal interest, it seemed that we always looked upon it as being federal interest equated to federal financing, and where Congress passed a law creating a federal interest, they

created a substantial amount of federal financing, therefore, we had one in the same. Under the current administration view, there is a federal interest without federal financing -- which is strange to us, I think. In terms of another federal interest, as opposed to federal financing, would be regulatory. So you have on one hand traditional federal financing or regulatory, one or the other. Through this conference I have tried to come to grips with the in-between, which is sort of a catalyst kind of orientation, where we are supposed to be the catalyst to bring everything together, but we can't offer the big program dollars -- not for implementation. We can for the catalytic kind of action for the planning.

Is that really a federal interest? Is there really a role there for the Corps either in the near term or in the long term in that in-between kind of orientation that we are really not accustomed to? It seems, with the economy the way it is, maybe that's okay. But it gets back to the question that Randy raised; that is the emphasis of deregulation, so we are going to become less regulatory. We are going to have less of a construction program, throwing us more into the catalyst orientation. Is that enough to maintain an agency and a capability which in the long term will be around to exercise those expertises, in either direction that we have been called upon to exercise them.

I guess, optimistically, I would feel that there are again going to be times where there is a need for federal programs, and that by being a catalyst we will be there to create an opportunity for the dollars to come to this agency as being the capability to execute a program if, nationally, there is to be one. I guess, pessimistically, you have to say, "Well, going after that catalyst orientation is just not getting us anywhere." I guess I am the optimist. In the event that Congress or the administration -- and perhaps Congress will keep putting in the program dollars -- can't put the program dollars in, what alternative do we have but to be an effective catalyst and keep up whatever expertise we possess? Maybe someone else has some comment on the role of the Corps of Engineers as a catalyst, rather than as a regulator or as a construction agency.

EDMUND PENNING-ROUSELL:

I am Edmund Penning-Rousell from London. I haven't got an answer to that question. That is something you have to settle yourselves. I would like to say that it has been a privilege for us to be at this seminar this week and to join in your discussions. It has been most interesting. Just a few points of observation: It has been said that the flooding problem is their problem. I would agree with that. But there is a great problem here, and that is that people forget. People forget very quickly, and yet, in a nonstructural area, the problems need to be uppermost in their minds all the time. In order for the thing to be implemented, it has to be. A relocation scheme has got to have a real momentum behind it. I don't suppose you could do a relocation scheme 15 years or 25 years after the last flood. People have forgotten. That is what they have to have uppermost in their minds. That's a real problem, to keep it uppermost in their minds.

The same with the insurance program. You have a compulsory insurance program. We don't have a compulsory insurance program; therefore, people have to keep renewing their premiums. But after the flood hasn't occurred for five years, they may forget to reinsure. A warning and preparedness system, about which we've heard a lot this week -- obviously, I think there is going to be more discussion about that. But you have got to keep it uppermost in the minds of the community. How do you do that 10 years after the last flood?

Really the role of the Corps of Engineers, and the same with our water authorities in Britain, is to be the collective memory. You've got to be the collective memory, because, otherwise, people forget. It is particularly important in nonstructural areas, because people will forget. In the structural area, a collective memory can be concrete, that you can put down. In the nonstructural area, if the collective decision becomes a preparedness plan, which in fact people forget about, it's not going to work. That's the first point.

The second point is that I have been immensely impressed this week with the sincerity and openness of the people in the Corps of Engineers to say that you don't know what the solution is -- to say, "We can do things, but we don't know what to do." I think perhaps that is the most useful attitude to have in a body of professionals, rather than say, "Yes, we can solve all your problems. Come to us. We can do it." They ought to say, "No, we don't really know what to do, but we will try to find out; we will sit down and think about it." The sincerity in questioning that has impressed me more than anything else this week. So, to use the phrase of the week, I am not in the Corps of Engineers, but I'd be proud to be.

INGRAM:

That was a nice compliment. I think he even answered part of your question. I was going to ask you what you meant by catalyst. At least part of what you mean by catalyst is collective memory. No state can really afford to have an Army Corps of Engineers. The nation can. Maybe it can afford to keep it even if it is not building things with concrete for a year or so. Maybe having it is like having a great university, which is something else I sell. Even if you don't need it this minute, you need it as a nation. That is important.

