FLOOD LOSS REDUCTION: A REVIEW OF ALTERNATIVE TECHNIQUES FOR MICHIGAN

Thesis for the Degree of M. S.

MICHIGAN STATE UNIVERSITY

TIMOTHY ALAN HILTZ

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ABSTRACT

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TECHNIQUES FOR MICHIGAN

By

Timothy Alan Waite

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A literature review was conducted to develop the range of alternative techniques which have been proposed for reducing and mitigating flood losses. Techniques which have been offered for reducing flood losses were classified under a Predevelopment, Postdevelopment, and Emergency Technique taxonomy. The objectives, means of implemention, and limitations of floodway encroachment regulations, flood plain zoning, subdivision regulations, building code regulations, flood proofing, urban renewal, building and rebuilding finance, taxation, acquisition, flood plain warning signs, flood warning, evacuation, redevelopment, flood insurance, engineering works of flood protection and regulation, education, technical assistance, comprehensive land use planning, and flood relief are developed from the literature review.

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techniques within Michigan. Chief reliance was given to personal interviews, personal correspondence, state and federal agency flood management files, and library holdings of local and state government documents for establishing the appropriateness and applications of the above techniques.

It was found that a number of the techniques which have been proposed in the flood literature are not thoroughly discussed in the literature nor known to be implemented or practiced at the state or local level. Building code regulations, taxation policies, warning signs, urban renewal, evacuation, redevelopment, building and rebuilding finance, education, and comprehensive land use planning were found to be poorly developed in terms of flood loss and flood plain management considerations. Inadequate coverage in the literature is paralleled by little technique implementation at the local and state level.

Significant attempts at utilizing floodway encroachment regulations, flood plain zoning, subdivision regulations, engineering works for flood protection and regulation, and technical assistance were found at the state and/or local level. Little use but considerable potential for productive use of flood proofing, acquisition, flood insurance, and education was apparent from discussions with local, state, and Federal government agency personnel.

Deficiencies and weaknesses were found in numerous applications of flood loss reduction techniques. Recommendations for additional specific studies are suggested for each of the techniques, regardless of whether they are currently being practiced within the state. More specific concerns and recommendations are directed at flood plain regulatory programs at the state and local level. Inadequate discrimination between floodway encroachment zones and flood plain pondage areas is apparent. Furthermore, clear differentiation and application of police powers and the power of eminent domain is needed. Existing ordinances and statutes do not appear to discriminate between uneconomic and economic

developments, nor hazardous and non-hazardous structures. Excessively restrictive and/or inflexible regulation of flood plain areas may be developed if the current trend of regulation continues in the State of Michigan. Greater attention should be given in the State to reassessing the sharing of flood plain regulatory programs. The State of Michigan, and the Water Resources Commission in particular, need to devote more attention to (1) redirecting the responsibilities and burdens of flood plain regulation to local units of government, (2) establishing criteria and guidelines for distinguishing economic and uneconomic flood plain zones, (3) clarifying the overlapping application of police powers in the province of eminent domain, and (4) evaluating the importance of education, technical assistance, and comprehensive land use planning programs in advancing and integrating the varied techniques for reducing flood losses.

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By

Timothy Alan Hiltz

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Resource Development

1972

677524

ACKNOWLEDGMENTS

Completion of this master's thesis could not have been possible without the sacrifices and support of my wife, Carolyn. Her encouragement and support were essential in my decision to return to graduate school to complete this thesis and to continue with further graduate study.

Dr. Milton E. Strelitzer has provided patient and continuous counsel in my academic studies and thesis research. I deeply appreciate and value the substantial contributions he has made to my graduate education. Mr. Lawrence N. Witte, Assistant Division Chief, Hydrological Survey Division, Department of Natural Resources, State of Michigan and Dr. Eckhart Derech, Assistant Secretary, State Soil Conservation Committee, State of Michigan have been of invaluable assistance in suggesting areas of inquiry and answering numerous questions. Professor Keith W. Lapp's excellent course in Zoning and Land Subdivision Regulation in Fall of 1968 facilitated the more penetrating thesis inquiry into the use of the police powers as a means of regulating flood plain development. My sincere appreciation is expressed to these gentlemen for [illegible] reviewing and offering helpful suggestions while serving as thesis committee members.

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CHAPTER I

INTRODUCTION AND BACKGROUND

Presence of a Problem

Floods are 'acts of God,'
but flood losses are
largely acts of man.[1]

As Gilbert White tersely noted, man has often settled in such a manner as to expose himself and his developments to the risks of flooding. Estimates made in 1966, based upon inadequate information, place the average annual flood loss in the United States above 1 billion dollars.[2] Figures for Michigan flood losses are even more difficult to report. Two decades ago, the average annual flood damage in Michigan was estimated in excess of 1.5 million dollars. This figure was apparently arrived at on the basis of tabulated flood losses. However, the actual flood loss figure was believed to exceed the estimated value by many times that cited, due to unaccounted flood losses.[3] A more recent tabulation of annual flood losses in Michigan was not

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[1]Gilbert Fowler White, Human Adjustment to Floods - A Geographical Approach to Flood Problems in the United States, Ph.D. Dissertation, Published as Research Paper No. 29, Department of Geography, University of Chicago (Chicago: The University of Chicago Press, 1945), p. 2.

[2]U.S., Congress, House, Task Force on Federal Flood Control Policy, A Unified National Program For Managing Flood Losses, House Doc. No. 465, 89th Cong., 2d sess. (Washington, D.C.: Government Printing Office, 1966), p. 3. Reference cited hereafter as U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966.

[3]State of Michigan, Water Resources Commission, First Annual Report, 1949-1950, First Annual Report to the Governor and Legislature (Lansing, Mich.: Michigan Water Resources Commission, n.d.), p. 37.

found or known. Nevertheless, numerous reoccurring accounts of flood losses appear in Michigan newspapers nearly every year.

A second perspective of the significance of flooding in Michigan is evident from figures on investments in engineering works of flood protection and regulation. Incomplete figures for 1967 show approximately 89.1 million dollars for investments in Corps of Engineer projects completed, underway, or currently authorized for Michigan.[1] More recent figures for 16 Small Watershed Protection and Flood Prevention projects reveal that more than 16.8 million dollars will be invested in these projects.[2] The figures are incomplete in that they do not represent a current dollar basis. In addition, some multipurpose projects costs are involved in several projects for which figures were summed. The figures do suggest that about 100 million dollars in flood prevention and protection projects have been constructed, or are presently authorized in Michigan. While this may not be as large an investment as found in other states, it still represents a considerable investment in flood protection and prevention.[3] Moreover, there is every reason to believe that the risk of flood loss is increasing in Michigan as well as nationally.[4,5]

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[1] Water Resources Development in Michigan - 1967 (Chicago: U.S. Army Engineers Division, North Central Division, January, 1967), pp. 39-41, 56-57, 59, 63, and 64.

[2] U.S., Congress House, Committee on Appropriates, Subcommittee on Department of Agriculture and Related Agencies Appropriations, Hearings, 90th Congress, 1st sess. (Washington, D.C.: Government Printing Office, 1967), pp. 514 & 515.

[3] William Glenn Hoyt and Walter B. Langbein, Floods (Princeton, New Jersey: Princeton University Press, 1955), pp. 80-86; Figure 25 p. 83; Table 1, p. 84; and Table 2, p. 86.

[4] Lawrence Witte, Chief, Flood Control Unit, Michigan Water Resources Commission, Personal Interview, Lansing, Mich., January 29, 1967.

[5] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966.

Hypothesis and Study Objectives

It has been evident that Michigan has continued to experience flood events and associated flood losses. Further, there has been an extensive literature developing at the national level dealing with new alternatives for managing and reducing flood losses. While many ideas and different management philosophies have been advanced in the literature, little discussion and review of such ideas has been reported in Michigan. Accordingly, a charge was given to the author to embark upon a review of flood management policies and programs as they might be relevant to Michigan flood loss management needs.

Accepting the premise that flood losses were a management problem in Michigan, it was hypothesized that such losses could be reduced and/or minimized in the future through a broader flood loss management program. To operationalize this hypothesis a number of objectives were established for the study. The initial charge involved providing a comprehensive review of existing and proposed flood loss management alternatives which could be applied in Michigan. A similar review was not known to exist for the state. Consequently, such a review was felt to be of sufficient importance to sponsor one. Moreover, it was felt a comprehensive review and outline of available flood loss management techniques was required in order to proceed to the second main objective.

Second, the study should provide useful recommendations to responsible authorities in Michigan for reducing flood losses. It was apparent that attainment of the second objective was dependent upon careful completion of the first objective.

Third, the study should provide a framework which researchers or managers could use to review policies and programs in their areas in a comprehensive fashion.

Fourth, because of the nature of this study, new ideas and additional recommendations will be posed for further research and study.

General Plan of Investigation

The approach adopted for this study was largely set by a larger, more comprehensive study carried on at the same time. The study of flood loss management in terms of Michigan needs was a component of a more general review of water resource policy undertaken while the author was with the Michigan Water Resources Commission. At the outset of the study it was recommended that the comprehensive study and review requested depended essentially upon secondary sources of data and information. Therefore, the approach taken entailed an extensive literature search. This included review of public documents and records. Supplementary information was obtained through personal interviews and by letter correspondence. In effect, (1) the nature of the study requested, (2) the time, and (3) the resources required in drawing together the policy review did not allow for detailed, primary data collection nor statistical analyses.

Quantitative methods have only recently been introduced to this subject area.[1] Some references were uncovered in which modest attempts have been made at modeling flood loss management alternatives.[2] However, the models to date have been restricted to a limited number of alternatives. Even these have involved extensive data collection and processing which required sizeable research staffs. Such requirements exceeded the

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[1] U.S., Department of the Army, Corps of Engineers, A Methodology For Flood Plain Development and Management, Report by TRW Systems Group, Redondo Beach, California submitted to U.S. Army Engineer Institute for Water Resources, Alexandria, Virginia (Springfield, Virginia: Clearinghouse for Scientific and Technical Information, December, 1969).

[2] L. Douglas James, Economic Analysis of Alternative Flood Control Measures, Research Report No. 16 (Lexington, Ky: University of Kentucky Water Resources Research Institute, 1968).

scope of this study and also fall short of the comprehensive review requested.

In contrast, much narrative material has been written in terms of general flood loss management concepts. A variety of alternative techniques for reducing flood losses have been proposed in such materials. However, there is a sizeable gap between general concepts and detailed treatment of possible alternatives. Many alternatives have not had the objectives, program requirements, and limitations of their implementation set forth. Consequently, some attempt has been initiated in this study to fill in this disparity between concept and technique development. To accomplish this it was necessary to bring together many references in the flood loss management with materials in allied or compatible areas of inquiry.

Limitations of Study

The disparity between concept proposal and technique development is an understandable one. It illustrates the problem of bridging the separation between the concepts and perspective of the generalist and the detail of the specialist. This study reflects the problems in trying to narrow such a separation. It was found that once a general concept was penetrated, the next level of inquiry and development was that of the technical specialist. The many alternatives proposed for flood loss management necessitate covering a wide range of fields, including: hydrology, soils, engineering, architecture, urban planning, economics, acturial science, law, and others. Within these fields many highly specialized areas are dealt with such as hydraulics, building design and construction, zoning, subdivision regulation, eminent domain, police power, public finance, and property rights to name a few. Moreover, it was

often found that after a general concept has been advanced in the general literature; subsequent treatment often moved directly to the applications level within a unique problem environment. The task here was found to be not unlike the task of developing a model building code; only here, a variety of management alternatives are dealt with as opposed to one building code within a unique community. Another notable limitation will be found in the treatment of alternative techniques. This concerns reviewing alternatives for physically managing flood flows, frequently termed flood control projects, or preferably, engineering works of flood protection and prevention. These have been well developed and implemented in the field of flood loss management. They are minimally treated here, and much better developed and understood in other engineering references. The significance of this weakness is somewhat allayed by the presumption that advancements in flood loss management in Michigan will not derive from new development in engineering protective devices so much as in programs for land use guidance, management, and control.

Other limitations of this study are also evident. A major weakness of this report relates to the time interval involved in conducting the study. The initial study inquiry was initiated in the fall of 1967 prior to and during graduate study at Michigan State University. Numerous interruptions in the study were experienced subsequent to its initiation. As a result, the perspective as well as support of the study were altered several times. In addition three notable developments occurred during the time frame of this study:

1. Completion and publication of the report of the Task Force on Federal Flood Control Policy. This was accomplished by Presidential Executive Order No. 11296, August 11, 1966.

2. Enactment of Act No. 288 of Michigan Public Acts of 1967.

3. Enactment of Act No. 167 of Michigan Public Acts of 1968.

The Task Force Report reflected the growing national awareness of a need for a more comprehensive approach to flood loss management in general. Provisions in the latter two Michigan legislative enactments reflected the interest in the state, particularly at the Michigan Water Resources Commission in obtaining enabling powers to expand their responsibilities in flood loss management.

This study to a large extent is a reflection of the interest at that time in broadening flood loss management responsibilities at the state level. No credit is claimed for these legislative enactments within this study. Early drafts of parts of this study were available during that period of legislative activity. However, at best such research can be considered reflections of the Commission interest in broadening its management program at that time.

Finally, because of the intervening periods between study development and writing, a number of revisions and adjustments were necessitated in earlier study drafts. It was found that a significant limitation in this study results from the rapid change and movement in the flood loss management field in general.

Review of the Literature

Extensive review of the literature will be undertaken in subsequent chapters while (1) developing the various flood loss management alternatives and (2) analyzing present policies. The following outline identifies the significant references relied upon in the flood loss management literature.

A number of proponents of comprehensive flood loss managements have been recognized in the literature. Professor Gilbert White, formerly of the University of Chigao and Mr. James E. Goddard, formerly of the Tennessee

Valley Authority have authored numerous works and stimulated others to do so also. Professor White's classic study in 1942 has been followed by a series of special studies at the University of Chicago.[1] His work was culminated recently in his chairing the Task Force on Federal Flood Control Policy. The report under his chairmanship came forth with far reaching recommendations for comprehensive flood loss management policy adoptions and adjustments.[2] One reference from the University of Chicago of considerable importance to the present study was that of Francis Murphy, a student of Professor White's at the University of Chicago.[3] His study was of principle benefit in contributing to the development of the framework of this study and the initial outlining of many of the alternative management techniques.

Professor Allisin Dunham's writings contributed greatly to the development of the legal considerations of this study. He provided the most comprehensive and definitive legal study of the application of police powers for flood plain management found to date.[4] Wertheimer is credited with the first substantive inquiry in this area.[5] Much of the work of both writers was still found applicable today.

Review of techniques used in engineering works of flood protection and prevention relied upon references of two authors and of the American

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[1]White, Human Adjustment to Floods, 1942.

[2]U.S., Task Force Report on Federal Flood Control Policy, House Doc. 465, 1966.

[3]Francis C. Murphy, Regulating Flood-Plain Development, Department of Geography Research Paper No. 56, University of Chicago (Chicago: University of Chicago, 1958).

[4]Allison Dunham "Flood Control Via the Police Power", University of Pennsylvania Law Review, Vol. 107, No. 8 (June, 1959); issued as a reprint.

[5]Ralph B. Wertheimer, Flood-Plain Zoning-Possibilities and Legality (Sacramento, Calif.: California State Planning Board, June, 1942).

Society of Civil Engineers. Harold Kilbirth Barrows,[1] Yan Ch'eng Shih,[2] and the Report of the Committee on Flood Control, Hydraulics Division, A.S.C.E.[3] provided the primary sources of information for this review.

Two publications of B. Tate Dalrymple[4,5] and one by the Hydrology Committee of the Water Resources Council[6] provided the basic information for outlining hydrologic considerations in flood events. The latter publication provides the current accepted practices for computing flood flow frequencies by Federal water resource agencies.

Finally several references deserve mention as general sources of background material. Floods by Hoyt and Langbein[7] along with The Flood Control Controversy by Leopold and Maddock[8] provided good introductory references to the general problem of flood loss management.

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[1]Barrows, Floods, Their Hydrology and Control (New York: McGraw-Hill Book Co., 1948).

[2]Yang-Cheng Shih, American Water Resources Administration, I and II (New York: Bookman Associates, 1956).

[3]American Society of Civil Engineers, "Flood-Control Methods: Their Physical and Economic Limitations," Report of the Committee on Flood Control, Hydraulics Division, Proceedings, Vol. 66, No. 2 (Lancaster, Pa: American Society of Civil Engineers, February, 1940), pp. 265-282.

[4]Tate Dalrymple, "Flood Characteristics and Flow Determination - Part I of Hydrology of Flood Control," Section 25 in Handbook of Applied Hydrology: A Compendium of Water Resources Technology, ed. by Ven Te Chow (New York: McGraw-Hill Book Company, 1964).

[5]Tate Dalrymple, "Flood-frequency Analysis" in Manual of Hydrology: Pt. 3, Floodflow Techniques, U.S. Geological Survey Water Supply Paper 1543-A (Washington D.C.: U.S. Government Printing Office, 1960).

[6]Water Resources Council, Hydrology Committee, A Uniform Technique For Determining Flood Flow Frequencies (Washington, D.C.: Water Resources Council, 1025 Vermont Avenue, N.W., December, 1967).

[7]Hoyt and Langbein, Floods, 1955.

[8]Luna Bergere Leopold and Thomas Maddock, The Flood Control Controversy; Big Dam, Little Dams, and Land Management (New York: Ronald Press, 1954).

CHAPTER II

THE PROBLEM SETTING

Introductory Comments

An almost implicit causal relationship between flood losses and riverine settings is assumed in most of the literature dealing with flood loss management. The consequences of this tendency can lead to the disregard of other causes of flood losses when dealing with comprehensive flood loss management programs. On the other hand, the degree of attention and amount of literature devoted to problems of river flooding is indicative of public priorities relating to management of flood losses. This is true at the Federal level and within the State of Michigan.

Certain definitions and a number of qualifications will be set forth below in order that a proper perspective of flooding as an occurrence and as a hazard may be obtained. Definitions are needed for at least two reasons. First, an understanding of types of flood events is important to the design of different sets of management techniques. Second, an explanation of a few concepts associated with flooding will indicate how technical considerations in an of themselves, tend to frustrate effective policy development for managing flood losses.

Definition of Terms

Flooding

Flooding, as an event, is commonly associated with flowing water bodies that have become excessively swollen from storm drainage and/or

snow melt. As a consequence, water overflows the channel banks and inundates adjacent land not usually covered with water.[1] Such a concept can be too restrictive at times. A broader concept of flooding may be needed in order to give recognition to flooding due to hurricane driven storms and inadequate drainage in urban areas. This will be brought out below in the discussion of causes of floodings. In general, subsequent discussions in this paper will maintain the narrower concept. That is, primary attention will be given to riverine settings and associated flooding in Michigan. This is due to (1) the dominant role riverine flooding has held in development of alternative flood loss management policies, and (2) to the prevalence of this form of flood event throughout Michigan.