GETZEN:

We are indeed a collective memory, and we also are explainers. Sometimes a bad PR job is a job we do to ourselves. We sometimes try to hide the fact that we don't know something behind a lot of fancy phrases. What we all could try to do better is remember that the simplest explanation is the best in many cases. Sometimes simply saying, "I don't know, but we will help you find out," would be a good answer to make. It is very difficult for a lot of people in a technical field to say, "I don't know," but is it easy to say once you let it roll off your tongue.

I think we have quite often been our own worst enemies by failing to do a good job in working with the local people. It is not that we are selling anything; certainly under the FPL3 program we are performing the service because the people ask us to do something, so I don't really see "selling" involved. But I see the explanation, a good explanation of what is happening and what they can do to solve the problem. The public part with the involvement process ought to prevent us from ever saying we are selling our plan to those people. If we ever say that, we failed somewhere in that process.

INGRAM:

I want to close by saying I believe that learning to ask good questions is a lot more important than finding answers -- really much more important. I feel really good about that. I think we have ended up with some first rate questions that ought to keep you all going for a while.

DONOVAN:

Let me thank you on behalf of all of us for conducting a very effective two-hour session on the general issues. We are going to finish up with General Gay. Allow me to say a couple of concluding things. The first thing I would like to say is after what I have heard over the last few days, I want to make it clear that I am really not an economist. If you look at my background, you will see that I am trained as a forester. I have kept my lifetime membership in the Society of American Foresters. Anyway, what I really want to do is express some "thank you's" to a variety of people who have helped tremendously in doing most of this work and bringing at this seminar together. I would like to thank all the speakers and all the panelists, and, of course, the general audience.

CLOSING REMARKS

## CLOSING REMARKS

BG FORREST T. GAY III:

The Corps of Engineers is in "whatever business it is in," whether it's water resource development or building air bases for the U.S. Air Force or camps for the Army or infrastructure for the Saudi Arabians, or air bases for the Israelis. We're in the business of planning, designing, and constructing so that if--God forbid--we ever have to go to war, or get ready to go to war, we will be here. The Corps of Engineers is a national asset that the nation turns to in time of adversity, when we have to build roads, when we have to build airfields and ports, barracks and training camps. When those things have to be done as they were in the 1917-1918 time frame, when they had to be done in 1940, the Corps was there.

It looks like we're going to need something like 50,000 to 60,000 people to do the work that we're going to have to do if we ever have a World War III. Now, we can either stockpile people, we can stockpile buildings, or we can stockpile ideas. But I think the best approach is to stockpile all of those. And the people that we stockpile: we keep them doing useful things for the United States, for our foreign policy, and for our national well-being.

In that perspective, nonstructural alternatives are an integral part of the kinds of things we can do. They test our mettle; they keep us challenged; they bring people to the Corps and keep people in the Corps who welcome the opportunity for challenge. We have to keep that because if we don't, and we're not there--if the Corps is not there, if nobody's there when the bugle is sounded and the balloon goes up--the fate of the nation may be at stake. So it's not hard for me to say the Corps is in the business of staying in business, because I mean it and I hope we can stay in business. And we'll do anything that we can to keep those kinds of people and to keep those kinds of skills ready for this nation when we need them.

A number of things I've learned from these three days here: I used to think that nonstructural was my particular bag and nobody else cared about it. I found that's not true. There are a whole lot of people who care about nonstructural terms. When I commissioned this study on the bluebook, as I call it, in St. Paul, it was because I found some inconsistencies in what was being said at the national level and what was being done at the local level. In fact, in the preface of this book I put down some words from President Carter. He said, "Nonstructural alternatives are often more cost effective and less environmentally damaging than structural measures. Therefore, we need to emphasize them." I put down the Chief of Engineers' words, which said essentially the same thing.

But I was finding, as we were trying to bring Prairie du Chien on line and as we were looking at other ways of having nonstructural alternatives implemented then, we just couldn't do it. We had to find some way to bring national policy words into being on the graph. There are still a great many difficulties, as those of you here have eloquently pointed out. But I think

at least one thing has been served by this three-day seminar--and I've been proud to be a part of it for three days, too--and that is that we've increased our awareness of all the facets of nonstructural alternatives.

I think each one of us has learned something from the others that have participated here: that there's a wide range of things that you can do nonstructurally that certainly makes sense from many perspectives, one of which is economic--and for the time being we're stuck with economic rationale for these things--but there are many other reasons for them as well.