Causes of Flooding

Hurricanes

One of the most dramatic and devastating causes of flooding is that associated with hurricanes. Here flood losses are not necessarily restricted to riverine settings nor coastal beachfronts. Flooding and subsequent damage may be a result of the interaction of hurricane winds and (1) intense rainfall, (2) high tides, and/or (3) wind driven watercourses.[2,3] Intense rainfall may cause immediate flooding due to (1) inadequate runoff and drainage with resultant ponding of waters, or to

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[1]This narrow definition of flooding as an event is illustrated in (a) Dalyrymple, "Flood Characteristics and Flow Determination," Handbook of Applied Hydrology, 1964, p. 25-2; (b) Hoyt and Langbein, Floods, 1955, Chapters 2 and 3; and (c) Webster's New Twentieth Century Dictionary -- Unabridged (New York: Standard Reference Works Publishing Company, Inc., 1957). Although, Hoyt and Langbein draw an apparent distinction between hurricane induced damage and riverine flooding; see page 24.

[2]Hoyt and Langbein, Floods, 1955, Chapter 2, "Why We Have Flood Problems".

[3]Shih, American Water Resources Administration I, 1959, p. 8.

(2) the subsequent overflow of taxed stream channels and waterways. A further potential element in this type of flood hazard is the damage which results from salt water intrusion associated with wind driven sea waters in coastal areas. The corrosive effect of the salt water is an additional source of flood loss relative to those destructive elements associated with river flooding which include losses due to sedimentation and siltation.

A variation of hurricane caused flooding is present in the Great Lakes Basin Region. Michigan along with other Great Lake states and the Province of Ontario, experience property losses from flood waters associated with wind driven storms sweeping across the Great Lakes during years of extreme high water levels. In preceding years of high lake stages, flood losses due to coastal flooding have been known to greatly exceed flood losses associated with riverine settings when averaged on a year-by-year basis. This dramatic form of flooding merits separate study and consideration.

Riverine Settings

River flooding may result from a number of causes.[1] As in hurricane (or wind driven) flooding, the causes of river flooding are not always distinct in their operation or contribution. The most frequently encountered form of flooding is that resulting from intense and/or prolonged rainfall. The rainfall is often coupled with rapid snow melt or rapid surface water runoff resulting from impermeable soil conditions. Impermeable soil conditions increase the rate of runoff delivery, as well as the amount of precipitation yielded in the form of surface and subsurface perched runoff. A second cause of river flooding is the obstruction

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[1] Ibid., p. 8.

of river flow by landslides, ice flows, debris, and/or structures built by man. Any of these forms of obstruction can impede flood flows causing the river to overflow its banks upstream from the obstruction. A third cause of river flooding is the overtopping and possible failure of dams. A variation of this would be the failure or sudden removal of an obstruction to flood flow cited in the second cause. A second variation of the third cause is the failure of river levees, flood walls, and dikes to retain flood flows and flood waters. In the event of a dam or levee failure a sudden surcharge of water may be released to the adjacent occupied flood plain formerly protected by the dam or levee system. In any of the three preceding causes of flooding, the overtopping of a retaining structure does not necessarily have to be accompanied by an eventual failure of the structure and accompanying sudden surcharge. Significant damage may result solely from the large volumes of water overtopping the retaining structure. In fact, in the case of levee systems, inadequate drainage behind levee embankments has been the cause of surface water accumulation and resultant flood damage not associated with a high river stage or flood event.

Urbanization as an Influence on Flooding

Another form of flooding has been increasing in its occurrence and importance in terms of economic losses. This form is associated directly with man's concentrated settlement patterns and urbanization. Soil permeability and vegetation are reduced or eliminated in large expanses of urban areas due to pavements and other sealed surfaces. Inadequate or insufficient drainage during intense rainfalls is resulting in depressional flooding of urban areas. Depressed expressways, roadways, and viaducts become surface waterways. Temporary surface water storage is

also provided by these roadways as well as other depressional areas, including basements and ground floors of low lying homes, businesses, and other buildings. This aspect of flooding is, in large part, an engineering design problem, i.e., relating storm sewer design to precipitation rates, runoff data, and cost data.[1]

A second facet of increased urbanization is the aggravation of riverine flooding. The aggravated flooding is attrubutable to impermeable surfaces, increased surface runoff, concentration of surface runoff, and accelerated delivery of surface runoff. The significance of urbanization on increasing levels of runoff are well illustrated in civil engineering references. Increases in levels of runoff are demonstrated with the progression from unimproved areas to highly developed downtown areas. Coincident increases in runoff coefficients are also noted by surfaces as they progress from porous to less porous surface types. For example downtown business areas and/or concrete streets may typically have runoff coefficients as high as 0.70 to 0.95. While unimproved areas and/or lawns of sandy soil types and flat slope may have coefficients of 0.10 or less. In short, the less pervious the surface type the greater the percentage of runoff of incident rainfall. Numerous additional factors, as surface or depressional storage, antecedent rainfall, intensity of rainfall, and surface slope will also influence the magnitude and direction of adjustment of the runoff coefficients.[2]

The aggravation of riverine flooding due to urbanization is apparently

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[1]Joint Committee of the American Society of Civil Engineers and the Water Pollution Control Federation, Design and Construction of Sanitary and Storm Sewers, ASCE Manuals of Engineering Practice No. 37 or WPCF Manual of Practice No. 9 (New York: American Society of Civil Engineers, 1960), Chapter 4, pp. 33-34, 47-50, and 77-78.

[2]Ibid., pp. 31-34, 47-53.

restricted in its effects to the smaller but more frequent flood events. That the problem is important and worthy of concern was indicated by the special Task Force on Effect of Urban Development on Flood Discharges.[1]

A review of the literature undertaken by the Task Force uncovered differing conclusions as to the degree of increased flooding associated with urbanization. However, it can be concluded that urbanized areas are increasing the magnitude and the frequency of the smaller, more frequent floods. This effect is lost as larger and less frequent flood events are considered. As will be noted in the following sections, this is but one of the conflicting interrelationships between human settlement on flood plains and the hydrology of flood events.

Flood Risk and Loss Concepts

While floods and flood damages are a very real and dramatically vivid phenomena, the defining of flood risk and hazard in riverine settings present problems of an abstract nature. The misunderstanding or ignorance of flood risk gives cause to much of the human and institutional difficulty in achieving flood loss reduction. The misunderstanding and ignorence stems in large part from the probabilistic nature of flood risk. As such, flood risk is a function of the frequency expectations of different flood events, i.e., floods vary in time and dimension. Accordingly, the defining of a flood plain risk area is an exercise in probabilities; which immediately creates problems in flood plain policy development and management.

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[1] Task Force on Effect of Urban Development on Flood Discharges, Committee on Flood Control, "Effect of Urban Development on Flood Discharge -- Current Knowledge and Future Needs," Progress Report in Journal of the Hydraulics Division Proceedings of the American Society of Civil Engineers, Vol. 95, No. 1 (Ann Arbor, Michigan: American Society of Civil Engineers, January, 1969). p. 289.

Flood Plain in a Riverine Setting

Each flood plain can be discussed in terms of its topographical relationship with the stream channel or river bed. The delineation and definition of the flood plain is, in part, a function of the susceptibility of the land to inundation as the water rises within the defined channel banks of the watercourse. (Use of "natural" can be misleading when specifying natural channel bank without setting forth the criteria for natural.) The delineation problem develops from the dynamic nature of a stream. The flood plain of the stream has been and may be at certain times part of the stream or river channel. At the same time the flood plain undergoes change or alteration due to flood scour, sedimentation, and changing stream bed or channel flow. Such processes all affect the subsequent flooding or overflow of the channel banks. As a consequence, the flood plains and the associated flood risk to land use are both dynamic and relative concepts.[1,2]

Floodway and Backwater Region

The topography and hydraulics of a watercourse are such that the flood plain may be sub-divided into two zones. The boundaries of each of the two zones are interdependent but variable, depending upon the flood magnitude under consideration. The area of first concern is the floodway. It represents the area necessary to actively pass the flood flow under consideration. The destructive forces and damage potential in the area are considerable, due to shear and scour resulting from active transport of flood waters and their suspended loads. Impediments in this zone restrict flow and effectively raise or increase the area of

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[1] Hoyt and Langbein, Floods, 1955, pp. 13-18.

[2] Leopold and Maddock, The Flood Control Controversy, 1954, p. 10.

the second zone. The second zone, the pondage or backwater region, results from overflow of waters from the floodway onto adjacent lands for temporary storage. Storage in the backwater area is necessitated by excess runoff and flood volumes relative to floodway capacity. Consequent, direct losses and damages in this zone are attributable to wetting action and/or sedimentation processes of relatively quiet ponded waters. (In the case of hurricane or marine water flooding, additional damage may be attributable to the chemical action of the salt water.) Indirect damages and losses are also related to general flooding as will be developed below.[1,2]

If the two zones were static, i.e., always of the same areal extent in each flood, then flood loss management practices might be more readily developed. This is especially true of land use regulatory measures. However, a portion of the pondage area for one flood may be in the floodway of a more severe flood. In some instances, the floodway may move out of the old channel bed and develop a new flood channel. The understanding of this dynamic phenomenon is apparent in engineering practices. However, the importance of this dynamic two zone phenomenon is not adequately reflected in previous considerations of regulatory programs for directing land use in the flood plain.[3] That the distinction

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[1] Francis C. Murphy, Regulating Flood Plain Development, 1958, pp. 13-14.

[2] John Richard Sheaffer, Flood Proofing: An Element in a Flood Damage Reduction Program (Chicago: University of Chicago Press, 1960), pp. 77 & 183.

[3] For example: Allison Dunham in "Flood Control via the Police Power," 1962, correctly distinguishes between flood damages and losses caused to a third party from those incurred directly by a flood plain occupant. However, the author fails to adequately distinguish between the two flood plain zones and their implementation for the resulting externally inflicted damages and those borne solely by the flood plain occupant. In reality, the distinction between the two zones is muddled by the fact that each flood plain area does, in fact, cause some external damage. The problem

between, as well as the existence of the two zones, is important in considering flood plain regulation and flood loss reduction can be viewed in the differing consequences of building in a zone prescribed by administrative or statutory action. Building in a permitted flood plain area predicated upon a certain flood event of a more severe nature occurs. The hazard would lie primarily in the ignorance of the flood plain occupant of the remaining flood hazard and/or the associated false sense of security of residing in a flood plain area adjoining the regulated flood plain area.

Frequency Expectations of Flood Occurrences

A common practice of classifying floods is by their frequency expectation. The frequency expectations are expressed in terms of variations in time and magnitude of flood occurrence. The most familiar expression of flood frequency is the selected time frequency flood, as in the notation of "a ten year flood," "a one hundred year flood," etc. These may be expressed alternately as floods having a ten percent chance or a one percent chance, respectively, of occurring in any one year. This latter is preferred, due to the misinterpretation often associated with the former notation. In either case, the floods have been associated with floods having a certain magnitude as measured by volume, rate of flow, and/or stage level which can be expected to recur on an average as prescribed by the notation.[1]

Two qualifications should be immediately noted. First, the probability of expectation is presumed to (1) be based on a long, historical

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is that the ability to determine the individual contribution to the displacement of backwater storage area and consequent increase in flood stage is very difficult to arrive at and sustain in a legal proceeding. This is not true in the case of the floodway.

[1] Hoyt and Langbein, Floods, 1955, p. 64.

record of events and (2) average out over a long period of time. Second, an expectation expressed in this way is less than ideal due to changes in the hydrology of the stream brought about by natural processes and human activities.

The first qualification results from limitation in the historical record of flood occurrences and the long term averaging requirements. General flood records do not go back beyond the turn of the century. This causes the calculation of frequency expectation to be subjected to readjustments as the years of record continue to accumulate. The long term averaging requirements complicate the interpretation of the record. It is conceivable and has happened, for an extreme event, such as "a one hundred year flood," to repeat its occurrence within a relatively short period of time.

The second qualification develops from the changes in the hydrology of a watershed. The changes often become significant as a result of human activities, especially in the case of urbanization. Accelerated rates in runoff or in drainage yield from a watershed can increase a flood magnitude that would be normally associated with a particular meteorological event and undisturbed environmental conditions. Human activities may thus increase the magnitude of a "ten year flood," or correspondingly increase the frequency expectation of a specified flood magnitude. This will also complicate the first qualification by altering the watershed conditions for which the flood record is being kept. The effect will be such that the historical record of a stream is a composite record of an ever changing stream.

A somewhat more desirable practice is the use of discharge frequency curves to note flood frequencies. This may be coupled with or used in deriving stage-frequency curves. The latter curves are of more immediate

relevance in determining the risks of flood loss. Discharge frequency curves relate different peak discharge flow rates (usually the flows are expressed in cubic feet per second, c.f.s.) at a reference point on the stream to a recurrence time interval.[1,2]

Similarly, the stage-frequency curve relates the different peak flood flow heights at a reference point on the stream to a recurrence time interval. This latter frequency measurement will allow determining how frequently a spot at a certain elevation on the flood plain may be inundated to varying depths. It does not relate the duration for which this location may be inundated by a certain flood stage. Further, both of these frequency curve methods are subjected to adjustments resulting from natural and cultural activities. The adjustments in stage-frequency curves are of considerable interest as they relate more directly to areas (points) and heights of inundation and therefore reflect more readily the changes or adjustments in flood damage risks.[3]

The length of time for which a location may be inundated by a certain discharge - or stage - frequency determined flood can be inferred from a third curve -- the flood hydrograph. Each reference station on a stream will have a distinct hydrograph for each frequency of flood. The flood

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[1]For further statistical discussion of flow frequency, see H. Alden Foster, "Theoretical Frequency Curves and Their Application to Engineering Problems," Transactions of the American Society of Civil Engineers, Vol. 87, Paper No. 1532 (New York: American Society of Civil Engineers, 1924), pp. 142-173 with discussions pp. 174-203. (See especially pp. 145-147 for treatment of unsymetrical or skew curve flow frequency behavior.)

[2]The currently recommended method for flow frequency analysis is the log Pearson Type III method; the basis for which was developed by Foster back in his 1924 article. See Water Resources Council, A Uniform Technique for Determining Flood Flow Frequencies, 1967, pp. 67.

[3]Task Force on Effect of Urban Development on Flood Discharges, "Current Knowledge and Future Needs," Proceedings of A.S.C.E., 1969, Appendix 1, pp. 293-308.

hydrograph will give the complete time record of a particular flood event at a specified reference point or station. A sequential series of different reference station hydrographs will yield an historical account of the particular flood event in question. The hydrograph does so by relating stage, discharge, velocity or other selected parameter of flood flow to the time period over which the flood developed and subsided.

> The hydrograph can be regarded as an integral expression of the physiographic and climatic characteristics that govern the relations between rainfall and runoff of a particular drainage basin. It shows the time distribution of runoff at the point of measurement, defining the complexities of the basic characteristics by a single empirical curve.[1]

Further, it allows relating various elevations adjacent to and lying in a line normal to the stream to the risk of inundation by that particular flood, along with the associated possible duration of inundation. This is an essential element in determining the risk of flood loss and/or damage due to a particular flood event.

Risk

In summary, the hazard of flood damages to cultural land uses is dependent upon the location of the parcel of property in question upon the flood plain and the frequency expectation of various flood magnitudes. In addition, the notion of risk involves economic and cultural concepts which introduce new elements to the assessment which go beyond the hydrologic possibilities and probabilities of natural occurrences. An extensive treatment of hazard and risk in relation to flood plain occupancy is given by Robert W. Kates.[2] Kates abstracted four fundamental assumptions

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[1] Ven Te Chow, "Runoff," Section 14 in Handbook of Applied Hydrology: A Compendium of Water Resources Technology, ed. by Ven Te Chow (New York: McGraw Hill Book Company, 1964), pp. 14-18.

[2] Robert William Kates, Hazard and Choice Perception in Flood Plain Management, Department of Geography Research Paper No. 78, University of Chicago (Chicago: University of Chicago, 1962).

Further, but less exhaustive treatment of hazard and risk in relation

underlying decision-making theory as it might relate to recognition of flood hazard and risk and any associated subsequent land use adjustment actions. The assumptions relate to

(1) the underlying view of man's rationality;
(2) the types of decision processes involved;
(3) the conditions of knowledge under which choice is made; and
(4) the criteria that are used to guide such choice[1]

All four of these assumptions were found to be related to the flood plain occupant's recognition of hazard, degree of risk, and the possible magnitudes of accompanying damages. Of importance is the fact that the perceptions of flood risk varied significantly between the individual flood plain occupant, the flood loss management professional, and the public decision maker causing differing perceptions of appropriate corrective or protective actions.

The principal concern here is for the flood plain occupant, for whom various alternative programs of flood loss reduction or relief are available to select from. His perception of flood risk will have significant bearing on what actions he may be willing to pursue. (Likewise, the cost sharing or bearing elements of various courses of action will also have a significant bearing on the individual's selected course of action.) His perception of flood risk will be important in accessing his need for and ability to take protective action. In light of the four assumptions, the flood plain occupant's perception of flood risk was found to be affected by

(1) his awareness or knowledge of previous flood events;

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to hurricane and tidal flooding is found in a paper by Ian Burton, Robert W. Kates, and Rodman E. Snead, The Human Ecology of Coastal Flood Hazard in Megalopolis, Department of Geography Research Paper No. 115, University of Chicago (Chicago: University of Chicago, 1969), see especially pp. 151-160.

[1]Kates, Hazard and Choice Perception, 1962, pp. 12-13.

(2) personal experience with flooding and flood loss;

(3) his assessment of local flood events, and

(4) the frequency of flooding experienced at his site in particular.[1]

The way the flood plain occupant integrates these elements and values then will directly affect his concern and initiative in seeking, or not seeking, a means of reducing his probable flood losses.

Losses and Damages

The inevitable inundation of flood plains or shorefront lands, coupled with inadequate risk perception and/or inadequate land use adjustment results in a wide range of damages, losses, and disruptions. Such concepts of flood loss and damage are usually discussed in terms of economic or accounting principles; although, the actual concept is in fact not exclusively economic in nature. Notwithstanding the latter qualification, the general identification and definition of flood losses and damages can be readily developed from existing federal flood control policies.

Losses and damages are placed in three categories: (1) damage and losses resulting from inundated property, (2) losses due to disruption of business and other activity, and (3) impairment of health, loss of security and loss of life.[2]

A finer detailing and more economically-oriented definition is available from a work (field) manual of the U.S. Army, Corps of

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[1] Ibid., p. 132.

[2] President's Water Resources Council, The Policies, Standards, Procedures in the Formulation Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources, S. Doc. No. 97, 87th Cong. 2d sess. (Washington, D.C.: Government Printing Office, 1962), p. 10. Reference cited hereafter as U.S., S. Doc. No. 97, 1962.

Engineers.[1] Here the listing is developed from a benefit context, i.e., recognition of losses and damages prevented through flood control engineering works. As such, the Corps of Engineers listing also includes costs foregone that would be incurred indirectly as a result of actual damages, losses, and disruptions.

Damages and losses resulting from inundated property would include damage to or loss of building structure or physical plant and the contents thereof, such as furnishings, equipment, decorations, stocks or raw materials, materials in process, and completed products. In addition, there is the additional cost over and above that resulting from actual loss or damage to physical plant and its contents, i.e., the cost incurred in post flood cleanup.

Disruption of business and other activities are exhibited by and measured in terms of the cost of evacuation and reoccupation of dwellings and businesses, flood fighting, disaster relief, special security forces, and abnormal wear and tear on alternate routes of traffic. Losses to businesses will be expressed in terms of business and financial losses. Such losses will include loss of normal profit and loss in earnings to capital, management, and labor which are not later recovered. As indicated in the manual, business losses are not consistently proportionate to the physical losses and damages and therefore not easily correlated or projected.

The Corps manual also gives recognition to the third loss category by incorporating additional intangible losses and damages in its flood control program evaluation. Here flood damages and losses are not only recognized through impaired health, loss of security, and loss of life; but

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[1]U.S., Department of the Army, Corps of Engineers, "Survey Investigations and Report -- General Procedures," Engineering Manual 1120-2-101 (Washington, D.C.: Office of the Chief of Engineers, October 12, 1964), pp. 50, 50a, 50b, 51.

also through damages to or loss of historic, scenic, archeological, recreational, and conservation resources.[1] In light of the economic or monetary evaluation orientation, the damages are categorized as intangible due to the problems in evaluating them in monetary terms.

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[1]For further classification schemes for damages and losses, see Sheaffer, Flood Proofing: An Element in a Flood Damage Reduction Program, 1960, pp. 81-83. His schemes are slight variations of those presented by the Corps of Engineers Manual E.M. 1120-2-101.

CHAPTER III

POLICY ALTERNATIVES

Background

As a result of the damages and losses wrought by floods of varying causes, two basic policy objectives have evolved in the development and assessment of a (public) flood loss management program.[1,2,3] Historically, the predominant objective has been centered on the protection of private and social values from flood damage or loss. As a corollary to this, where protection has not been secured or inadequately secured, the alleviation of severe flood loss has been sought. The values being protected have been generally enunciated in legislative and other public policy documents and are expressed in terms of public health, public welfare, and the security of private life, home, and business.

The second objective concerns obtaining economic development and efficiency with water resource investments. Historically, the second objective has been subordinate to the first objective of providing protection to life and property. Specifically, economic efficiency has been used as criteria in assessing alternative programs proposed for obtaining the first objective. Recently, however, maximization of economic development has evolved into an equivalent objective to that of protection.

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[1] Fox, "National Water Resources Policy Issues," 1957, p. 475.

[2] Flood Control Act of June 22, 1936, Statutes at Large, 49, Sec. 1, 1570 (1936), U.S. Code, Vol. 8, sec. 701a. (1964).

[3] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966.

For example, engineering works of improvement are used in protecting flood prone lands from (a specified range of) flood events, often so that subsequent land development can take place. Moreover, recent inclusion of other considerations, such as the use of flood control construction funds as a means of stimulating the use of underutilized resources, has caused the field of flood loss management to take on expanded objectives relative to the historical protection of existing development. In any event, economic efficiency is expressly sought in obtaining protection and development objectives.

In an attempt to achieve both objectives, criteria have been developed for assessing alternative means which reduce flood losses and/or maximize economic development of the flood plain. The primary criteria fall under an analytical device known as benefit-cost analysis.[1,2,3] At this juncture, it is sufficient to note that the internal definitions, applications, and importance of the benefit-cost concept are experiencing considerable scrutiny and debate.[4,5] Notwithstanding the continuing questioning and debate, the concept and analytical device is increasingly

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[1]U.S., Federal Interagency Committee on Water Resources, Subcommittee on Evaluation Standards. Proposed Practices for Economic Analysis of River Basin Projects (Washington, D.C.: Government Printing Office, May, 1958).

[2]U.S., S. Doc. No. 97, 1962.

[3]William Whipple, Jr., "Optimizing Investment in Flood Control and Flood Plain Zoning," Water Resources Research, Vol. 5, No. 4 (Washington, D.C.: American Geophysical Union, August, 1969), p. 761.

[4]Robert H. Haveman, Water Resources Investment and the Public Interest: An Analysis of Federal Expenditures in Ten Southern States (Nashville, Tennessee: Vanderbilt University Press, 1965), Chapter 5 and Appendix B.

[5]U.S., Congress Senate, Speech by Senator William Proxmire on the Senate floor, 89th Cong., 1st sess., July 27, 1965, Congressional Record pp. S 18325-18333.

being incorporated into public decision making in assessing programs directed at obtaining the above objectives.

Policy Alternatives

As in the development of two policy objectives, there have evolved two (philosophical) approaches which are considered when attempting to reduce flood losses. Historically physical regulation of flood flows through the use of flood control works of improvement has been predominate. However, the regulation of human settlement and development in flood risk areas has increasingly gained recognition and importance as a means of reducing flood losses. For analytical purposes, the discussion of the two approaches will be considered in an integrated classification system. The successful integration and balanced implementation of these techniques are as essential to the successful mitigation of flood losses. In addition, a third area in a comprehensive flood management program will be treated, i.e., flood loss emergency measures. These will be regarded as distinct from the first two approaches since they generally do not focus on the prevention of flood losses except those adopted in an emergency setting.

In considering the alternative approaches and possibilities in achieving flood loss reduction and prevention some qualifications should be noted. In the survey of possible alternatives much reliance is placed upon presently practiced methods or upon adapting existing techniques in other management endeavors to that of flood loss reduction. Thus limitations and constraints arise due to reliance on existing knowledge. This does not preclude the possibility of the existence of alternatives not yet developed and foreseen. What research into management techniques will uncover and what more original thinking in the policy field will develop is difficult to assess. However, this area in itself constitutes

an alternative due to the prospects of developing further approaches in flood-loss management along with the following discussed ones.

A Classification of Alternatives

The array of techniques available to direct land use on flood plains are varied. Ways of conceptualizing and classifying the various techniques are also varied.[1,2,3,4]

The technique classification schemes may be structured on the basis of the:

(a) type of land area to be secured or managed, e.g.,
rural-urban
undeveloped-developed; or

(b) timing of technique implementation, e.g.,
preflood-postflood,
predevelopment-postdevelopment; or

(c) means of technique implementation; e.g.,
individual-collective,
compulsory-subscriptive or elective.

For the purposes of this thesis, the classification of the flood loss management techniques will be one of implementation timing. (See Table I). The techniques will be structured and reviewed according to their application in the (a) predevelopment or (b) postdevelopment period. Coupled with this there will be an underlying emphasis on means of implementation. This concerns essentially whether the techniques are compulsory or subscriptive in nature. This can be exemplified by

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[1] Kates, Hazard and Choice Perception, 1962, p. 104.

[2] Jerrold A. Moore, Planning for Flood Damage Prevention, Engineering Experiment Station Sepcial Report No. 35, Georgia Institute of Technology (Atlanta: Georgia Institute of Technology, Reproduced under sponsorship of the Tennessee Valley Authority, n.d. (post 1958)).

[3] Murphy, Regulating Flood-Plain Development, 1958, pp. 6-10.

[4] White, Human Adjustment to Floods, 1945, Chap. IV.

TABLE 1
TECHNIQUES FOR MANAGING AND MITIGATING FLOOD LOSSES

Predevelopment		Postdevelopment		
Compulsory	Voluntary	Compulsory	Voluntary	Emergency Measures
Floodway encroachment regulations	Building finance	Floodway encroachment regulations	Engineering works of improvement	Relief
Land use zoning regulations	Taxation policies	Land use zoning regulations	Flood proofing	Flood fighting
Subdivision regulations	Warning signs	Building code	Taxation policies	
Building code regulations	Acquisition	Urban renewal (eminent domain)	Rebuilding finance	
	Insurance		Redevelopment	
	Education		Insurance	
	Technical assistance		Acquisition	
			Education	
			Technical assistance	

Comprehensive Planning

the contrast between regulatory devices and incentive, elective, or educational devices. Such considerations are felt to be important due to their instructive value in terms of technique selection and understanding the rationale for applying the technique. This is particularly important in the area of regulatory techniques, where the justification for applying a device having compulsory provisions needs careful development.

The discussion of the alternative techniques for reducing flood losses will be structured by their application to pre-flood plain development or post-flood plain development. Commonly proposed techniques falling under predevelopment applications are: (1) floodway encroachment regulations, (2) land use zoning regulations, (3) subdivision regulations, (4) building code regulations, (5) building finance, (6) modified tax policy, (7) warning signs, (8) land acquisition, (9) insurance, (10) education, and (11) technical assistance. Under postdevelopment implementation, the commonly proposed approaches include: (1) engineering works of improvement and flood control, (2) flood proofing, (3) evacuation, (4) redevelopment, (5) insurance, and (6) land acquisition. The relative placement of some of these techniques is somewhat arbitrary. (See Table I). Engineering works of improvement and flood proofing are techniques available to prospective flood plain developers, and therefore, are equally appropriate under predevelopment techniques; although current stress or attention under both techniques is directed toward securing existing development. Similarly, land acquisition is available in both time periods. Differencs may exist in the general availability or appropriateness of the various techniques available for acquisition. However, the distinction is not critical to the philosophy of acquisition. Rather, it is reflective of the different land uses and options available for acquiring land. For example, open space type easements would not be appropriate for acquiring developed riverfront areas.

One of the other classification techniques can be viewed to varying degrees within the implementation timing based structure. A distinction between compulsory and subscriptive means of obtaining implementation are discernible in the predevelopment plan. (See Table I). The distinction fades in the second or postdevelopment class. Channel encroachment, zoning, subdivision regulations, and building codes are all well established regulatory techniques for influencing land use. Building financing, taxation policies, warning signs, and evacuation are a collection of policy techniques varying in their means of implementation. But they are basically voluntary or incentive in terms of attempting to direct flood plain land use.

Engineering works of improvement, flood proofing, urban renewal, or acquisition may either fall under a compulsory approach or one of the other policy approaches depending upon the agent utilizing them. If condemnation is coupled with or accompanies engineering works of improvement, urban renewal, or acquisition, then the technique takes on a compulsory aspect. So to, if flood proofing is made part of a building code requirement, it takes on or becomes part of a regulatory device.

Predevelopment Flood Loss Management

An emerging concept of obtaining reductions in flood loss is one of influencing the pre-development and use of the flood plain. Here, the focus of thinking is upon (1) securing flood plain areas, (2) directing the type of uses to which flood plains may be put and (3) adjusting the ways in which each use should be undertaken. The desired outcome or goal is the prevention or minimization of losses and damages to life and property which are associated with the inundation of these lands. If a prospective flood plain occupant or developer is made aware of the hydrologic risk inherent in a flood plain site and subsequently adjusts

his use of the flood plain in light of the risk, then flood losses and damages may accordingly be prevented or reduced. Various public policies and techniques are available for influencing both the awareness-perception function and the ultimate private-public use of these flood plains.

Engineering works of improvement are increasingly utilized and justified in terms of securing flood plain areas from flooding.[1] Protective flood water control structures are viewed as providing enhancement benefits in that more economic development can subsequently take place. At the same time land use regulations can be used in guiding the new land use developments in terms of wise use of the flood plain. Such regulations can control types of use and guide the means in which such uses are undertaken. The regulatory and guidance function is important due to remaining unprotected flood plain areas and to any continuing risk of flooding in protected areas.

For purposes of discussion, however, treatment of engineering works of improvement will be deferred to the postdevelopment technique section. This is in large part a reflection of the continued justification such measures have in terms of reducing flood losses in developed areas. Further, unprotected areas continue to have flood loss management needs which must be provided irrespective of possible or contemplated engineering works of improvement. Consequently, land use regulation will be treated first under predevelopment flood loss management techniques.

Compulsory Devices

Floodway Encroachment Regulations

Influencing development and land use in the floodway portion of the flood plain is one of the first land use policy goals usually recommended

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[1] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 9-10.

in reducing flood losses and damages. The goal is one of preventing incompatible land uses from developing in or encroaching upon the floodway. When buildings, structures, fills, and other incompatible land uses are allowed in the floodway, an obstruction occurs to the natural flow of flood waters. Increased flood stages caused by encroachments may result in increased peak discharges downstream from encroachment areas and in increased flood stages in upstream reaches. This often results in greater property loss. Accordingly, losses and damages are reduced by preventing such obstructions through regulating the use of floodway areas.

There are a number of possible ways of influencing the use of land in the floodway. The public sector has five broad powers to draw upon i.e., taxation, spending, eminent domain, proprietary, and regulatory for influencing land use in the floodway. All have been drawn upon in the past to implement one or more programs for using or influencing land use in the floodway. Recently, however, it has been the police power, which has been increasingly advanced as the means for directing land use in the floodway. It provides a comprehensive direct, and compulsory power through which regulatory techniques can be developed.

The justification for using the police powers in regulating use of lands in the floodway relates to the external effects arising from use of such land. The consequences of land uses in a floodway are not always borne solely by that flood plain developer. That is, while damages may be experienced by the floodway land developer, greater damages or losses may be inflicted upon upstream and downstream land owners due to the actions of the floodway developer. Consequently it may be argued "free choice as to occupancy and use of a flood plain

(floodway) should be restricted by government because the use by one owner may harm the other."[1]

Dunham addresses the justification of using the police powers in regulating the floodway from several viewpoints: economic, hydrologic, and legal. He suggests:

> The only questions [refers to legal recourse] for judgment here are the validity of the claimed causal relationship between building and flood damage, and the method of accomplishing the end (should it be a preventative or liability imposing rule?). The legal principles are the same for any method?[2]

The selection of a preventative course of action results in the use of the police powers of the states. It has the advantages of (1) being preventative in terms of managing flood loss or damage and (2) avoiding the complexities of trying to affix prices and values for purposes of reimbursement. The liability recourse poses awesome problems with respect to determining causal relationships between actions and damages, and subsequently affixing values for reimbursement purposes. Not withstanding the judgment problem, there are the added factors of irrecoverable losses or damages which may only be preserved through preventative actions.

The preventative course of action focuses on defining the floodway within which limits no filling or structural development shall take place, unless specifically authorized by issuance of a publicly controlled permit. The definition of the floodway, due to its dynamic nature, will necessitate the adoption of a specified flood event. The flood channel, i.e., the

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[1]Allison Dunham, "Flood Control Via the Police Powers," 1959, p. 1110. This is but one of four rationales reviewed by the author for justifying the use of police powers in regulating flood plain lands. He notes that of the four rationales "This one is the most ancient of reasons for exercise of the police power and is one completely acceptable to all schools of politics. . . ."

[2]*Ibid*., p. 1112.

"normal" channel area and that portion of the flood plain needed to actively transport the flood associated with the specified flood event, can then be delineated with hydrologic data and recorded on maps for enforcement purposes. The permit system referred to allows variances to the restrictions of the floodway encroachment regulation where it can be established that interference with flood flows will not result from the intended structural development, or that compensating adjustments can be developed.

Dunham's reference to "the claimed causal relationship" involves the resolution of a major problem in establishing floodway encroachment restrictions. The problem not only frustrates development of preventative regulations, but the effective use of a liability recourse, also. Both recourses are dependent upon (1) engineering abilities to define and causally correlate the interrelationships of land use and flood hydrologic responses, and subsequently, (2) for economists (appraisers) to differentiate the losses and damages which would be expected to be associated with the "undisturbed" flood event and the floodway restricted flood event.

The difficulty with the problem lies in the variability of the floodway which is dependent upon the topography of the flood plain and the magnitude of the flood event. Consequently, a consensus among hydrologists, economists, and policy decision makers must be arrived at with respect to what flood event (magnitude and/or frequency) should be adopted as a legal basis for regulating floodway encroachment. Further, analytical tools are needed for relating hydrologic phenomena to cultural occupancy of the floodway and the greater area, the flood plain.[1]

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[1]For evidence of such problems and needs, see Murphy, Regulating Flood-Plain Development, 1958, p. 34.

Besides a number of administrative and political problems, there are certain inherent limitations associated with the level of institutional enactment. If floodway encroachment is enacted at the local levels of government, problems may arise in inconsistent or nonuniform criteria of program design. Or, more troubling, are the differences which may arise from partial program adoption among the watershed basin communities and political jurisdictions. On the other hand, state, regional, or river basin planning units may also be faced with problems of developing their plans and controls in harmony with the plans of the diverse local units of government which may have only a portion of their jurisdiction lying in the floodway.

Flood Plain Zoning

Flood plain zoning is another technique available in regulating human activities in a flood plain such that a reduction in potential flood losses may be obtained. Its principles and use follow that rationale and application of the general land use zoning concept.[1]

Zoning originally developed in response to a need for public regulation of land uses, which by their nature were of a hazardous character or posed a nuisance to the public in general. The technique evolved eventually into a planning instrument whose goal was one of providing for orderly urban growth by which nuisances associated with certain land uses and arising out of improper or incompatible use of land might be minimized and such that the public welfare would be advanced.[2] Consequently, as an instrument of land use planning, the enactment and

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[1]Murphy, Regulating Flood-Plain Development, 1958, p. 47.

[2]J.H. Beuscher, Land Use Controls--Cases and Materials, 3rd edition (Madison, Wisconsin: The College Printing and Typing Company, 1964), pp. 263-264.

administration of a zoning ordinance is dependent upon a comprehensive plan that is preferably drafted and adopted prior to or as an antecedent of the zoning ordinance. The land use zoning technique

> . . . takes the form of dividing the city into districts, and within each district limiting the height, bulk, and use of buildings and other structures, the density of population, the use to which land may be put, and other matters.[1]

Flood plain zoning is a further extension of the land use zoning concept and technique. As such, a special flood plain zoning district may be set up. In this event, the district would be uniquely defined, and the allowed uses therein would be characterized by their (1) low flood loss susceptibility, (2) low flood damage threat to other land uses upstream or downstream, and (3) compatibility with the remaining land use plan. A variation or second application of the flood plain zoning technique is the delineation of a flood plain zone over existing zoning districts. As an overlay approach, it would entail applying further qualifications and restrictions as to types of uses to be allowed in those portions of existing zoning districts which happened to fall within the flood plain as defined by the ordinance.