I, for one, had not thought much about flood warning and preparedness planning as an effective measure. I have a different perspective of that nonstructural measure now. It's probably the most cost effective one that we have, and we shouldn't turn our nose up at it just because it doesn't result in any "big-buck" projects for the Corps of Engineers. Even when the best you can get may be 30 or 40 percent savings of those things which are in the floodplain, that's pretty good when you don't put a whole lot of money into it. And I think that's a worthwhile reason for providing nonstructural protection.

We need some goals. Maybe one of them has to be to preserve nonstructural alternatives as viable alternatives. I still have a question about are we using double standards. I don't know, but I'm going to ask the folks here to tell me after this is all over with. Are we really using double standards for structural and nonstructural? I don't think we should.

I'm glad to see Larry say that the states are becoming activists in this business. It's long overdue. We're pleased to have the states involved. It's pretty tough when a national agency is dealing with a locality and the state's wiping its hands of it. I think the "new federalism" promotes that as well. I think that's a welcome alternative.

Do we want nonstructural alternatives to flood problems to be a social program? I've heard some people imply that that may be what we're after. If that's the case, maybe we should give them to HUD. Maybe we should give them to Health and Human Services. But if they're going to remain a part of our bag of tricks, they've got to be made viable by our rules, even if those rules have to change. Don't let the professors become the spokesmen for nonstructural solutions. We're better experts than they are. Why don't you guys publish? You won't perish, but you could publish anyway. I'd like to see some papers written on the subject from some of you in this audience.

I would like to propose another discipline. I've heard about sociologists and public relations experts and engineers and economists. I took a course once in social anthropology, and I think that's what we need--some social anthropologists, agents of change, because that's what you are. If you're trying to change the way people live and you want to make it happen, you've got to be a social anthropologist or have a knowledge of social anthropology. You've got to get into the minds of these people and into their way of life if you're going to make the program work. By asking questions, you influence the answers. So you've got to be careful how you phrase your questions.

I'm reminded how easy it was for the St. Paul District and Prairie du Chien to mark the floodplain with the high water mark from a flood record. Those signs, I hope, today are still there, those little two-inch by three-inch metal markers saying "Flood waters reached here in 1965." That's a visible reminder--and there are hundreds of them around--to anybody going into Prairie du Chien, whether they live there or are just visiting, that flood waters can get that high. And when you're living there and you're living below that level, you tend to be a little bit nervous; that's pretty healthy.

I'm also reminded of an unsuccessful attempt to do the same thing in West Fargo, North Dakota. We tried to put the same signs up, but the real estate people wouldn't let that happen. It would depress the values of real property around there. That's certainly a way of heightening awareness, and someone here mentioned, "Keep people aware." They won't think beyond the five-year or 10-year flood event. If it gets beyond that, they've completely forgotten. Let's mark it so they'll know.

I think there will always be a place for nonstructural alternatives as a part of an overall flood-control solution. There will always be a use for it--a little piece here, a little piece there. The big question for me now, and for us to wrestle with in our policy study, is, "Is there a place for nonstructural alternatives pure and simple that will stand by themselves, with maybe a little structural piece to go along with them?" I think there is support here for that if we can make it work. Perhaps to make it more viable we need to modify our rules or change the laws. We won't always have the same rules. We can change those, but we're always going to have the same OMB. They're always going to have the same objective in mind, and that is to save money. We're going to have to show in whatever way we can that not only do nonstructural solutions make sense from an engineering standpoint or a social standpoint, but they also make sense from an economic standpoint. We have to prove that.

I would hope that after this is over you will continue to give us your feedback on this conference--what you think about it, any ideas you might have for incorporating into our policy study. The proceedings won't be published until after the first of the year. We publish in the first quarter, so we'll have a chance to consider your thoughts upon reflection when you get back home. We'd like to have those. As I told Helen earlier, I think with all these things in hand, with our policy, we can pick out the proper avenue down which to march with confidence. Confidence can be epitomized by the man who's going after Moby Dick, and all he takes are a rowboat, a harpoon, and some tartar sauce. So I'm looking forward to the results of our policy study, and I've got my tartar sauce ready!

APPENDIXES

APPENDIX A  
BACKGROUND NOTES ON SPEAKERS

## WILLIAM J. DONOVAN

William J. Donovan, with a professional background in natural resources management and policy, economics, and regional planning, is a member of the senior staff in the Planning Division, Directorate of Civil Works, Office of the Chief of Engineers. For the past two years he has been chief of the Flood Plain Management Services and Coastal Resources Branch. Previous assignments with the Corps of Engineers include five years as chief of the Plan Formulation and Evaluation Branch and four years as chief of the Economic and Evaluation Branch. He has brought an interdisciplinary interest to all his planning assignments, emphasizing a concern for the integration of economic, social, and environmental considerations in decision making.