Establishing flood plain use provisions necessitates an adequate supply of hydrologic data to delineate those areas susceptible to inundation and the frequency expectation associated with inundation at various (topographical) levels on the flood plain. Information on existing and projected economic development and cultural use of the delineated risk areas is also required. The economic and cultural use data will most likely already be in the adopted or existing master plan, official map, and zoning ordinance. The integration of the three sets of

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[1]Fred H. Bair, Jr. and Ernest R. Bartley, The Text of A Model Zoning Ordinance with Commentary, 3rd edition, (Chicago: American Society of Planning Officials, 1966), p. 1.

data (hydrologic, economic, and cultural) and such other information that is contained in the master plan should provide the basis for developing the allowable land uses and/or the restrictions on how such uses are to be made.

Murphy, in his late 1950's study, went farther in specifying the essential items to consider or include in the drafting of a flood plain zoning ordinance. It should be made clear (1) in the delineation of areas subject to flood that the adopted flood plain zone and the restrictions accompanying it do not obviate the need for further consideration of adjacent and outlying land areas with respect to their flood risk; (2) in flood zones where economic development is to be allowed, requirements for the protection of the proposed development and its use need to be developed and also provisions for the review of development plans; (3) in preference to the use of a special purpose ordinance, the flood plain zoning ordinance should be placed over the master zoning ordinance; (4) detailed provisions should be incorporated which indicate the allowable and conditional uses for the zoned flood plain areas; (5) provisions should also be included which will allow adjustments of lot size and set back restrictions; and (6) instead of using the phrase flood plain zoning, use of some other phrase as "restricted district" or "conservancy district" should be adopted. The latter is designed to avoid the initial opposition to classifying zoning areas as flood plain districts by current land holders and developers.[1]

Ideally, provisions 1, 2, and 3 of Murphy's list can be combined, such that they provide a series of zones which presents a gradation from highly restrictive use requirements as contained in the floodway to relatively permissive use regulations in the upper limits of the delineated

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[1]Murphy, Regulating Flood-Plain Development, 1958, pp. 145-146.

flood plain. As will be seen later, such a gradation (ideally) will be based in part on the varying applicability or appropriateness of other land use guidance techniques as flood proofing, building codes, flood insurance, building finance, or other techniques as those found in the philosophy of physical regulation of floods. The variable and selective use of these techniques will allow the gradation to evolve, as opposed to the tendency of having extremes of no development.

Some inherent limitations exist in flood plain zoning. First the enabling provision allowing zoning regulations must exist. That is, state constitutions or enabling acts must precede the use of zoning (police powers) and must also be broad enough in their enabling provisions so as to allow the use of zoning in regulating flood plains.[1] Second, the existence of hydrologic data of sufficient quality (length of record, continuity, number of recording station positions, etc.) to allow the sound delineation of flood hazard areas is important. Where data is deficient or unreliable, the ordinance is open to questions and challenge.[2] This is not to say that adoption of a certain flood frequency or magnitude based on subjective judgment will invalidate the ordinance. The data upon which the statutory flood is based must be sound. Third, the relationship of the restrictions in the regulations to the stated purpose of the (flood plain) zoning ordinance are open to challenge. Care

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[1]Edward M. Bassett, Zoning--The Laws, Administration, and Court Decisions During the First Twenty Years (New York: The Russell Sage Foundation, 1936), Chap. 1, esp. pp. 13 and 31-32.

[2]Evidence of this is indicated indirectly by the provisions allowing for reconsideration of flood district lines in a model flood plain zoning ordinance amendment proposed by Beuchert. In Section 3, allowance is made for petition by landowners challenging the validity of the flood district lines as established by the enacting legislation. Edward W. Beuchert, A Legal View of the Flood Plain, Paper submitted in the Seminar on Land Use Planning of Harvard Law School, (Reproduced by the Tennessee Valley Authority, 1961), pp. 58 and 67-68.

must be exercised in relating the provisions of the flood plain regulations to the purposes of the ordinance. In part, this is a function of the provisions in the enabling legislation or constitution of the state.[1]

Another and possibly the most relevant limitation relates to the application and utility of the zoning ordinance provisions. Their utility in preventing unnecessary damages in undeveloped areas or proposed developments is high. However, their effective application to old or existing developments is constrained. Retroactive application of the provisions to nonconforming uses is not generally possible. Generally, the ordinance can only prevent (1) redevelopment of a nonconforming use after it has been substantially damaged, (2) alteration of its use, (3) expansion of the development, and (4) prevention of reinstatement of use once it has been abandoned.[2] In the event of a flood and associated destruction of property, the redevelopment of these areas will subsequently come under the restrictions of the flood plain zoning ordinance. In this delayed manner, subsequent flood losses can be reduced in existing developed areas.

Subdivision Regulations

Subdivision regulation is a third technique often cited as a means of regulating land development and occupancy of the flood plain so as to prevent flood losses. As a land use planning and regulatory instrument, it is closely allied and coupled with the master plan and zoning regulations. This relationship is succinctly stated by the following:

> Zoning relates to the type of building development which can take place on the land; subdivision control relates to the way in which the land is divided and made ready for

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[1]Bassett, Zoning, 1936, pp. 54-56.

[2]Bair and Bartley, Model Zoning Ordinance, 1966, pp. 105-116.

> building development. The two are mutually dependent because the layout of an area is inseparable from the character of the use to be made of the land. . . .[1]

In general, subdivision regulations attempt to guide the division and development of rural or expansive land areas into smaller plats or tracts of land devoted to more intensive land use. How these subdivided lands are replatted and complimented with improvements will influence the permanence and maintenance of the subsequent developments in the ensuing years. Performance standards and standards of design are set forth in terms of the subdividing, replatting, and recording of the land; improvements and services to accompany the subdivided plats; and the dedication or reservation of undeveloped lands to assure the harmonious, orderly, and progressive development of the community. It is necessary to be able to demonstrate that the functions and safeguards are prescribed for and related to the public health, safety, comfort, convenience, and welfare of the people in general in order to justify invoking the police powers to obtain compliance.[2,3]

Consequently, subdivision regulations may be utilized in dictating how the flood plain shall be considered and utilized in subdividing a parcel of land located partially or completely within a flood plain. The subdivision regulations will reflect the contents of the master plan and zoning ordinance which guide the type of uses which shall be allowed on the flood plain portions. For example, a zoning ordinance may forbid the location of a dwelling within a portion of the flood plain, as the floodway,

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[1]Beuscher, Land Use Controls, 1964, p. 210; citing Marygold Melli, "Subdivision Control in Wisconsin," 1953, Wisconsin Law Review 389.

[2]American Society of Planning Officials, A Model State Subdivision Control Law (Chicago: American Society of Planning Officials, March, 1947), Sec. 5 (p. 16) and Sec. 7 (p. 28).

[3]Beuscher, Land Use Controls, 1964 pp. 210-214.

and yet allow for some means of crediting flood plain land to minimum lot areas, setback requirements, etc., which are important considerations in drawing up subdivision plats. This example is illustrative only; as complicating factors could enter, as health questions relating to sewage disposal, which would prevent the credit from meeting necessary and sufficient performance standards.

Techniques vary within subdivision regulations for obtaining flood plain regulations. Murphy suggest they will incorporate the following practices: (1) the delineation of the flood risk areas on subdivision plats as the precondition to their being filed, accepted, and recorded; (2) the establishment of design standards for platting and developing in flood risk areas; and (3) the establishment of easement, reservation, or dedication provisions to allow for the active transport of flood flows along the floodway.[1] The second practice may in fact begin to overlap with building code regulations as an additional and distinct means of reducing flood damages on a flood plain. Similarly, the third practice may be viewed as a modification of encroachment regulations.

While Murphy found the inclusive integration of floodway, zoning, subdivision, building regulations a common practice where subdivision regulations had been enacted; it is not necessarily the desirable form for developing the different regulatory techniques. Which is not to say that the overlap or merging should not occur. Rather, the successful integration of the separate and distinct regulations may be accomplished through cross linkages and references between distinct and separate codes and ordinances. In contrast, accommodation of varying flood plain regulatory devices and programs under one regulatory ordinance may dilute and erode the philosophy or justification for each program. In

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[1]Murphy, Regulating Flood-Plain Developments, 1958, p. 47.

such event, the regulatory effectiveness of the combined program may be deficient. Conversely, overregulation may also result, if for example a floodway encroachment regulation was incorporated into or drawn up as a (flood plain) subdivision regulation or flood plain zoning ordinance. In both cases, the differentiation needed can be attributed to the differences (1) in restrictiveness needed in development location or (2) in the focus of the regulatory provisions. There appears to be a delicate balance lying between individual, distinct, operational techniques and the complete, all-inclusive integration of all regulatory techniques into one onmibus package.

The limitations in this technique are essentially the same as in floodway encroachment regulations and flood plain zoning. As inferred above, there are limitations resulting from limited application and scope of the subdivision regulation, as is true of the other regulatory devices. Equally true or similar with respect to the other techniques are the limitations resulting from (1) constitutional or legislated enabling provisions and (2) absent or deficient hydraulic data.

Building Codes

The previously discussed land use regulatory techniques were oriented toward controlling the type of use to be made of flood plain lands. A subsequent management focus is on how the allowed uses shall be implemented. If permitted uses will necessitate construction of buildings or structures, then techniques of influencing the design and construction of such structures are needed to secure them as much as practical from flood damage. There are several techniques and enabling powers available to the public sector for influencing the erection of structures needed in developing a proposed land use.

All of the five basic public powers available for directing land use are applicable here to differing degrees. Possibly the most promising power is that of the police power, wherein individuals and organizations may be regulated in their conduct and the manner in which they make use of their own property, such that other individuals or the public are not unnecessarily injured. It poses as possibly the most comprehensive, direct, and relatively inexpensive (in terms of public expenditures) means of directing building and structural developments on the flood plain.

The commonly used technique in the public sector for influencing design and construction of buildings and structures is the building code. Building codes attempt to safeguard the health, safety, and even the public morals through regulating the design of, construction of, use of materials in, and alteration of buildings or structures. Health safeguards are related to and reflected by requirements assuring adequate heat, light, ventilation, water, and sewage facilities. Safety considerations likewise are related to and reflected in requirements assuring minimum risk of fire, collapse, or accident associated with deficiencies in building design, construction, materials or building and equipment operation. The safeguards for morals are related to requirements for separate or minimal sharing of bathroom facilities, soundproofing of structures, and other design or structural provisions assuring the privacy or protection of family units and individuals.[1,2]

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[1]Building Officials Conferences of America, Inc., Basic Building Code, 1950 edition (New York: C.J. O'Brien, Inc., 1950), Sec. 100.3 "Code Remedial," p. 1.

[2]Robert M. Oster, "Municipal Housing Codes in the Courts," (New York: American Council To Improve Our Neighborhoods, Inc., September, 1956.)

While little discussion was found in the literature of merging flood proofing concepts with building code development or amendment, the two management techniques focus on the same problem. A basic objective is to reduce potential flood damage and loss through alteration of building design, construction, or materials used in construction. The distinction in the two techniques is more adminstrative than substantive. Under building code development, much of the burden of technique initiation falls upon the building inspection department to enforce the code regulations by making building permit applicants aware of the minimum provisions and then seeing that the applicant incorporates those provisions in the construction of his building or structure. Under flood proofing, the emphasis is placed upon the various engineering facets of the technique and the initiative of the flood plain occupant in adopting elements of flood proofing. This will become more apparent with the later treatment of flood proofing as a flood loss reduction management technique.

The drafting and enforcement of a flood plain building code is most aptly done in conjunction with the general building code. Like flood plain zoning, flood plain building codes should not be viewed as a separate planning instrument to the larger, more comprehensive regulations. Flood hazard is but one of a large number of considerations which can be and should be dealt with in a comprehensive zoning ordinance or a general building code.

The extension of building codes, such that they give adequate recognition of flood risk and accompanying destructive forces, would presumably be justified on the basis of safety and health. Currently, the recommendations for building code coverage of flood plain areas are directed at design and construction specifications with some definition

of performance standards. Murphy suggested building codes could

> (1) specify minimum elevation for footings on the first floor of a structure; (2) require re-enforcement to withstand water pressures and high velocity flow; (3) prohibit basements; (4) require that buildings can be firmly anchored to prevent their floating off their foundations.[1]

Such recommendations illustrate possible areas or types of approach, as opposed to constituting adequate specifications. They also illustrate the current mixing of specification and performance type building code standards.

Questions have existed in the past concerning whether special minimum building standards could be developed on a uniform basis for application in flood plain areas.[2] Presuming the questions can be answered affirmatively for both performance and specification building standards, a consensus among building code drafters is needed for deciding where research efforts should be directed in assisting the development of sets of minimum flood plain building standards.

Questions and doubts have been expressed by model building code officials concerning the feasibility of developing flood plain standards capable of inclusion in a model building code. Murphy discounted the doubts while giving recognition to the fact that flood events vary by physiographic region. He suggested that from a building code or structural standpoint there should only be a limited number of variations necessitating different code requirements. Accordingly, a corresponding number of building standards should be capable of being set forth for the various physiographic settings.[3]

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[1] Murphy, Regulating Flood-Plain Development, 1958, p. 98.

[2] Ibid., p. 99.

[3] Ibid., p. 100.

The more apparent limitations will develop from the deficiencies and problems associated with the drafting, enactment, and enforcement of general building codes. The Advisory Commission on Intergovernmental Relations conducted a comprehensive review of building codes in 1965. They found a larger number of deficiencies and problems at all stages and levels of building code development and use. Most of these problems relate to building code practices and not their designed purpose. Although the practices in effect dictate the outcome in terms of realizing the expressed purposes.

The implications for limitations in terms of flood plain building codes are several. First, it is apparent that research efforts and current knowledge are not sufficient to develop performance type flood plain building standards. Second, there is not an adequate means of getting approval of any such standards on a comprehensive basis. Third, implementation and enforcement of such standards, where adopted, would depend upon existing administrative and enforcement procedures. These procedures have been frequently criticized and found deficient.[1] Consequently, while building codes can be discussed as an alternative technique, it appears that such consideration needs to be tempered with knowledge of limitations associated within the general building code area. These limitations should be reviewed with respect to their relevance to the special treatment of flood plain areas by building codes. It is also apparent that it would be undesirable to attempt developing a special flood plain building code separate from the general building code. From the standpoint of special flood plain consideration, this might be desirable. However,

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[1] U.S. Advisory Commission on Intergovernmental Relations, Building Codes, A Program for Intergovernment Reform (Washington, D.C.: Government Printing Office, January, 1966), pp. 81, 96-102.

from a general planning and administrative standpoint, this would be undesirable as noted in those areas having fragmented special building codes and code authority.[1,2]

Subscriptive Devices

Floodway encroachment regulations, flood plain zoning ordinances, and building codes are all dependent upon the ability of the state to exercise police powers. In contrast, the techniques which will be treated in the following sections are not dependent upon the police powers. Consequently, such techniques will not have the regulatory directness of those utilizing police powers. Such a statement does not infer that the remaining powers do not present significant bases for developing techniques to manage flood losses and influence flood plain land use. Public policies concerning property taxation or building financing which are based upon the power to tax and the power to spend, respectively, are examples of measures containing considerable leverage for influencing decisions on whether and how to develop land lying in a flood plain.

Warning Signs

A little discussed technique for influencing decision outcomes of prospective developers of flood plain areas is that of warning signs.[3] The lack of current literature discussion and emphasis with respect to such a technique might be attributable to experiences reported for communities which have previously employed such measures or had them employed in their environs. As a result, the lack of success and

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[1] Ibid., pp. 28-30.

[2] Regional Building Codes (Detroit: Metropolitan Fund, Inc., 1966), p. 15.

[3] Murphy, Regulating Flood-Plain Development, 1958, pp.

popularity of such a program in the past may now be a source of discouragement in either suggesting, proposing, or implementing such a program. Such a hypothesis needs testing, but initially offers some explanation for the current status and state of the art with this technique.

The philosophy of flood plain warning signs appears to be one of informing and warning a prospective property buyer or developer of the flood hazard inherent with the location under consideration for development. The signs serve an educational function in alerting unsuspecting land buyers or developers of the existence of a flood hazard.

Building Financing[1]

The means for obtaining financial assistance in acquiring and developing flood plain land are relevant to program development considerations in managing flood losses. The policies of public and private lending and loan guarantee institutions pose as possible policy areas available for modification in terms of their consideration of loan applications.

The degree of flood risk in the proposed development area should be reflected in the criteria utilized in evaluating a credit application where flood plain areas are involved. Denial of sources of financial assistance or penalties added to a loan in the form of increased interest or insurance rates can contribute greatly to the prevention of unwise

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[1]Although, building finance as a technique is alluded to by several flood plain management authors, there is an absence of detailed discussion of this technique as a means for reducing flood losses. Consequently, reliance has been placed upon such general studies as (a) U.S., Department of Housing and Urban Development, Federal Housing Administration, Digest of Insurable Loans (Washington, D.C.: Government Printing Office, October, 1966); and (b) Federal Housing Administration, Housing and Home Finance Agency, F.H.A. Experience with Mortgage Foreclosures and Property Acquisitions (Washington, D.C.: Government Printing Office, January, 1963).

development in the flood plain. Thus, the objective in using financial policies as a land use guidance technique are directly related to the directive influences financial institutions may have through withholding or granting credit to flood plain developers.[1,2]

Techniques for using building financing as a means of directing flood plain occupancy involve relating hydrologic events to economic considerations. Essentially, the same hydrologic data is needed as that necessitated for the previously discussed flood plain management techniques, i.e., history of flood events (flood magnitudes and their frequency expectations), selected flood hydrographs, valley cross sections, stage-discharge curves, and stage profile curves. Subsequently, the process of relating the proposed development to flood risk can be undertaken and an evaluation can then be made of the associated economic risk. This risk can be expressed and evaluated in terms of property damage and loss, interrupted business activity, and premature amortization of property. These will influence the continuity of loan repayment schedules and/or the ability to successfully repay financial obligations. Similarly, the provisions for loan, mortgage, or other credit insurance programs should reflect considerations of flood risk, the associated factors of disruption and destruction, and the implications for defaulting on loan repayments. The presumption here is that foreclosure proceedings resulting from flood losses and damages are less desirable than precluded development resulting from restrictive lending policies.

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[1] *U.S.*, Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966.

[2] Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, Public Law 90-448, August 1, 1968, 82 Stat. 573, Section 1302(e).

The point or source of leverage for flood loss management in financing developments lies in the process of granting, underwriting, or guaranteeing a loan, mortgage, or other extension of financial credit. Approval of an application for financial assistance could be made dependent upon hydrologic and economic criteria unique to flood plain areas. Where it is determined that the flood risk is such that it will jeopardize the financial security of the development and/or the repayment of the loan, mortgage, or debt; the application for financial assistance may be disapproved. In this way development of flood plains can be guided and ill-advised construction may be forestalled.

A large number and assortment of financial institutions and programs exist which would have influence in the acquisition and development of flood plain lands. Because of diversity in private and public financial institutions, it would be necessary to have substantial agreement among various lending and financing institutions in terms of evaluating flood plain risk and subsequent approval or rejection of an application for financial assistance.[1] Such agreement would effectively increase the influence financial institutions could bring to bear in inhibiting unwise development in the flood plain.

The adoption of policies by financial institutions which reflect considerations of flood risk in their review and approval of loan applications may be encouraged through several processes. Educational programs which relate (a) the importance of flood risk, (b) the incorporation of flood risk within the determination of interest rates, (c) the means of evaluating and incorporating the risk in review of loan applications, and (d) the means for reducing flood risk which are available

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[1]Examples of this need are illustrated in U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 27.

to the flood plain developer. Educational programs can be initiated, directed, and coordinated by public agencies and various associations of financial institutes. Second, existing public loan, mortgage, credit, or other financial assistance programs may be modified by administrative rules and regulations. Administrative policy may direct that loans, mortgages, etc., shall be withheld where flood risk is not adequately accounted for in the location and design of the development. Such conditional policies may be instituted by the public sector where it underwrites loan or credit guarantee programs.

Some of the limitations associated with this technique are characteristic of most of the land use guidance programs. Specifically, a limitation exists in the ability to translate hydrologic data of limited history and reliability into economic locational factors and design factors. Where the hydrologic data is deficient, technical assistance is lacking or the responsibilities of the financial institutions are unclear; accordingly, such institutions will be unable to act in a supportive manner to flood plain land use control.

Other limitations arise due to the number and diversity of loan, mortgage, and credit institutions which operate in the building finance field. Strong directives can be exerted where public credit programs are involved. Indirect influence from the public sector can be exerted on private financial institutions and their programs through the modification of public credit programs which interface with the private sector. For example, FHA and VHA mortgage insurance programs can be adjusted such that their risk assessment procedures are adjusted to more adequately reflect and cover flood hazards and risk. Subsequently, private mortgage applications for public insurance or credit underwriting can be approved or denied upon the basis of flood risk in addition to other risk factors.

However, the diversity of lending and financing programs is such that comprehensive and compulsory coverage of financial policies in their application to flood plain areas is not easily obtained. Consequently, undirected or uncontrolled building and development can take place due to the less than comprehensive, compulsory building financing policy.

It might be noted here that flood risk is but one of many risks and factors which should be evaluated by a lending or insurance institution in reviewing a loan application. However, such a limiting phenomenon, i.e., where flood risk is but one of many factors to be considered in a land development loan application, is pervasive throughout the land use directive program effort. Consequently, while the philosophy of land use adjustment can focus on flood plain land use and the available techniques for directing land use therein, actual technique implementation and practice are confronted with the limitations associated with a merger of flood plain risk considerations with the myriad of other considerations inherent in each land use guidance technique.

Taxation Policy

Taxation is another financial policy technique which is little developed in the flood loss management literature. Murphy suggested that tax relief could be utilized ". . . as an incentive for development of flood plains in accord with the master plan of development in the area."[1]

The philosophy for using taxation as a policy technique in guiding land use in the flood plain originates with the knowledge that taxation practices influence and affect land use decision making. Property taxation policies and income tax policies are credited with having varying degrees of influence upon the use made of land. The type of use

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[1]Murphy, Regulating Flood-Plain Development, 1958, p. 157.

and quality of uses made of land are influenced by tax policies. However, it is not always apparent how the influences are manifested due to the countering or conflicting influences of different tax policies.[1,2]

The objective in using tax policy as a flood plain management technique would be one of supporting or maintaining certain select types of land use while discouraging land use adjustments in the flood plain which are felt to be undesirable from a public viewpoint. This often means preserving existing undeveloped flood plain areas and of not contributing to the influences which induce more intensive development in the flood plain. Consequently, an underlying argument is that through public tax policy an improper or uneconomic use of land resources can be forestalled or discouraged. Thus, in this land management area, tax policy is meant to intervene in the market forces which might otherwise bring about land uses thought to be contrary to the best interests of the community, state, or nation.

It should be noted, though, that the public is attempting to guide and not regulate the private landowner's use of the flood plain. The technique is dependent upon financial incentives and disincentives issuing from the public power to tax. The compulsory elements of the police powers are absent here insofar as the actual use made of the land is concerned. The type of land use is still under the discretion of the flood plain landowner. This presumes that existing zoning, subdivision regulations, and other land use regulations have not been developed such

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[1] Jerome P. Pickard, Changing Urban Land Uses As Affected by Taxation -- A Conference Summary Report, Research Monograph 6 (Washington, D.C.: Urban Land Institute, 1962), Chapters I, II, and III.

[2] Jerome P. Pickard, Taxation and Land Use in Metropolitan and Urban America -- A Progress Report, Research Monograph 12 (Washington, D.C.: Urban Land Institute, April, 1966), pp. 9-12; 18.

that they reflect the special needs of the flood plain. Herein lies a fundamental weakness of this technique, in that no certainty of contract or regulation is inherent in the technique. Consequently, the technique is not sufficiently directive. Only where other techniques (e.g., flood plain zoning, flood plain acquisition) are the primary management tools utilized; then flood plain preferential taxation finds its appropriate role.

The possibility of adjusting tax policies for influencing flood plain use has been suggested in flood plain management literature. At the same time, little detailed discussion or development of possible techniques has been found in the same literature. Consequently, a process of extrapolating techniques from allied or similar problem areas to that of the flood plain management area has been adopted here.

There is a notable absence of discussion of income tax policy as an available tool in flood plain land use management literature.[1] General land use and taxation literature note that (1) depreciation allowances, (2) capital gains provisions, and (3) deductibility provisions of income taxation policies do have an influence on land use.[2,3] Such influences were assessed from a perspective of intensity of land use, associated income generation, and related investment or speculative characteristics. In general, they were found to be significant as incentives in entering the speculative real estate market and in conferring benefits to home-owners and selected improvements to the land. Speculative incentives

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[1]The problem is briefly identified in U.S., Task Force Report on Flood Control Policy, 1966, House Doc. No. 465 1966, pp. 30 and 31.

[2]Pickard, Taxation and Land Use, 1966, pp. 9-10.

[3]Pickard, Changing Urban Land Uses, 1962, pp. 18-23.

are related to capital gains policy. While the depreciation allowance policies influence the rates of return on the equity held in an improvement.[1]

The adaptability of income tax policies to flood plain management considerations is not clear, due to the absence of specific literature coverage of this flood loss management topic. It might be noted also that the income tax deduction provisions covering financial losses resulting from natural disasters such as floods may also play a role in flood plain land use. It is most likely that in this case such income tax policy technique considerations would be most applicable to past land development management policies. This stems from their potential role in influencing rebuilding and/or relocating damaged or destroyed structural uses of land. This latter will be treated briefly, later, under the Postdevelopment Policies Section. In general, however, it appears that further research would be desirable in assessing the potential role income tax policy might play in managing flood plain areas. An initial point of inquiry might relate to the possibilities of placing restrictions on the number of times a financial loss can be claimed as a result of flood events or the amount of financial losses which may be claimed successively from a development on a parcel of flood plain land.[2]

A similar problem to that found in the income tax area results from the paucity of specific literature discussion of property tax policy in a flood plain management context. It is possible to extrapolate flood plain tax policies from existing property tax policy provisions in other land use management fields. It needs to be noted, that, the process of extrapolating tax policies from other land management fields underscores

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[1] Pickard, Changing Urban Land Uses, 1962, pp. 19-20.

[2] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, Recommendation 7(c), p. 31.

the need for integrated and coordinated land use planning and control. In this instance, literature discussions of special land use (taxation) policies for preserving open space often cite flood plain areas as one of several areas ideally suited for application of such taxation policies. As a result, the question of orientation and placement of program technique may become muddled unless coordinated and integrated land use management programs are developed.

It appears that flood plain management and open space preservation are often compatible and integrative by nature. Accordingly, in such instances, the open space preservation program might be the greater objective with (open) flood plain preservation posing as a potential secondary or auxiliary goal. This compatibility may not always be the case though. It does not necessarily follow that those areas having the greatest need for open space preservation or development are always found in or adjacent to a flood plain. Further, it may be unwise, at times, to preclude development in flood plain areas for open space purposes where the flood risk is adequately evaluated and covered by flood loss preventative measures. Accordingly, flood plain taxation policies may be distinct from those developed for open space preservation purposes.

Some of the selective taxation policies suggested for consideration in open space preservation programs are (1) property tax exemption, (2) preferential property assessment, and (3) property tax deferral.[1,2] Property tax exemption policies are designed with the objective of

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[1]William I. Goodman and Eric C. Freund, editors, Principles and Practices of Urban Planning (Washington, D.C.: International City Managers' Association, 1968), pp. 204-205.

[2]U.S., Department of Agriculture, Economic Research Service, Open Space: Its Use and Preservation, Miscellaneous Publication No. 1121 (Washington, D.C.: Government Printing Office, November, 1968) pp. 14-15.

conferring partial or complete exemption from property taxation as long as open space requirements are maintained. Preferential assessment policies may be developed such that open space land areas are taxed in effect at a preferential rate. Or the tax rates may be set lower, outright, so they do not contribute to or compound market pressures to transform the land to a more intense (structural) use. Tax deferral policies are a variation of tax exemption in the sense that imposed property taxes may be deferred indefinitely as long as acceptable open space uses are maintained. If the land use is altered to a publicly undesirable use, then all the back taxes must be paid up prior to public approval of the new proposed land use.[1]

All of the above types of tax policies are ultimately designed to preserve the relatively undeveloped nature of the land affected. This may or may not be the desirable goal for flood plain use. Where structural developments are not generally advisable, as in the floodway, open space taxation policies may be conjunctive with those of flood plain management. In the pondage or backwater storage areas of the flood plain, structural developments may be justifiable and desirable. If the latter be the case, open space objectives may not outweigh the arguments for development and more intensive land use. Consequently, open space objectives and flood plain policy in such instances may be in conflict. Accordingly taxation policies developed to assist in securing open space areas may be inappropriate in application to flood plain areas. Conversely, flood plain lands may not necessarily be among those urban areas most in need of securing open space or may exceed the general needs of open space land in the area in question.

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[1]It might be noted that the tax deferral plan may border upon a license or permit system, depending on how the system is designed. If this be the case, tax deferral may border more on a regulatory type of device than on incentive.

Integrative considerations are not restricted to open space flood plain policy interfaces. In general, flood plain taxation policies and techniques will have to be integrated or coupled with various land use planning policies and programs. Taxation policies as isolated or autonomous land use regulatory programs are weak or limited in their effectiveness, due to their incentive or disincentive nature. Consequently, their effectiveness may be increased (or utilized as a supportive device) when they are coupled with other public planning, development, and regulatory programs.[1]

Use of taxation policy in flood plain management is beset by an assortment of potential limitations. Many problems are those associated with existing taxation policies and are inherited with attempts at modify existing policies to reflect flood plain management needs. Others arise due to the unique problems generated by flood plain considerations.

A limitation attributable to flooding and flood plain considerations arises with the problems of hydrologically defining various flood risk zones on the flood plain. The ability to hydrologically define flood risk zones is basic to most land use management alternatives, and is therefore not unique to tax policy considerations. Specifically, the ability to define suitable and unsuitable land uses in the flood plain is dependent upon the ability of the manager to define and translate the flood risk. This is necessary so that the economic costs of utilizing various risk zones in the flood plain can be arrived at when considering alternative land uses. This capacity will allow development of various land use classes which can accordingly receive supportive property tax assessment practices.

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[1]Goodman and Freund, Principles and Practices of Urban Planning, 1968, p. 205.

In the case of income tax policy, the relationship between being able to hydrologically define flood risk zones and policy reform is less clear. A relationship may surface if relevant policy considerations take under study the potential influence or lack of influence flood loss tax provisions may have on a flood sufferer's decision to rebuild or relocate. For example, to what degree or extent can flood loss income tax provisions be supplemented or encumbered such that repeated losses to the same or similar flood plain property can be reduced or prevented? Is it feasible or desirable to restructure income tax provisions relating to flood loss? This is an area where more research appears to be needed; due to the lack of discussion or treatment of this tax policy area in terms of flood plain management. If it is found that income tax disaster loss provisions can be redeveloped, it is likely that the definition of flood risk zones and uneconomic land uses zones will be involved in implementing such policies.

Several limitations carry over from existing taxation policies and practices. Questions of reasonableness develop from equity requirements and the general objective of neutrality in developing acceptable tax policies.[1,2,3] Equal treatment of persons or property in like circumstances and reasonable treatment of persons or property in unlike circumstances are the two elements needing resolution to satisfy requirements of equity. On the other hand, questions of neutrality are immediately denied in this management context. Tax policy considerations in flood plain

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[1]John F. Due, Government Finance -- An Economic Analysis (Homewood, Illinois: Richard D. Irwin, Inc., 1963), Chap. 6, especially pp. 104-107; 118.

[2]Pickard, Changing Urban Land Use, 1962, Chap. II.

[3]Dick Netzer, Economic of the Property Tax (Washington, D.C.: The Brookings Institute, 1966), pp. 71-74, 164-165, and 174.

management are founded upon the premise that selectively imposed taxes will have a controlled disruptive effect upon the existing market distribution of those resources, goods, or services which are being evaluated. By their selective interference in existing market processes, tax incentives or disincentives are imposed such that unneutralities result. In the case of property taxation, the selective application and interference considerations are in turn dependent upon the ability to define distinct hydrologic risk zones and establish the reasonable uses to be granted special tax consideration. Such risk zones and their associated controlled development classifications will need to satisfy the requirements of uniform and equitable class definition to satisfy state and Federal constitutional provisions for uniform treatment and equal protection of the law.[1,2]

A second limitation which carries over from existing taxation policy considerations arises from the multiplicity of taxing units and taxing entities as well as taxation policies. The numerous taxing units and taxing entities pose problems in obtaining an integrated treatment of a river basin or watercourse.[3,4] This is illustrated by special property tax concessions offered to new business and industrial developments by

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[1]Stephen Sussna, "Open Space Controls," Kentucky State Bar Journal, Vol. 33, No. 4 (October, 1969), p. 48 (Reprinted from The New Jersey Law Journal, XCII, No. 18, May 1, 1969).

[2]U.S. Advisory Commission on Intergovernmental Relations, The Role Of the States in Strengthening the Property Tax, Vol. 1 (Washington, D.C.: U.S. Government Printing Office, June, 1963), pp. 9, 11-12, 23-25.

[3]Netzer, Economics of Property Tax, 1966, pp. 136-137.

[4]Pickard, Changing Urban Land Uses, 1962, p. 25.

communities as a competitive device to attract industry.[1,2,3] Or, conversely, where communities develop selective property class enclaves, i.e., develop select economic class communities, which may afford low effective tax rates due to the limited services required per economic class unit, high property value, and accompanying assessment base.

As a consequence, the varying assessment objectives and policy practices of communities within an area can pose problems for obtaining uniform tax treatment of flood plains. These may be resolved by other means of regulating land use, e.g., metropolitan or regional zoning, state floodway encroachment regulations, state subdivision regulations, etc. However, where other means are not taken, the fact remains that the potentials for differentials on flood plain property tax assessment and taxation may exist between taxing units. These may, in turn, portend differential community pressures for flood plain land use and therefore fragmented flood plain management.

A third limitation may arise from inherent weaknesses in proposed property tax techniques. The proposed techniques do not remove the problems of land speculation. In fact, in some cases, they may accentuate the attractiveness of investing in open space flood plain areas by allowing them to be held under preferential property taxation policies until surrounding properties have been developed and associated property values have increased substantially. The earlier discussed third proposed technique of deferring property taxes may tend to discourage such speculative practices; especially if retroactive interest payments

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[1] Netzer, Economics of Property Tax, 1966, Chapter V.

[2] Pickard, Changing Urban Land Uses, 1962, p. 26.

[3] U.S. Advisory Commission on Intergovernmental Relations, The Role of the States in Strengthening the Property Tax, June, 1963, pp. 11-12.

are applied against the deferred property taxes.

A fourth limitation develops from the incentive nature of tax concessions. This is evident in property tax concession or adjustments, where the landowners actions are essentially voluntary. Further the community does not have strong or certain control over the timing of a land use change.[1] The severity of the tax disincentives involved, retroactively in some cases, still do not assure that undesirable changes in land use will not occur. This limitation can be offset, if tax policy is used in conjunction with other flood plain management techniques which draw upon the police powers, as in zoning or subdivision regulations.

Another notable limitation is that the costs of the tax subsidies or concessions are usually not well known. The U.S. Advisory Commission on Intergovernmental Relations indicated that in terms of special tax exemptions:

> The indirect subsidies thus conferred on various taxpayers do not appear on a State's budget or accounting records, and thus tend to receive approval with much less scrutiny than appropriations for the same purpose would be subject to. They appear, in a bookkeeping sense, to be without cost to the State and local governments; they do, in fact, impose a forced expense on the taxpayers to whom the burden has been shifted, complicate the work of the property tax administration, and progressively weaken the property tax system.[2]

Many other limitations arising from existing (property) tax practices exist which are essentially administrative by nature. For a comprehensive review of existing property tax administration and the economic effects of property taxation, the reader is directed to studies by the U.S. Advisory

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[1]Charles E. Little, Challenge of the Land, (New York: Pergamon Press, Inc., 1969), pp. 71-72.

[2]U.S. Advisory Commission on Intergovernmental Relations, The Role of the States in Strengthening the Property Tax, 1963, p. 11.

Commission on Intergovernmental Relations[1] and Dick Netzer.[2]

Acquisition

Acquisition of full title or of selected interest and uses of flood plain lands provides another technique for both public and private management of flood losses. Purchase of the fee simple confers exclusive proprietary rights to the titleholder; while acquisition of partial rights confers only those positive or negative interests specifically acquired through negotiation or condemnation. By holding full or selected development rights in flood plain land, the holder of the rights may exercise control over the development of the flood plain. The nature and extent of the controls are a function of the rights held and how they were acquired.

Community and private efforts to influence and direct flood plain use may reach their zenith through the adoption of a flood plain acquisition program. If fee simple ownership of the flood plain is achieved, the holder becomes proprietor and steward of the land. If selected interests are held under prescribed conditions, then the degree of control over flood plain use is limited by the nature of the rights held and conditions attached to the holding of those interests. For purposes of discussion, the consideration of partial rights and interests will be restricted to those controls inherent in the rights acquired, and not to the existence of other social controls, as floodway encroachment regulations, flood plain zoning, etc. This is due to the fact that such other social controls may be developed to regulate use of flood plains irrespective of a program of land acquisition.