He acquired his initial interest in natural resources and related environmental activities and problems as a Civilian Conservation Corps (CCC) enrollee in the state of Oregon. After more than three years of service in World War II, he commenced his formal education in resources management and planning. He has a B.S. in resources management from the College of Environmental Science and Forestry, State University of New York at Syracuse; a masters degree in public administration from the Kennedy School, Harvard University, where he was awarded the Zellerbach conservation fellowship; and a masters degree in economics from American University. He has done considerable additional graduate work in resources planning and economics at the U.S. Department of Agriculture Graduate School and at Colorado State University.

In addition to his employment with the U.S. Army Corps of Engineers, Mr. Donovan has wide-ranging experience in land and water resources problems and programs as a forester and resource manager, natural resources planner, biologist, agricultural economist, and budget examiner (water resources) during extensive previous service with the Department of the Interior, the Department of Agriculture, and the Office of Management and Budget, Executive Office of the President.

## H. JAMES OWEN

H. James Owen is the principal of Flood Loss Reduction Associates, located in Palo Alto, California. He is a civil engineer with 20 years' experience in water resources planning and management as an employee of the states of Illinois and Nebraska and as a consultant to federal, state, and local governments and various private firms. Mr. Owen's practice is specialized in the area of nonstructural measures for flood loss reduction, with emphasis on flood warning and preparedness programs. He has authored a number of guides and manuals on flood warning and preparedness for the Corps, National Weather Service, Federal Emergency Management Agency, and others. He is also the principal author of the Water Resources Council's handbook on flood plain management and the Corps' guidelines for emergency planning for dams.

ROBERT L. CARNAHAN

Robert L. Carnahan is a native of Holton, Kansas. He holds a bachelors degree in meteorology from the University of California in Los Angeles and a masters degree in civil engineering from the Johns Hopkins University. His past experience includes two years as a staff engineer in the Water Waste and Weather Group of the Engineering Service Division of E. I. duPont de Nemours and five years as staff meteorologist for the Travelers Weather Service in Hartford, Connecticut. In 1960 he joined the Travelers Research Center in Hartford and ultimately became vice president and secretary of the corporation.

In 1970 he came to Washington as deputy assistant administrator for administration in the National Oceanic and Atmospheric Administration and, in addition, served as special assistant for industrial meteorology. In 1979 he moved to the National Weather Service as chief of the Warnings Coordination Staff, directing disaster preparedness activities and a special project for improvement of flash flood forecasting in the central Appalachians. Early in 1982, he moved to his present position as chief of the Industrial Meteorology and External Affairs Staff, a position in which he has oversight of the interagency activities of the National Weather Service and maintains close liaison with many of the external users of Weather Service data and information.

Mr. Carnahan is a certified consulting meteorologist and a charter member of the National Council of Industrial Meteorologists. He presently serves as the National Oceanic and Atmospheric Administration representative to the Federal Radiological Preparedness Coordinating Committee and the advisory committee to the Natural Hazards Research and Applications Information Center in Boulder, Colorado.

JON A. KUSLER

Jon A. Kusler is an attorney, author, and president of J. A. Kusler & Associates of Chester, Vermont. He has practiced environmental law for 17 years and has published many reports dealing with floodplains and wetlands, including Volumes 1, 2, and 3, Regulation of Flood Hazards to Reduce Flood Losses and Regulating Sensitive Lands and Strengthening State Wetland Regulations.

COLONEL GERALD E. GALLOWAY, JR.

Colonel Galloway is professor and deputy head of the Department of Geography and Computer Science, United States Military Academy, West Point, New York. His principal academic interests are in the fields of water resources program management and evaluation and computer mapping and statistical analysis.

Following graduation from the U.S. Military Academy in 1957 and commissioning as a second lieutenant in the Corps of Engineers, Colonel Galloway served tours of duty with the 3d Armored Division in Germany; with the New York Engineer District; as aide de camp and special assistant to the

Superintendent, USMA; and as operations officer with the 45th Engineer Group and later the 1st Air Cavalry Division in Vietnam. From 1968 to 1972 he served in the Pentagon. In 1972 he was assigned in Vietnam, first as commander of engineer activities in Military Region I, the northern quarter of Vietnam, and then as assistant U. S. Army Vietnam/Military Assistance Command, Vietnam, engineer. In 1973 he served a special duty tour in the Office of the Chief of Engineers, studying worldwide base development activities. From 1974 to 1977 he was assigned as district engineer in Vicksburg.