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[1] Ibid.

[2] Netzer, Economics of the Property Tax, 1966.

A distinction in public policy and purposes arises here between a public program of acquiring fee simple ownership and a program of regulating land use through police powers.[1,2,3,4] If a community decides to rely on its police powers for regulating flood plain use, it has found and declared in effect that the potential loss to the community (or conversely, the public welfare which will be preserved) is sufficient cause for noncompensable regulation to be invoked. On the other hand, if the community follows a program of flood plain acquisition, it is in effect declaring that there are public benefits to be derived from holding and administering certain or exclusive rights in the flood plain. Such public benefits are desired at the expense of private use of the same land, and therefore, the private land holder must be justly compensated. The community benefit sought is thus a public good which cannot be achieved with the certainty desired when the private sector is allowed proprietary use of the flood plain.

To illustrate, regulation of flood plain use is felt to be desirable in order to prevent uses which will be inimical to the general welfare of the community. A point of issue arises, however, if a community permits only those uses upon the flood plain which are amenable to open

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[1]William H. Whyte, Jr., Securing Open Space For Urban America: Conservation Easements, Technical Bulletin No. 36 (Washington, D.C.: Urban Land Institute, 1959), p. 28.

[2]Sussna, "Open Space Controls," 1969, p. 44.

[3]Dunham, "Flood Control Via the Police Power," 1959, pp. 1123-1124.

[4]Considerable differences in policy recommendations can arise here. For example, U.S., Senate Doc. No. 97, 1962, p. 6, can be contrasted with Bureau of Outdoor Recreation Manual, Chapter III, Section III, B.2.d. on Acquisition. Senate Doc. No. 97 suggests techniques might be appropriate for circumventing the need to acquire interests in land to preserve open space and future development options. This policy suggests a potential for serious conflicts with policies of due compensation and acquisition of rights taken.

space purposes, such that open space objectives are achieved at the expense of reasonable private land uses. That is, if reasonable land uses or means of attaining land use (e.g., flood proof buildings) are denied ostensibly for flood loss prevention purposes, when in essence they are invoked to achieve open space objectives; then an unfair taking of land would seem to have occurred.

> Thus it has been held unconstitutional to compel an owner, without compensation, to leave his land vacant in order to obtain the advantages of open land for the public or in order to save the land for future public purpose, but it is within constitutional power to compel an owner to leave a portion of his land vacant where building would be harmful to the use and enjoyment of other land (e.g., set-back lines).[1]

Thus a river community may decide to acquire partial or exclusive interests in portions of its flood plain. Depending upon the nature of the interests secured or conveyed, proprietary or less than proprietary interests in the land may be secured. Such interests will determine whether active, positive, or assertive land use management functions can be carried out. In some cases, the interests conveyed or secured will not be much more than regulatory interests, yielding a similar result as that obtained through the use of police powers, e.g., restrictive covenants or possibilities of third party reversion may parallel achievements of land use zoning.

If active management of the land is desired then proprietary interests may be secured with the acquisition of fee simple title. Similar but restricted management interests may also be obtained through a conveyance of an easement. Other conveyances, which will be discussed, have conditional elements that complicate their land use management aspects, and therefore may not be as attractive in trying to secure land uses desired

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[1] Whyte, Securing Open Space 1959, citing Professor Allison Dunham in Columbia Law Review, May, 1958.

by the public. In most of these conveyances, the management of the land uses may be stipulated, such that private use of the conveyances and/or flood plain may be achieved and still be compatible with those uses deemed compatible by the public sector. In this event, private conveyance and land use management may be equally satisfactory. The ultimate test of acceptability, however, will be to what degree does the conveyance technique meet the needs and objectives of flood plain management.

The techniques for acquiring land or to interests therein are many. To acquire fee simple ownership, a community may

(1) acquire tax title land;

(2) solicit donations of land (by gift, will, dedication, etc.);

(3) negotiate purchase; and

(4) condemn by eminent domain.[1]

To acquire interests less than fee simple, a community may follow one or more of the above procedures; or may lease such interests for a desired period. The latter depends upon the type of interest conveyance being considered. As in the discussion of tax policy techniques, much reliance for technique development is placed upon the discussion of techniques for acquiring and preserving open space lands. Accordingly, techniques which have been suggested for holding selected rights and interests in land for open space purposes include

1. easements (affirmative and negative, appurtenant and in gross);

2. leasehold;

3. license (with and without interests);

4. restrictive covenants;

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[1] Murphy, Regulating Flood-Plain Developments, 1958, p. 119. Note: The discussion of eminent domain will be dealyed until consideration is undertaken of postdevelopment techniques for influencing land use in the flood plain.

5. acquisition of the fee and lease-back; and

6. possibility of reverter and right of entry for condition broken.[1,2,3,4,5]

The above array of holdings and conveyances provides a complex set of alternative possibilities of controlling the uses of and the development of the flood plain by both public and private entities. They allow both private and public entities or persons to hold fee title to flood plain lands and/or convey certain interests, in this case usually development rights, to other persons or entities.

Each technique has limitations affecting its applicability for flood plain management purposes. These will be covered as each technique is presented and discussed below. First, however, certain important qualities or elements will be outlined as they will often determine the basic limitations inherent in any technique used for conveying interests in land.

Several elements of concern should be reviewed in assessing various techniques of conveying interests in land for flood plain management purposes. This is especially true in those instances where less than fee simple title interests are being discussed. Those elements of particular concern relate to technique (1) availability and applicability,

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[1]Allison Dunham, Preservation of Open Space Areas: A Study of the Non-Governmental Role, Publication No. 1014 (Chicago: Welfare Council of Metropolitan Chicago, 123 West Madison Street, August, 1966), pp. 7-27.

[2]Charles E. Little, Challenge of the Land: Open Space Preservation at the Local Level (New York: Pergamon Press, 1969), Chaps. III and V.

[3]Sussna, "Open Space Controls," 1969, pp. 43-47.

[4]Whyte, Securing Open Space, 1959, pp. 11-14.

[5]Norman Williams, Jr., Land Acquisition For Outdoor Recreation -- Analysis of Selected Legal Problems, ORRRC Study Report No. 16 (Washington, D.C.: U.S. Government Printing Office, 1962), pp. 38, 40-53.

(2) expense, (3) alienability, and (4) duration.[1]

The concern over availability issues from the question, For whom is the technique in question available and applicable? Is it primarily available to the private sector or equally available to the public sector? Is it restricted to landholders, in this case flood plain occupants? Does the land management interest of particular concern, i.e., the physical use of the flood plain portion of the plot in question, reside with the conveyor or is it transferred with the passing of interests to the conveyee? The importance of these questions varies according to whether the conveyor of the partial interests in a flood plain plot is the party concerned about compatible uses of the flood plain, or whether he is the recipient of the conveyed interests through which he wishes to secure the reasonable use of the flood plain.

Questions concerning expense relate generally to the costs of acquiring the interest through the particular technique of conveyance. This allows the cost of acquiring the appropriate, less than fee, interest to be compared with acquiring the fee simple or with other conveyance techniques. Other relevant expenses or costs might relate to taxation, i.e., where does the burden of property tax fall, what are the assessment practices, what influence does income tax policy have on the conveyance, and what other taxation policies have a bearing on the conveyance? These will be especially significant where a gift or donation of land is being solicited and the alternatives for conveying such interests are varied.

Concern for alienability of interests held pertains to the ability of the titleholder and of the partial or selective interest holder to convey, devise, assign, or otherwise transfer their respective interests

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[1]Dunham, Preservation of Open Space Areas, 1966, pp. 7-31.

to another person or party. This may be important for the grantor of a selected interest or conditional interest, wherein an attempt at conveying, or even devising, his retained interests might terminate his interests, e.g., rights of entry for a condition broken or a possibility of reverter. The same element of concern will hold true, if not more so, for the grantee or recipient of the conveyed interests.

In some cases, the question of duration will relate also to questions pertaining to the alienability of acquired interests. In other cases, questions of duration will relate to issues of judicial discretion and interference in terminating interests conveyed and held due to a change of conditions. Or the legal principle of the rule against perpetuities may be applied or susceptible of application to some conveyance techniques. Where such judicial or legal tests are applicable, the concern for duration of interests held becomes heightened, for the stability of such interests decreases.

The applicability of each of the above four elements of concern varies in importance and emphasis with any one technique being considered. For example, a gift of a conservation or open space easement in a flood plain tract may secure desired public interests in that portion of the flood plain without direct cost to the community. (This is not true where the public has to negotiate a purchase of the easement.) Considerations of expense or cost may enter indirectly, due to diminished or foregone tax revenues. Depending on the circumstances, such considerations of indirect expense may or may not be of more importance than the consideration of direct expenses. In contrast, the judicial test of changed conditions poses as a more significant limitation and problem for such conveyance techniques as right of entry for condition broken, possibility of reverter, and restrictive covenant, than does considerations of expense.

Easements have possibly been the most widely discussed and suggested technique for acquiring or preserving open space interests in land.[1,2,3] Generally, a negative easement may be acquired from a landowner which prohibits him from developing his land in ways which would normally be legitimate uses but which now would be in conflict with open space preservation. The general compatibility of open space preservation and flood plain management suggests the natural extrapolation of such a technique into the flood plain management program. At the same time, the use of affirmative easements may readily be adopted for flood plain management purposes. Under the affirmative easement, a nontitleholder to a parcel of land is allowed to acquire specified interests from the landowner, such that the nontitleholder may enjoy those acquired interests. In this case rights to allow floods to flow or be ponded on portions of flood plain land may be secured in this fashion.

Any easement will be termed appurtenant if the grantee (recipient of the easement) has land adjoining and benefiting from the land to be burdened by an easement. The benefiting land is termed the dominant tenement under the easement, while the land burdened by the easement is termed the servient tenement. Appurtenant easements run with the land as opposed to with the owner and accordingly are assignable.

In contrast, an easement will be termed in gross when the servient tenement provides a personal benefit to the holder of the easement and does not directly relate to or benefit land adjoining the land burdened.

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[1]Dunham, Preservation of Open Space Areas, 1966, pp. 19-22 and 24.

[2]Oakes A. Plimpton, "Conservation Easements" (Washington, D.C.: The Nature Conservancy, 1522 K Street, N.W., n.d. circa 1966), pp. 3-8 and 10-17.

[3]Williams, Land Acquisition for Outdoor Recreation, 1962, pp. 46-53.

Here the qualities of assignability and alienability are thrown into doubt due to variations in state by state statutory treatment and judicial interpretation of easements in gross. If easements in gross are inalienable or nonassignable, their applicability to managing flood plain lands is weakened. That is, they appear to be weaker than appurtenant easements. This is especially evidenced by the fact that courts apparently are reluctant to recognize negative easements in gross. In contrast, appurtenant easements benefit from their relative stability and strength, as evidenced by the fact that they may constitute an additional property right which increases the bundle of property rights of the dominant tenement.

Easements, whether appurtenant or in gross, offer further stability in that they may exist indefinitely. Changes in circumstances do not generally pose a threat to an easements viability and validity. As indicated, the appurtenant easement runs with the land, and privity of estate is not necessary to validate the creation of the easement.

Probably the most limiting factor present in the use of easements is the one of expense. Although they were conceived with the idea of possibly avoiding the expense of acquiring fee simple title, the actual implementation of such a technique has indicated that their cost may at times approach the cost of the fee.[1,2,3] The question of tax treatment is also another matter related to expense. The considerations involved in property tax assessment, property tax foregiveness, and income tax policy all influence the motives and ability of property owners to convey easements or for parties to acquire an easement.

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[1] Whyte, Securing Open Space, 1959, p. 33.

[2] Williams, Land Acquisition for Outdoor Recreation, ORRRC Study Report 16, 1962, p. 38.

[3] Little, Challenge of the Land, 1960, pp. 64-65.

Leases are contracts negotiated between a property owner and a prospective tenant for the use of specified property, for a definite period of time, under an accepted rental arrangement, and with other negotiable terms.[1,2,3] Under the terms of the contract, all or selected affirmative rights and uses of the property pass to the lessee, while the property owner retains reversionary interests and unassigned rights.

Since an affirmative use of the property is the usual objective of a lessee, the lease may not have a significant applicability to flood plain management. This is not to say that a lease may not be used as a flood plain management device, in that limited or selective affirmative flood plain uses may be marketable, depending upon local circumstances. The limitation in applicability arises in the selection or judgement of what reasonable (profitable) uses are available and marketable for leasing purposes.

The potential applicability of the lease as a flood plain management device will be influenced by the landowner's perception of reasonable and unreasonable uses of the flood plain portion of the tract in question. This consideration does not account for external judgement constraints, as flood plain zoning, floodway encroachment regulations, and other land use controls. This consideration also presumes that the titleholder or lessor would be the appropriate party within a lease arrangement who would be interested in restricting, securing, or assuring reasonable use of the flood plain. Accordingly, while the lease technique is available

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[1] Raleigh Barlowe, Land Resource Economics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1958), pp. 346-347 and 412-424.

[2] Williams, Land Acquisition for Outdoor Recreation, ORRRC Study Report 16, 1962, p. 38.

[3] Sussna, "Open Space Controls," 1969, p. 46.

to both private as well as public landowners, it may be that the lease finds more applicability under the public sphere where flood plain land use management may be of more immediate as well as long-term concern.

Other elements of concern which may be limiting include assignability, expense, and duration. Leases are assignable, suggesting that this is an area of concern which is not as limiting as in others. The expense involved with a lease will relate largely to the rental terms agreed upon. As indicated, marketability of the property to be leased will be affected by allowable, reasonable, and profitable uses available for adoption on the property. Finally, duration of the lease is also negotiated. Consequently, the degree of stability of the leasehold is in part a negotiable factor. Leases of 99 years have a significant stability inherent in them, as opposed to one renewable from year to year or for lesser periods.

A license consists of the granting by a landowner of a privilege to use of his land by another person or party.[1,2,3] The use is specified as to purpose and may be limited to a prescribed time. In terms of flood plain management considerations, some relevant distinction between an easement and a license are

(1) there is nothing in a license as an instrument of transferring interests analogous to a negative easement;

(2) licenses may be considered legal interest but not a property interest;

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[1] Restatement of the Law of Property, Vol. V. (St. Paul: American Law Institute Publishers, 1944) Chpt. 37, Sec. 450; Chpt. 43, Sec. 512-521.

[2] Herbert Thorndike Tiffany, The Law of Real Property (Chicago: Callahan and Company, 1939), Vol. 3, Chpt. 15 "Licenses," Sec. 829-838.

[3] Williams, Land Acquisition for Outdoor Recreation, ORRRC Study Report 16, 1962, p. 38.

(3) licenses are not generally protected against third person interference;

(4) licenses cannot be created by prescription;

(5) licenses arise by consent and consequently are generally subject to being revoked at will; and

(6) licenses, especially those not coupled with interests, are not generally assignable.[1]

The granting of a license may be oral or written, i.e.,

> No formalities are essential to the creation of a license. . . Not infrequently, . . ., licenses arise because of the failure in the attempt to create interests other than licenses, to comply with the Statute of Frauds or other formal requirements.[2]

Licenses with interests brings the general license instrument closer to the stabler conveyance instrument of easements. The primary distinction arises from the absence again of the necessary formalities of creation. Such earlier cited distinctions in licensing as nonprotection from third party interferences (item 3), interests granted are subject to being revoked (item 5), and nonassignability (item 6) are diminished or removed.[3] However, since easements are in general a more stable and durable means of transferring interests in land to that of granting licenses in general, they are preferred. This is especially notable in the fact that negative appurtenant easements may be the most desirable instrument of transferral within the techniques of licensing and easement.

Restrictive covenants may be used as a flood plain land use control much in the manner they are used in new residential subdivision developments. In general, a restrictive covenant can be initiated when a fee owner promises (covenants) not to make a specified use of his land or otherwise

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[1] Ibid.

[2] Restatement of the Law of Property, 1944, Chpt. 43, Sec. 515.

[3] Tiffany, Law of Real Property, 1939, p. 835.

restricts his freedom of enjoyment of his land.[1,2] In order for the covenant to run with the land (pass onto subsequent owners), the covenant should be made at the time of a conveyance. (Tiffany indicates that under the more restrictive Massachusetts doctrine, followed in some states, a further requirement exists wherein during the conveyance of an estate, two distinct interests in the land must exist, i.e., privity of estate exists between covenantor and covenantee, respectively.)

Further, the covenant should be so closely related to the land or the estate such that it meets the test of "touching and concerning" the land. Otherwise the restrictive covenant will be considered a personal or collateral one, and, thus will not pass with ownership.[3,4] Dunham indicates that in addition to the questions of privity of estate between original covenantor and covenantee and of "touching" and concerning land,

> . . .there must be privity between the covenantor and his successor; and. . . if the performance of the promist or the transaction of which the promise is a part does not benefit the promisor in the physical enjoyment of his land, it must benefit the promisee or another beneficiary in the physical enjoyment of land possessed by him.[5]

One other relevant quality of restrictive covenants which concerns their terminability, arises under changing conditions. Unless carefully drawn and unless proper account is made for possible changing surrounding conditions, a once sustainable restrictive covenant may lose its applicability

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[1] Ibid., Chpt. A "Covenants Running With the Land," Sec. 848-857.

[2] Williams, Land Acquisition for Outdoor Recreation, ORRRC Study Report 16, 1962, p. 38.

[3] Dunham, Preservation of Open Space Areas, 1966, pp. 15-16.

[4] Tiffany, Law of Real Property, 1939, Chpt. 17 "Covenants Running with the Land," Sec. 851, 852, and 854.

[5] Dunham, Preservation of Open Space Areas, 1966, pp. 15-16; summarizing the contents of Restatement of the Law of Property, 1944, Chpt. 45, "Running of Burdens," Sec. 530-538, Chpt. 46, "Running of Benefits," Sec. 541-552.

and enforcement. This could have substantial importance in flood plain management, where an assortment of devices may be used to secure the land from flood loss. In some cases under changing conditions, it may be desirable for a restrictive covenant utilized in securing a flood plain tract from development to lapse. For example, where construction of flood protection works is undertaken and the hazard to a tract of flood plain land is significantly reduced, it may be reasonable for such land to be developed, notwithstanding the existence of a restrictive covenant.

In general, however, restrictive covenants may be viewed as instruments of transferring land interests which should be avoided. This stems primarily from the fact that restrictive covenants are viewed as a highly technical and complicated field in real property law.[1,2] Accordingly, it has been recommended, by some open space preservation writers, that other instruments of conveying or transferring interests in land be utilized when and where available in lieu of restrictive covenants. Their conclusions appear to have relevance and application to flood plain management.