In 1977 Colonel Galloway was appointed as a professor at the U.S. Military Academy. Colonel Galloway has been awarded the degrees master of science in engineering from Princeton, master of public administration from Penn State University, master of military art and science from the Army Command and General Staff College, and Ph.D. in geography from the University of North Carolina at Chapel Hill. He is a graduate of the Army's Airborne and Ranger Schools, the Army Command and General Staff College, and the Army War College.

Colonel Galloway holds the Legion of Merit (with two oak leaf clusters), the Bronze Star Medal, the Meritorious Service Medal, the Joint Service Commendation Medal (with two clusters), and the Air Medal with cluster.

He is a member of the American Society of Civil Engineers, the Association of American Geographers, and the American Water Resources Association; he is a registered professional engineer in the state of New York. He is the author of several reports on water resources management and evaluation.

#### FRANK H. THOMAS

Frank Thomas, senior policy specialist in the Natural Hazards Division of the Federal Emergency Management Agency, is responsible for the Unified National Program for Flood Plain Management and for the review of the implementation of Executive Order 11988, Flood Plain Management, being carried out for the president's task force on regulatory relief. From 1975 to 1982, he directed the flood plain and wetlands management programs of the Water Resources Council. Before 1975, he served as department chairman and professor at Georgia State and Southern Illinois universities. As author of several articles on flood plain management, he served as the United States member of a work group which prepared documentation for the United Nations' 1977 conference on water. He earned a Ph.D. from Northwestern University and a B.S. from the University of Illinois.

#### EDWARD T. PASTERICK

Edward Pasterick is deputy assistant administrator for insurance operations with the Federal Insurance Administration. He has been with that agency since 1973, first as a program specialist in the Operations Division of the Office of Flood Insurance (1973-77), and later as deputy director of the Operations Division, Office of Financial and Administrative Management (1977-78). Before joining the Federal Insurance Administration, he was an equal opportunity specialist in the Buffalo Area Office of the Department of Housing and Urban Development (1971-73), and from 1968 through 1970, associate pastor of the Blessed Sacrament Cathedral in Greensburg, Pennsylvania.

Mr. Pasterick holds a B.A. in philosophy from Josephinum College in Worthington, Ohio, and an S.T.B. in theology from the Catholic University in Washington, D.C.

#### LARRY LARSON

Larry Larson is currently chief of the Flood Plain and Shoreline Management Section of the Wisconsin Department of National Resources, a position he has held for the past five years. Before his present job, he had 10 years' experience working in flood plain management and other local zoning issues, including shoreline and wetlands regulation and permits and dam safety. In the five years previous to that he was with the California Department of Water Resources, where he designed dams and other hydraulic structures.

Mr. Larson holds a degree in civil engineering from the University of Wisconsin at Platteville. He is co-author of the 1980 National Science Foundation study on flood hazard mitigation. He was a member of the working group from Wisconsin on President Carter's federal-state task force for alternatives to La Farge Dam. He also served as the Wisconsin representative on the "Great River" study. He is presently executive director of the Association of State Flood Plain Managers, an organization which he previously chaired for a term of three years.

#### WILLIAM K. JOHNSON

William K. Johnson is a civil engineer with the Hydrologic Engineering Center (HEC), Corps of Engineers, Davis, California. At the HEC he has been responsible for research, training, and special assistance projects in water resources planning, including nonstructural flood control and water supply planning. He is author of a widely used HEC research report entitled "Physical and Economic Feasibility of Non-Structural Flood Plain Management Measures" and has published technical papers in various water resources journals. He is a member of the Executive Committee of the Water Resources Planning and Management Division, American Society of Civil Engineers, and lectures in water resources planning at the Department of Civil Engineering, University of California, Davis.