Acquisition of the fee from and lease-back to the vendor has been a

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[1] Williams, Land Acquisition for Outdoor Recreation, ORRRC Study Report 16, 1962, p. 38 concludes:

"No one in his right mind would ever tangle with this morass (several sets of erratic technical requirements) if any other conceivable course of action were available."

[2] Sussna, "Open Space Controls," 1969, p. 45, in part suggests: "Although covenant law is highly technical and even confusing to the initiated, the possibility of redrafting in statutory form should not be overlooked . . . However, this would mean tracing out and simplifying in the particular state many tortuous case law encrusted topics."

suggested means of acquiring and protecting interests in the flood plain.[1,2] This in essence is a combination of two techniques of acquiring interests in land. The first technique is simply one of acquiring the fee simple title to land; the second consists of conveying partial interests or interests with attached future, reversionary, interests through a leasehold.

Williams discusses a variation of the acquisition of fee and lease-back arrangement for dividing ownership of land between public and private parties. He recommends that new state statutes be enacted which enable

> Public acquisitions of the fee and reconveyance to the former private owner of a new type of legal interest in land, consisting of whatever rights are specifically reconveyed. This interest should specifically be made assignable and devisable, i.e., it can both be sold and inherited.[3]

The suggested advantages to such a new conveyance technique are several. (1) The public would retain the residual rights which may be of importance for new, future uses or purposes. (2) The reoccupant receives those interests essential to the uses he has conducted in the past, which he may still sell or assign. (3) The net costs of conveyance may be lower than in acquiring easements, due to the value of the reconveyed interests will recoup a substantial part of the acquisition of fee costs. This is based on the presumption that the nature of the easements being sought would cause the costs of easement to approach the acquisition costs of the fee simple. Finally, (4) the existence of a sales price and a

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[1] Sussna, "Open Space Controls," 1969, p. 45.

[2] Williams, Land Acquisition for Outdoor Recreation, ORRRC Study Report 16 1962, pp. 38-39.

[3] Ibid.

reconveyance sales price will facilitate the assessment of reconveyed land for property tax purposes. Consequently, the acquisition of fee and reconveyance of partial interests might constitute an improvement on the lease-back arrangement. This stems from the increased stability of the interests reconveyed to the land user over those obtained through lease. However, the novelty of the technique and the apparent need for statutory revisions pose problems for fully developing and assessing its potential as an available technique for acquisition of interests in the flood plain.

Another technique suggested for conveying interests in land for open space purposes which has potential relevance to flood plain management is that of rights of entry for condition broken or a possibility of reverter.[1,2] The distinction between the two varies by statutory treatment and judicial interpretation from state to state. However, the principles of operation in a right of entry and in a possibility of reverter are essentially the same. The techniques allow a landholder to convey his fee to another party subject to a condition or limitation. Depending on how the condition is worded, the fee will revert back to the original grantor or his heirs when and if the condition is violated or broken. The burden or conditional limitation will be the key to securing the flood plain management interests. Therefore, the key management interests remains with the conveyor or his heirs.

The wording of the conditional conveyance will determine whether the reversion will be automatic, i.e., without re-entry, or whether

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[1] Leda Rothman, "Reverter Clauses and Related Legal Problems" (Washington D.C.: The Nature Conservancy, 1522 K Street, N.E., December, 1964).

[2] Dunham, Preservations of Open Space Areas, 1966, pp. 7-13.

actual re-entry is necessary for repossessing the fee by the original grantor or his heirs. The conditional limitation desired in open space land preservation would most likely be the denial of structural development or use of the conveyed land. This may or may not be appropriate for flood plain purposes, depending on the watershed and the area. Although, this should not preclude the question and possibility of varying the conditional limitation to fit the management objectives.

Problems do arise in the areas of alienability and possible duration of rights of entry for conditions broken and for possibilities of reverter. States vary in their allowance of these techniques to be assigned, conveyed, or devised. This in turn has a partial influence on limitation of duration.[1] Further, the limitation on duration of rights of entry and possibility of reverter is subject to questions relating to (1) the rule against perpetuities and (2) judicial prerogative in terminating the conditional limitations where a change of conditions has occurred. The latter problem is analogous to that found in the case of restrictive covenants.

Flood Insurance

An insurance program has been suggested as another means of reducing flood losses.[2,3,4] On the surface, an insurance program would not seem to

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[1]In Michigan a right of entry is alienable; while it is not so certain with a possibility of reverter. See Dunham, Preservation of Open Space Areas, 1966, p. 9; cf. Mich. Stat. Ann. Sec. 26: 851 (1963)

[2]Francis C. Murphy, Regulating Flood-Plain Development, 1958, pp. 9-10, 123-127.

[3]John V. Krutilla, "An Economic Approach to Coping with Flood Damage," Water Resources Research, Vol. 2, No. 2, Second Quarter 1966, pp. 186-188.

[4]U.S., Congress, House Committee on Public Works. "Insurance and Other Programs for Financial Assistance to Flood Victims." Report from the Secretary of the Department of Housing and Urban Development to the President, Committee Print No. 43, 89th Cong., 2d sess., 1966. (Washington, D.C.: Government Printing Office, 1966), pp. 47, 74, and 132.

be a technique for reducing flood losses, nor one appropriate for predevelopment flood plain management purposes. In part, this is true. Flood insurance might be conventionally taken out on already existing property to provide compensation in the event of flood loss. In this instance, the flood plain property has been developed, and flood losses are anticipated in relation to a risk probability function. Thus, flood insurance has an appropriate application as a postdevelopment technique, and is one ostensibly designed to provide compensation for damages and not actually for the reduction of damages.

If a flood insurance program is developed such that it has compulsory features attached to or associated with the program, then it can become a potentially potent predevelopment technique for reducing flood losses. In this event, the desired and intended goal is one of forcing the prospective flood plain occupant to weigh the locational costs against the locational benefits which are unique to a flood plain location. Heretofor it has been argued that the prospective flood plain occupant has not adequately taken account of the social costs of the flood plain location due to potential flooding, or else he has chosen to ignore them by not bearing such costs.[1,2] It is argued that compelling a prospective flood plain developer to acquire and keep current a flood insurance policy as he develops his property will cause him to assess the locational costs of the flood plain through the actuarial risk portion of the quoted annual policy premiums.[3] Upon assessing the actuarial risk based annual premiums, the

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[1]Kates, Hazard and Choice Perception, 1962, pp. 12-16.

[2]U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, p. 34.

[3]Krutilla, "An Economic Approach to Coping with Flood Damage," 1966, pp. 187-188.

prospective flood plain occupant is in a better position to determine if the flood plain location in question does offer locational benefits in excess of the associated costs of occupancy. However, in order that such a predevelopment insurance induced calculation be made, the insurance program must be made compulsory or obligatory through several alternative measures. Consequently, it has been suggested that the compulsory element be achieved by developing the insurance program such that it is conditional upon or attached to some other (flood plain) land use management program.[1]

Several objectives have been set forth for a flood insurance program.[2] At the outset, it would be desirable that a flood insurance program meet the objectives of the overall flood loss management program. This was recognized by the Secretary of Housing and Urban Development in a report submitted to the President and the Congress in which it was stated "National policy should be concerned to limit future flood hazards without at the same time limiting national economic development."[3]

There are several subobjectives or program goals coupled with the above two basic objectives of limiting flood loss and encouraging economic development. (1) Inherent in the insurance concept is the quick compensation or reimbursement of flood losses due to property damage.[4] As implied,

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[1] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 48, 1966, pp. 82, 89, 93-95, 104, and 129.

[2] Ibid., pp. 33-34 and 127.

[3] Ibid., p. 217; also see pp. 10 and 97. Note in the Secretary's statement of policy concern that the emphasis was placed on not limiting economic development, as opposed to the usually more positive statement of fostering or encouraging economic development. This points up the different direction a flood insurance program takes in directing economic development; i.e., one of discouraging uneconomic development.

[4] Ibid., p. 33.

only property damages to structure and contents are covered. Monetary losses due to inconvenience and disruption were not generally envisioned as a part of a flood insurance program. (2) Secondly, to effectively achieve the basic objectives of flood loss management, it will be necessary to integrate and interrelate the various other flood plain management programs: flood plain zoning, building permits, acquisition, protective works, relief, lending and finance, etc.[1,2] (3) At the same time, a flood insurance program may (a) alleviate the need for certain programs (e.g., flood relief, flood protection works) or (b) enhance other programs (e.g., flood proofing). This will develop if a goal of insuring all existing flood prone properties is sought and if compulsory coverage of all new flood prone properties is enlisted as a national policy.[3,4]

Several institutional alternatives for implementing a flood insurance program have been proposed. These include (1) a fully private insurance industry program, (2) a private insurance industry program with governmental assistance, (3) a government insurance program with private assistance, or (4) a fully governmental insurance program.[5] However, more at issue and fundamental to the flood insurance concept is the ability to develop sound insurance terms which can adequately relate the acturial risk

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[1] Ibid., pp. 129-132.

[2] U.S., Congress, House, Committee on Banking and Currency, National Flood Insurance Act of 1967, House Rept. 786 to Accompany S. 1985, 90th Cong., 1st sess., 1967, pp. 10-11.

[3] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, p. 130.

[4] Krutilla, "An Economic Approach to Coping with Flood Damage," 1966, pp. 188-189. Note: Krutilla puts forth the proposition that a compulsory flood insurance program would be more desirable as an alternative management technique than flood plain zoning and further asserts that it could largely replace the latter.

[5] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, p. 133.

associated with a flood plain property to be so insured. If the terms can be worked out, then the institutional alternative selected should not be critical to the insurance program concept *per se*; rather a question of which alternative is more efficient and administratively desirable.

A number of means of deriving flood risk related policy premiums have been developed and put forward. These include the following methods:

(1). Annual flood damages

(2). Insurance-Industry

(3). River basin

(4). Hydrologic or flood-risk zone

(5). Specific gage

(6). Customized rate[1,2,3]

The above listing is ordered so as to rank the methods in an increasing order of refined flood hazard probability-actuarial risk based premium development. Progressing downwards, the methods demonstrate increased discrimination in flood hazard assessment and damage-risk evaluation. As the refinement increases, the problem of adverse selection associated with average premium rates is diminished.[4]

From a theoretical standpoint (5) the specific gage method and (6) the customized rate method hold the greatest appeal. Both methods allow the prospective purchaser of flood insurance the opportunity of selecting

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[1] *Ibid.*, pp. 48-51 and 58.

[2] Krutilla, "An Economic Approach to Coping with Flood Damage," 1966, pp. 663-666.

[3] Howard Kunreuther and John R. Sheaffer, "An Economically Meaningful and Workable System for Calculating Flood Insurance Rates," *Water Resources Research*, Vol. 6, No. 2, April, 1970, pp. 660-666.

[4] For illustrations of how adverse selection is reduced with successively listed methods, see U.S., Congress, House "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 86-87.

the amount of coverage desired after reviewing information relating the various levels of flood damage, flood risk, and associated annual premium rates. The differences in the rate setting is actually dependent upon amount of policy coverage elected as opposed to differences in assessing hydrological and property damage risks.

The specific gage method determines the probabilities of various floods as marked by given heights on a stream gage. Thereafter, a flood plain property may be correlated with a specified gge, and the associated levels and probabilities of flood damage to the property may be determined. The prospective policy purchaser may then select the amount of coverage he wishes to be covered by flood insurance. All damages below a certain flood height will accordingly be borne by the policy owner. The primary deficiency noted with this method is that it places such decision making burdens on the prospective policy buyer in terms of perceiving and understanding concepts relating to probabilities, hydrology, risk, and premium schedules.[1]

The customized rate method can achieve selective coverage through provisions of deductable clauses. First a series of relationships must be established. (a) General depth damage relationships are developed for a flood plain property, i.e., structure and contents. (b) Concurrently, a series of flood frequencies and recurrence probabilities are derived. (c) Accompanying the flood frequencies determinations are a series of estimates setting forth the varying areawide flood conditions. (d) Floor elevations must be established for each structure which will enable the integration of general depth-damage relationships with the flood profiles and their associated probabilities. With the above sets of rela-

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[1]Kunreuther and Sheaffer, "Economically Meaningful Flood Insurance Rates," 1970, pp. 660-661.

tionships, the actuarial risk based portion of the premium may be established by calculating the average annual damages for each structure to be insured. By providing various deductible clauses, either on a percentage basis or absolute amount, the premium rates may be lowered with the reduction in net coverage.[1,2] The proponents of customized flood insurance rates suggest that the major criticism of such a method might be that it is too cumbersome due to time and costs in administering. To offset this argument somewhat, they offer some evidence to indicate that this would not necessarily be true.[3]

In addition to considerations of institutional form and internal development, other considerations are necessary to make flood insurance an effective predevelopment flood plain management technique. These considerations relate to the earlier mentioned need to incorporate compulsory features or conditional limitations in the flood insurance program. Several techniques are available to bring about such conditions.[4]

Certain conditions may be required before a flood insurance program is made available to a flood plain or flood prone area. Such land use regulatory programs as flood plain zoning, subdivision regulations, floodway encroachment regulations, or building code regulations might be required as prerequisites to a flood insurance program. Similarly, lending institutions might require flood insurance as a prerequisite to approving a mortgage or loan. Or, relief programs may be redeveloped, such that

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[1] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, p. 101.

[2] Kunreuther and Sheaffer, "Economically Meaningful. . . Flood Insurance Rates," 1970, pp. 660 and 663-666.

[3] Ibid., pp. 665-667.

[4] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 27, 77, 82, 89, 93-95, 104, and 129.

provisional allowances are first made for the existence and availability of flood insurance at reasonable rates. Where flood insurance is available, the availability of disaster loans at subsidized interest rates may be restricted in such a manner as to favor the adoption of insurance. The desired effect would be to bring about a reduced need and demand for flood relief after floods strike a flood plain community.

Further integration with other land use management techniques may be desirable and advantageous. The drawback with such other techniques is that they might not carry the conditional elements which are essential to the flood insurance program adoption and success. Encouragement may be given to floodproofing to bring about a lower damage risk, and thereby lower premium rates.[1] Further, flood insurance can be of assistance in long range planning by helping in determining where land use changes are desirable and are likely to result from program implementation. The actuarial risk based premium rates will indicate areas which should be secured or restricted from further development and/or areas where an acquisition program might be undertaken for open space, recreation, urban renewal, or other purposes.

The conditions imposed will either (1) encourage other programs to be adopted or else, (2) cause flood insurance to be considered and/or purchased when anyone is planning a development in the flood plain. In the first case withholding the availability of the desired flood insurance program induces a community into adopting predevelopment management policies. In the second case, other programs are modified so as to cause

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[1]It is important to note that utilization of floodproofing measures to lower insurance premiums, i.e., flood damage risk, presumes individualized or customized insurance policies and rates. Where zonal, areal, or regional insurance rates are applied uniformly, premium adjustments may not be available or applicable for those individuals adopting floodproofing measures.

flood insurance to be purchased or used as a means of evaluating development or redevelopment plans in the flood plain.

At least five major problems are suggested by critics of flood insurance. These include:

(1) Establishment of insurance would require extensive preliminary work to measure and rate probable risks for different locations and types of property and to establish a manageable rate structure.

(2) The lack of interest in insurance protection in the bulk of the nation where flood risks are nominal, and very high premiums which would be required in flood-prone areas would make it difficult to sell enough policies to spread the risk and expense efficiently.

(3) The administrative and selling costs would absorb a relatively large share of the total premium income.

(4) Many property owners in flood-prone areas could not afford the high premium which a full-cost rate structure would entail, and/or would regard compulsory purchase of insurance or failure to provide insurance protection at reasonable rates on their past investments in such areas as inequitable.

(5) The catastrophe risk would be much greater than for most hazards.[1]

The problem of extensive preliminary work and ability to establish a manageable rate structure have been frequently discussed and cited as reasons for defeat or non-implementation of earlier proposed flood insurance program.[2,3,4,5] The extensive preliminary work cited relates to both the

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[1] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1965, p. 42.

[2] Blair Associates, "Flood Insurance and Flood Plain Zoning," a report to the Legislative Research Commission of the Commonwealth of Kentucky (Providence, R.I.: Blair Associates, Seven Dyer Street, September, 1957), pp. 7-8.

[3] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 48-49, 58-59, and 84-87.

[4] Kunreuther and Sheaffer, "Economically Meaningful. . . Flood Insurance Rates," 1970, pp. 665-666.

[5] U.S., Congress, House, "National Flood Insurance Act of 1967," House Report No. 786, 1967, pp. 58-59.

data needs of a flood insurance program and adequate procedures for calculating flood frequencies, developing estimates of potential and probably property losses, and eventually calculating policy premium rates. Such calculations demand a large and varied amount of data. Part of the problem relates back to that one found in most of the land use regulatory programs, i.e., the briefness of many of the historical records for stream gaging and the problems of constructing or projecting probabilities for flood occurrences of extreme magnitude and infrequent occurrence.

In the past, collection and manipulation of such data has not been centered in one institution nor correlated and integrated into a workable insurance program. This is evident in the evolution of proposed methods for deriving the actuarial risk element of policy premiums. Adequate methodologies have only recently become refined sufficiently through coordinated and cooperative efforts to institute a flood insurance program. In the past, problems of adverse selection in marketing policies were anticipated by the private insurance industry due to the crude or general methods of rate determination. The private insurance industry's early stand on the prospects for a flood insurance program was that

> floods are not a type of natural phenomenon which can be guarded against by insurance because of a belief that they do not have the essentially random quality necessary to a sound insurance program.[1]

This view slowly progressed to one of skepticism but willingness to provide technical assistance to public efforts in developing a program, and subsequently to one of endorsement, coupled with cooperation and technical assistance in developing a joint private-public program. As to the issue of whether a manageable rate structure can be developed, field tests of a recently developed pilot flood insurance program may offer further information

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[1]Blair Associates, "Flood Insurance and Flood Plain Zoning," 1957, p. 4.

which may resolve the issue.[1,2]

The lack of interest in flood insurance for low flood risk areas coupled with the problem of high premium rates in high flood risk areas present marketing problems for flood insurance. The interest in and acceptability of flood insurance as a means of reducing (compensating) flood loss for a property owner is governed by several factors.[3] First, the flood plain occupant must discern the flood hazard and deem it of sufficient risk to cause him to take some action. This perception function was discussed earlier.[4] Second, the occupant must view flood insurance as a rational means of protection. Third, he must consider it an economically feasible alternative for flood loss protection.

Marketing problems in low flood risk areas may result from problems resulting from the second factor. Other alternatives as floodproofing or simply absorbing flood loss may pose as more attractive alternatives to flood insurance. The third factor, ability to pay or afford flood insurance premiums, may not be a limiting factor here. Conversely, in the high flood risk areas where actuarial risk based premiums are also high, the ability to pay factor may become limiting. That is to say, flood insurance may in fact be deemed a rational means of compensating flood loss but the premiums required for a policy may be prohibitively expensive. Such actuarial risk based premiums would accordingly reflect the folly of locating in such a high flood hazard area.