#### LAWRENCE N. FLANAGAN

Lawrence N. Flanagan, a native Mississippian, attended Mississippi State University, receiving a B.S. degree in civil engineering in 1960. Mr. Flanagan has spent his entire professional career with the Corps of Engineers, having served in the Memphis District, Vicksburg District, and presently the Lower Mississippi Valley Division. He became chief of the Flood Plain Management Services Office at the Vicksburg District in November 1969 and served in that capacity until February 1974, when he became assistant chief of the Planning Division for Flood Plain Management Services at the Lower Mississippi Valley Division. He presently holds that position. He has been actively involved in research on flood proofing residential structures for

several years and serves on the Corps' Committee on Residential Flood Proofing.

Mr. Flanagan is a registered professional engineer in the state of Mississippi and is a member of the American Society of Civil Engineers.

#### CHARLES EDWARD SIMPKINS

Charles Simpkins holds a bachelors degree in government from the University of Arizona and a doctorate in sociology and the philosophy of science from the University of Minnesota. He has taught formal organization, social stratification, and social theory and research design at Minnesota, at Macalester College, and at Lawrence University of Wisconsin.

In 1976 he joined the Corps of Engineers in the St. Paul District, where he assumed responsibility for social impact assessment. He proposed the concept of social analysis as a broader application of social factors and research methods in planning, which allowed for design for social betterment as well as measurement of adverse affects. He planned a program application of social research functions to Corps planning.

In 1979 he began work in his present position at the Institute for Water Resources, where he has continued developmental research in the application of concepts in social organization and social psychology in a broad "social analysis" approach to water resources planning and decision making. He manages a course in social analysis, developed a course in environmental quality planning, served on the Tug Fork and the National Waterways Study teams, and is about to begin a three-year research and development effort toward a planning resources and information management system to be integrated into the Corps-wide finance and accounting report system.

#### DAVID J. MILLER

David Miller received his baccalaureate in psychology and sociology from the University of Minnesota in 1976. After finishing a research appointment at the university, he took a position in the St. Paul District of the Corps in February 1977.

He began work in St. Paul doing social impact assessments in the Environmental Branch in close interdisciplinary liaison with study managers and economists in the Planning Branch. He contributed to developmental work toward full integration of social research on human organization, values, perceptions, and behavior into the interdisciplinary planning process. In 1979 he assumed supervisory responsibility for social analysis in the district.

Since 1979, he has developed a systematic program of social analysis functions, serving all district elements. He has done much to advance the early integration of sociological and psychological factors in the planning process, thus using social research to avoid many human adversities of planned change rather than measuring them after decisions have been taken. Mr. Miller recently became chief of economic and social analysis in the new St. Paul Planning Division.

APPENDIX B

CORPS FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING NONSTRUCTURAL MEASURES

**FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING  
NONSTRUCTURAL MEASURES**

<u>DIVISION</u>	<u>DISTRICT</u>	<u>STUDY/PROJECT</u>	<u>NONSTRUCTURAL MEASURE</u>	<u>STATUS OF/ STUDY/PROJECT</u>
NED		1. Upper Charles River Natural Valley Storage Areas	Acquisition of wetlands and adjacent areas to preserve flood storage capability	Under construction
		2. Section 205 Pawtuxet River, Warwick, Rhode Island	Acquisition of land and residential structures, flood-proofing; raising	Approved DPR
		3. Section 205 Berkeley Local Protection, Warwick, Rhode, Island	Closure of openings (bricking and blocking); ring walls around industrial complex	DPR under preparation
		4. Housatonic River Basin, Massachusetts	Flood proofing; flood walls	Negative Report, but identified areas to be considered under Section 205 authority for nonstructural plans
		5. Connecticut River Basin: Springfield, MA	Wall raising; computerized flood forecasting and warning system	Approved DPR
		6. Connecticut River Basin: Northampton, MA	Flood proofing; small levees	Small project under study
		7. Connecticut River Basin: Keene, New Hampshire	Section 205 involving combination structural/nonstructural	Under study
POD		1. Waimea River, Hawaii	Levee with early warning system	DPR not yet approved
		2. Aiehaio, Hawaii	Elevation of 11 existing houses plus wall or berm around two gas stations	At BERH for approval

**FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING  
NONSTRUCTURAL MEASURES**

<u>DIVISION</u>	<u>DISTRICT</u>	<u>STUDY/PROJECT</u>	<u>NONSTRUCTURAL MEASURE</u>	<u>STATUS OF/ STUDY / PROJECT</u>
SWD	Tulsa	Haley Creek, Oklahoma Section 205	Relocation of 10 homes, and implemen- tation of flood plain regulations	Under construction (nonstructural funds of \$450,000 provided in June 1982)
	Galveston	(1) Baytown, Texas	Acquisition and relocation of dwellings;	No local cooperation
		(2) Cypress Creek, Texas	Flood plain acquisition	Continuing survey stud.
SAD	Savannah	Peachtree and Nancy Creeks, Georgia	Evacuation; flood proofing	No local cooperation
	Mobile	(1) Village Creek, Alabama	Permanent evacuation and relocation	Final Report to go to Assist. Secretary of Army's Office for revl.
		(2) Brewton and East Brewton, Alabama	Permanent evacuation and relocation (with flood proofing and flood warning a local responsibility)	Under construction
	Jacksonville	Upper St John's River	Land acquisition to preserve Flood Plain in its natural state	Phase I GDM under preparation
	Charleston	Wilson Branch, Cheraw, SC	Permanent evac of 5 residential structures	Under construction
MRD	Omaha	Littleton, Colorado	Flood plain acquisition and con- version to recreation land	Project underway
	Kansas City	Beatrice, Nebraska	Permanent evacuation and flood proofing	Negative report
ORD	Huntington	West Columbus, OH	Permanent relocation and flood plain acquisition	Study in formulation stage. Will likely consider relocation and acquisition

**FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING  
NONSTRUCTURAL MEASURES**

<u>DIVISION</u>	<u>DISTRICT</u>	<u>STUDY/PROJECT</u>	<u>NONSTRUCTURAL MEASURE</u>	<u>STATUS OF/ STUDY / PROJECT</u>
NCD	St. Paul	(1) La Crosse, Wisconsin	Permanent evacuation and relocation of 40 residents, implementation of flood plain regulations	Potential New Start-Phase I Study
		(2) Prairie du Chien, Wisconsin	Permanent evacuation and relocation of businesses and residents	Nearing completion of project
		(3) Bassett Creek, Minnesota	Flood proofing of 19 homes; permanent evacuation and relocation of 3 homes	Authorized but not yet constructed
		(4) Crow River, Rockford, Minnesota	Flood proofing; permanent evacuation	Negative Section 205 Report
		(5) Rochester, Minnesota (Zumbro River)	Land treatment measures; continuation of flood warning system; participation in flood insurance program and issuance of flood plain regulations	Not yet authorized
		(6) St. Peter and East St. Peter, Minnesota	Permanent evacuation	Section 205 study terminated because of lack of local support
		(7) Kickapoo River Valley, Wisconsin	Flood emergency evacuation plan	Relocation (of Soldiers Grove) by local implementation using HUD funds. Evacuation using FPMS Program
	Detroit	(1) Monroe County, Michigan	Flood proofing of 91 dwellings and commercial structures; raising 155 dwellings	No local cooperation - unfavorable report
		(2) Midland, Michigan	Permanent evacuation and relocation	Authorized, not yet constructed
		(3) Burton, Michigan	Section 205 Study - consists of the relocation of 20-30 homes	Section 205 Reconnaissance Report completed

FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING  
NONSTRUCTURAL MEASURES

<u>DIVISION</u>	<u>DISTRICT</u>	<u>STUDY/PROJECT</u>	<u>NONSTRUCTURAL MEASURE</u>	<u>STATUS OF / STUDY / PROJECT</u>
SPD	Los Angeles	(1) Allenville, Arizona	Permanent evacuation and relocation	Construction began in January 1981 and is complete
		(2) Indian Bend Wash, Arizona	Acquisition of floodway land for use as recreational land	Nearing end of construction
		(3) Callegeus Creek Simi Valley to Morepark, California	5.8 miles of area along channel to be left in natural state for overbank storage	Not justified
		(4) Phoenix New River Streams, Arizona	19.5 miles of flowage easements created along Skunk Creek, New River, Agua Fria	Construction underway
San Francisco		Klamath River, CA	Relocation of entire town	Project completed
Sacramento	(1)	Cache Creek, CA	Flood proofing of existing houses; raising of new houses when constructed	Under review at the Office of the Sec'y of the Army
	(2)	Lower Jordan River, Utah	Acquisition of floodway lands for use as park lands	BERH returned report to District as unacceptable. Study no longer active

FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING  
NONSTRUCTURAL MEASURES

<u>DIVISION</u>	<u>DISTRICT</u>	<u>STUDY/PROJECT</u>	<u>NONSTRUCTURAL MEASURE</u>	<u>STATUS OF STUDY / PROJECT</u>
NPD	Seattle	(1) Flathead and Clark Fork River Basins, Montana	Flood plain regulation	Local sponsor has withdrawn support from this authorized project. Project placed in "deferred category"
		(2) Snohomish River, Washington	Flood proofing existing structures	Report scheduled for completion in Dec 82
		(3) Sultan River at Sultan, Washington	Permanent flood plain evacuation; flood proofing	DPR recently initiated
	Walla Walla	Willow Creek Lake, Oregon	Flood warning system (joint project with National Weather Service, local sponsor and Corps)	Authorized Project, Dam under construction. System to be set-up.
NAD	Baltimore	(1) Lock Haven	Relocation of 139 structures; Flood proofing of 4 structures	Report at Secretary of Army's Office
		(2) Wyoming Valley	Flood proofing; acquisition and evacuation were considered as mitigative measures against induced flooding	Phase I GDM Approved by BERH
		(3) Conklin-Kirkwood Nonstructural Flood Protection Study	Flood proofing, raising, flood forecast and warning, ring levees, relocation, acquisition and demolition all being considered	Study in Stage III Planning

FLOOD CONTROL STUDIES AND PROJECTS INCORPORATING  
NONSTRUCTURAL MEASURES

<u>DIVISION</u>	<u>DISTRICT</u>	<u>STUDY/PROJECT</u>	<u>NONSTRUCTURAL MEASURE</u>	<u>STATUS OF / STUDY/PROJECT</u>
NAD	Philadelphia	(1) Darby-Cobbs Creek	Evacuation (permanent and temporary), flood proofing	Negative Section 205 Report
		(2) Christina River Basin, Delaware and Penn- sylvania	Improved flood warning, preparedness planning, evacuation, flood proofing	Project not justified
		(3) Chester Creek Basin, PA	Flood warning and preparedness planning; flood proofing;	Project not justified
		(4) Delaware River Basin	Study in formulation stage	Stage II of Survey approved
		(5) Schuylkill River, PA	Varied	Negative Report
	New York	(1) Green Brook Substation, New Jersey	Flood proofing. Acquisition	Report in the Office of the Secretary of the Army
		(2) Mahwah-Suffern, New Jersey	Varied	Stage III Report under preparation
		(3) Saw Mill River at Elms- ford and Greenburgh, NY	Varied	Phase I AE&D under preparation
		(4) Winooski River, Vermont	Varied	Reconnaissance Study under way
		(5) Mamaroneck and Sheildrake, New York	Varied	Phase I AE&D underway

APPENDIX C  
ATTENDANCE LIST

ATTENDANCE LIST

SEMINAR

on

IMPLEMENTATION OF NONSTRUCTURAL MEASURES

Hosted

by the

Civil Works Directorate  
of the U.S. Army Corps of Engineers

Auditorium  
Casey Building  
Ft. Belvoir, Virginia  
15, 16, 17 November 1982

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LATE CHANGES ADDENDUM SHEET

- Mr. Duncan will attend in Mr. Shwaiko's stead, and will sit as a General Issues Forum Panelist on Tuesday, as well.
- Dean Gerald McLindon, who chairs the Chief's Environmental Advisory Board has had to cancel. Mr. Larry Larson will take his place as a General Issues Forum Panelist on Wednesday.
- Additional OCE observers are:
  - Mr. Don P. Rogers  
Policy Office
  - Mr. David Hottenstein  
Economic and Social Analysis  
Branch  
Planning Division
  - Mr. Joe Cooley  
Acquisition Division  
Real Estate Directorate
  - Mr. Martin Reuss  
Historical Division
  - Mr. Bory Steinberg  
Chief, Programs Division
  - Mr. Louis Jones  
Planning Division
  - Mr. Maurice Parker  
Historical Division
- Additional Guests will be:
  - Mr. Steve Parker  
National Research Council  
Washington, D.C.
  - Dr. Annabelle Motz  
American University  
Washington, D.C.
  - Dr. Daniel Smalley  
Fish and Wildlife Services  
Washington, D.C.
  - Mr. Richard Krimm  
Federal Emergency Management  
Agency
  - Mr. Richard Sanderson  
Federal Emergency Management  
Agency
- Mr. Schilling will take Mr. Larson's previous place on the panel responding to the tenth address, on floodproofing.
- Mr. James Wright of TVA will be unable to attend and serve as a Panelist.