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[1] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 58-59.

[2] Kunreuther and Shaeffer, "Economically Meaningful. . . Flood Insurance Rates, 1970, p. 659.

[3] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 78-80, 86-87, and 98.

[4] <u>Supra</u>, pp. 21-23.

Some critics expect or fear that the costs of selling and administering flood insurance to be relatively high.[1] Such criticism would be compatible with the first criticism in that problems of developing manageable and marketable premium rates will be frustrated by additional administrative costs which necessitate higher premium rates. As to the issue of whether the administrative costs will be high or not, sufficient experience with an implemented program has not been reported to settle the issue. Kunreuther and Shaeffer offer some data to suggest that costs in establishing flood frequency and depth damage relationships are manageable.[2] However, overall administrative costs may still be sufficiently high that they do result in high premium rates, or equally, do constitute a large proportion of the policy premium. While this factor is essentially an administrative problem, it does bear directly on the inherent qualities of flood insurance through the marketability of flood insurance and the ability of the (actuarial risk based portion) premium to test the wisdom of a flood plain development.

As suggested in the above three criticisms, it is argued that a program of flood insurance may be largely unmarketable due to the high premium rates. If such a program were to become compulsory, it would present a heavy financial burden on those who had made unwise investments in the flood plain. To such occupants, the program would be inequitable.[3] Conversely, it may develop that where a flood insurance program is initiated, the flood plain occupant, particularly those lying in the high risk zones,

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[1] U.S., Congress, House, "National Flood Insurance Act of 1967," House Rept. No. 786, 1967, pp. 87-88 and 98.

[2] Kunreuther and Sheaffer, "Economically Meaningful. . . Flood Insurance Rates," 1970, pp. 665-666.

[3] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 87-88 and 98.

will expect policies to be offered at reasonable rates.

This criticism and anticipated problem has been countered by proponents of flood insurance. To offset problems of high premium rates, a support program of public subsidies has been discussed and proposed.[1,2,3] The objective and purpose of a subsidy program is to allow acturial risk based premiums to be developed; but also offer financial support to the program, such that subsidized premium rates are available to those occupants in high risk-high flood insurance premium areas. Such a program enables the information and education function of flood insurance to continue, i.e., evaluation of the costs of locating in the flood plain in terms of annual average flood losses. Concurrently, it provides a means of offering flood insurance to those unable to pay high premium rates.

The catastrophic risk confronted by a flood insurance program is ever present. The risk poses an inherent threat to the flood insurance program due to the crippling effect an extreme flood event may have on the risk pool and accumulated insurance reserves. This would be especially true in the early stages of a flood insurance program before reserves had accumulated sufficiently to cover an extreme flood event and the accompanying catastrophic losses. Further, a series of large flood events, closely spaced in time, could also easily bankrupt a flood insurance program.[4]

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[1] U.S., Congress, House, Final Report on the Federal Flood Indemnity Administration, House Doc. 426, 1958, pp. 1-2.

[2] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 87-89.

[3] U.S., Congress, House, "National Flood Insurance Act of 1967," House Rept. No. 786, 1967, pp. 19, 39-40, 58-59.

[4] U.S., Congress, House, "Insurance and Other Programs. . .," Committee on Public Works Print No. 43, 1966, pp. 105-107.

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Again, the proponents of a flood insurance program have proposed means of accommodating such a deficiency and limitation. A second public support program is proposed whereby funds may be borrowed or secured through a reinsurance coverage program. The public reinsurance program creates a means by which excessive flood losses may be born by the regular flood insurance program without bankrupting it. In an all government sponsored program, such a reinsurance program would not necessarily be needed, where the public (federal) treasury is pledged as a means for securing the claims repayment element of the flood insurance program.

Postdevelopment Flood Loss Management

Compulsory Techniques

Many of the management techniques discussed under the predevelopment policy section have application for existing developed areas as well. Their placement under the predevelopment policy section as opposed to the postdevelopment policy section is based upon the emphasis inherent in the technique or the period of greatest leverage in reducing flood damages and losses. This is best illustrated by flood insurance, wherein the technique is designed ostensibly for compensating flood damages to existing structures, but derives its greatest leverage for reducing flood losses through conditional requirements relating to community regulations and controls over development of flood plain property.

Floodway encroachment regulations, flood plain zoning, and building code regulations are techniques discussed in the predevelopment policy sections which have application in the postdevelopment land use management area.

In the case of floodway encroachment regulations, power may be conferred upon a regulatory agency to not only prevent encroachment in the

floodway but also remove existing developments (buildings, structures, other obstructions) where they clearly pose a hazard which threatens the health, safety, or property of others. Claims of compensatory damage may not be required as contrasted to eminent domain proceedings. Consequently, this development and application of floodway encroachment regulations would constitute an extremely powerful management tool, but one restricted to the floodway where the externalities of the nuisance can be clearly demonstrated.

Use of the flood plain zoning is also possible in a postdevelopment policy program. Application of flood plain zoning to existing developments may be accomplished through nonconforming use regulations prohibiting further development, alteration, or remodeling of existing developments which exceed certain prescribed limits or conditions. Similarly extensive rebuilding of flood damaged structures may also be prohibited under the nonconforming use doctrine. In this instance, a formula or proportional factor may be set up as a basis of permitting or denying a permit to rebuild or restore or denying a permit to rebuild or restore a flood damaged structure. For example, if flood damage to a structure exceeds 50 percent, then a permit to restore the structure on the flood plain site may be denied.

Building code regulations may follow a similar tack. If a structure is to be remodeled, expanded, or altered to an extensive degree, building code regulations may be used to restrict or deny such improvements unless they are accompanied by floodproofing. Or in the event of extensive flood damage, restoration of the old structure may be made contingent upon the adoption of required floodproofing elements.

Subscriptive Techniques

Other appropriate predevelopment management policies which have application for influencing existing developments include taxation, acquisition, building finance, and insurance. These will all be explored in more detail, subsequently. The degree of distinction or the extent of variation between the postdevelopment use of techniques and their employment in predevelopment flood plain settings will vary. Brief illustrations of such distinctions are set forth below. Federal Income Tax provisions become relevant under tax policy considerations. While, under predevelopment policies, property taxation policies received primary attention. Land acquisition programs in existing developed areas will depend upon or utilize the power and instrument of eminent domain to a greater extent than in predevelopment settings. An example of this is in urban renewal of river front or flood plain areas. Building financing policies can be slightly modified or supplemented, such that the policies also cover loans or extensions of credit for rebuilding or restoring flood damaged structures. A flood insurance program ostensibly finds its most direct application in existing developed flood plain areas. Compensation of flood damages is the immediate objective of such a program. However, the greatest leverage for reducing flood losses arises from the modification of a flood insurance program such that it can be applied in a predevelopment flood plain setting. There is also the potential for technique modification in conjunction with financial policies for rebuilding or redeveloping in existing developed flood plain areas. In this way, financing of restoration efforts in flood damaged developed areas can be influenced and directed by conditions and constraints attached to financing and insurance policies. In summary, many predevelopment flood loss management techniques find application in postdevelopment flood plain settings.

Attention now will be directed at presenting a comprehensive review of the full array of subscriptive or voluntary postdevelopment flood plain management techniques. The review will begin with engineering works for flood prevention and protection.

Engineering Works for Flood Protection and Prevention

Historically, engineering works for flood protection and prevention have had their application directed at developed flood plain areas. Their function was essentially to protect and secure existing developments from further flood loss. Recently, the function of flood protection structures has embraced the protection of undeveloped land as well as existing developed land. As noted earlier in the chapter, such a function is regarded as an enhancement benefit which allows formerly flood threatened land to be subsequently developed.[1] Notwithstanding this, a continued justification for engineering measures in flood protection results from securing existing developed areas from flood loss. Accordingly, their treatment is developed here, under the postdevelopment section.

Accordingly, reduction of flood losses can be achieved in part, through the application of engineering principles and measures which attempt to physically manage flood flows. These are often loosely classified under and referred to as construction measures or flood control measures. The measures cover a wide variety of approaches which concentrate on (1) retaining and storing flood waters and (2) managing the transport of flood waters.

At this point, it would be of value to clarify a misconception often held by the public in general. Engineering works of improvement are often

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[1] *Supra*, pp. 26-27. Specifically, see (a) U.S., S. Doc. No. 97, 1962, pp. 7 and 10; and (b) U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 9 and 10.

thought of synonymously with the concept of flood control. The synonymity ends when the latter term is used in a broader context or sense, i.e., one which incorporates flood plain regulations and other socio-political regulatory devices along with an array of engineering measures. A second source of confusion and misconception is the unfortunate connotation often associated with the term flood control. The implication of complete regulation of flood flows is sometimes associated with it; thus, instilling a false sense of security in the interpreter. This phenomenon continues today, even though it was recognized early in the national flood loss management program. The early recognition was evident in a statement made by a committee of the American Society of Civil Engineers:

> Moreover, the widely used term, 'flood control,' itself may convey to the public an erroneous impression of the actual results to be obtained. Floods cannot be stopped; they should only be controlled to such an extent as may be warranted by benefits.[1] (underlining added for emphasis)

Detention and storage of flood flows

Reservoirs. -- A much used technique of detaining or storing flood waters is that of reservoir construction. The reservoir impounds and detains or stores flood waters upstream from the areas desiring protection. The structure thus reduces and delays flood peaks (within the design capacity of the structure) by inundating upstream lands lying behind the reservoir. The upstream land is flooded so as to store flood waters in order to protect the higher valued land lying downstream.

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[1]"Flood Control Methods: Their Physical and Economic Limitations," Progress Report of the Committee of the Hydraulics Division on Flood Control in Proceedings of the American Society of Civil Engineers, Vol. 66, No. 2, (Lancaster, Pa: American Society of Civil Engineers, February 1940), p. 266.

Reservoirs for flood control purposes are commonly classified as either (a) retarding or (b) detention reservoirs.[1] The retarding reservoirs are more commonly found in upstream or small watershed areas where unmanned, automated structures can be utilized. They are constructed with sluices of a preset or fixed opening near their base. The desired net effect is one of dimishing and retarding flood peak flows by inhibiting the downstream delivery of the runoff from the upstream small watersheds. The detention reservoirs are usually controlled release structures having regulating gates near their base and crest gates to control flood waters flowing over the spillway. The detention reservoir is often part of a system of integrated retarding and detention reservoirs; which are used for other water related functions other than flood control, e.g., hydroelectric power generation, navigation, irrigation, water supply, and so on.

There are several limitations associated with reservoir control of flood waters.[2] Some of these are preventable or correctable with further engineering or management practices and are noted below.

The potential failure of a reservoir is an associated risk. In the event of a failure, the subsequent flood surge may have a more catastrophic effect than that associated with an unregulated flood for which the reservoir was providing protection. The risk is largely a function of professional practices and judgment in designing the structure and accordingly is sensitive to engineering and management practices.

The protection provided by a reservoir diminishes as use of flood plains progress downstream. This results from the accumulation of downstream tributary discharges and uncontrolled runoff entering the watercourse.

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[1] Shih, American Water Resources Administration, 1956, pp. 42-44.

[2] "Flood Control Methods: Their Physical and Economic Limitations," 1940, pp. 272-273.

This limitation is recognized and compensated for by the development of large watershed flood control programs; often utilizing a system of reservoirs, as examplified by the Ohio River flood control program.

A problem develops with the need to schedule release of the stored flood waters. The desired goal is one of releasing the stored waters without creating or aggravating a flood event on the regulated stream or in other watersheds and still minimizing the time the reserved flood storage is occupied by any one flood event. This is to allow handling of any subsequent flood event which may follow in a relatively short period.

Compounding this problem is the possible multiple use objectives of the reservoir. Continued storage or stabilized reservoir levels are desirable for irrigation, low flow augmentation, water supply, recreation, etc., which may exert their greatest demands on water supply during drought periods. This may necessitate storing some of the flood waters for later use which in effect reduces the amount of reservoir storage available for flood storage.

The construction of reservoirs tends to change the basic hydraulic properties of the watercourse for which flood protection is being sought. "Unless reservoirs are planned and operated with due regard to channel maintenance in the rivers below them, there is danger of deterioration of river channels in the use of storage projects to reduce floods."[1] The danger manifests itself in two ways. There is usually a readjustment in the erosional cutting of the stream channel which results in (1) decreased downstream scour and (2) increased channel cutting immediately below the reservoir. The first results from the reduction or removal of intermittent flood (bank full) flows which have an associated flushing action. The

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[1] *Ibid.*, p. 273.

second and converse process is a function of the lowered silt bearing reservoir discharges; which increases the transport capacity and erosional effects of the released waters. This also interrelates with the changes in the hydraulics of the watercourse, as discussed elsewhere.[1]

Another limitation in the use of reservoirs associated with losses in available flood storage reserve results from sedimentation. The rate and amount of sedimentation will influence the available service life of a flood control reservoir. Deposition of sediment in the reservoir basin displaces the available flood storage reserve. In turn, the rate and amount of sedimentation are sensitive to upstream land use practices and their associated influence on soil erosion and runoff.

Land treatment. -- A different approach to retaining or detaining flood waters lies in the regulations of watershed runoff by retaining larger amounts of precipitation or storing incident precipitation for longer periods of time on and in the land. This has traditionally been done through modifying and adjusting land management practices, especially in the areas of agricultural and forestry land use.

Much controversy has existed in the past over the value of land treatment as a flood control measure.[2] The accepted argument now appears to be one of justification and encouragement of land use treatment under a rationale much broader than just that of flood control. The argument is that the value in adopting various land use treatment practices

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[1] Supra, p. 16 and infra, footnote 3, p. 105.

[2] The height to which this controversy developed may be seen in Elmore Theodore Peterson, Big Dam Foolishness: the Problems of Modern Flood Control and Water Storage, (Introd. by Paul Sears) (New York: Devin-Adair, 1954), See also, White, Human Adjustment to Floods, 1945, pp. 132-133.

which are found beneficial to flood control, is often exceeded by the value obtained from their utilization in increasing and/or preserving the productivity of the land.

Notwithstanding the relative values of land treatment in securing flood control, a second consideration is in order. This stems from the merging of the two basic philosophies of flood loss management: (a) the physical regulation of floods and (b) the regulation of land uses. The point for consideration here is the successful integration of physical and social land use management techniques. In short, the success of flood damage management techniques is dependent upon their integration into a comprehensive interrelated program.

Channel modification. -- A second approach in managing flood waters is that of regulating the flow and movement of these waters in the floodways. This is accomplished by (1) the construction of levees, dikes, or other retaining structures; (2) the improvement in the stream channel capacity; and (3) the provision of supplementary means of transporting flood waters.

Retaining structures. -- The construction of levees, dikes, floodwalls, or other similar retaining structures may either (1) confine flood waters to a floodway or river channel or (2) restrict flood flows from entering an area. Levees can be of two types. An embanking levee supplements the natural stream channel by confining flood flows to a restricted floodway and prevents flood waters from being released into adjacent developed or inhabited flood plain land. (In this sense it might be viewed and included under the second technique of channel modification, i.e., increasing the channel capacity.) Protective levees constitute the second type and are constructed around an area in need of protection. They surround an area in semi-circular or curved fashion and are not designed to increase the

floodway carrying capacity. They are strictly for restricting flood waters from areas desiring protection.

Levees have several inherent limitations, particularly, embanking levees. Problems of sedimentation, drainage, overtopping, breaching, and susceptibility to damage are encountered to varying degrees where levees are constructed.[1,2]

Sedimentation in the constricted floodway leads to the gradual filling of the river bed. This will happen in spite of increased flood flow velocities associated with embankment levees. Over a period of time the net effect may be such that the levees will be overtopped by flood frequencies for which they were initially designed to offer protection, if improvements are not undertaken.

Internal drainage poses another problem which is associated with both embanking and protective levees due to the entrapment of water on the interior land areas receiving protection. The entrapped water may result from occassional precipitation not necessarily associated with flood events. Corrective or preventative measures usually consist of discharge sluices and/or pumping stations.

More serious entrapment of water may result from failure of the levee system due to breaching or overtopping during a flood event. Specifically, overtopping will result when floods of a greater magnitude occur than that for which the levee was designed. This can be related to the fact that it is generally economically unfeasible to build a levee to protect against the largest flood event deemed possible. If breaching accompanies overtopping, the resultant damage and destruction will be extensive.

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[1]Shih, American Water Resources Administration, 1956, pp. 42-44.

[2]"Flood Control Methods: Their Physical and Economic Limitations," 1940, pp. 274-275.

Overtopping will also be facilitated due to the decreased storage area associated with the construction of both types of levees. The decreased storage area will result in increased flood heights. This in turn tends to offset the protective effect provided by the levee. Further, the reduced storage area tends to act in concert with sedimentation and influence increased flood stages such that the net effect is susceptibility of overtopping; unless again, improvements are allowed for and executed.

Limitations in levee effectiveness also develop from construction hazards, such as seepage, slides, and/or subsidence. This may be attributed to poor construction materials and/or foundations. Where this problem is encountered, the risk of breaching is present during a flood. As in overtopping, the effect can be devastating in terms of damages and losses. This is especially true due to the absence of warning in this type of failure.

As in the analogous situation of reservoir failure, preventive and corrective measures are largely of an engineering nature. They develop with and are a function of the design and construction process.

Other limitations cited by the Committee of the Hydraulics Division on Flood Control, A.S.C.E. are associated with the susceptibility of levees to be damaged or weakened by such agents as ice jams (northern United States) and animals (rodents). As in the previous limitation, breaching of a weakened levee may result during a flood event.[1]

Improvements in the stream channel capacity. -- Regulation of flood movements and flows may be obtained by means of stream channel straightening, widening, deepening, and/or clearing. As a supplementary measure, the

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[1] *Ibid.*, p. 274.

channel bed and sides may be lined such that erosion of channel bed is retarded, flood flow increased, and improved channel location stabilized. The net effect desired in all cases is an increased channel capacity to transport flood waters.[1,2]

In general, this technique is limited to short stretches, and accordingly, frequently finds its application in urban areas. This results in part from the disruptive effect of the improved channel on the upper and lower reaches. This relates to the increased delivery capacity and efficiency of the improved channel relative to its proximal reaches. Consequently, a disequilibrium will result and the processes of sedimentation and erosion (or aggradation and degradation) will cause adjustments to be made in the unmodified channel to reestablish a dynamic equilbrium.[3]

Diversion of flood flows. -- The diversion of flood flows from the natural channel such that they pass around or by an area desiring protection is a third form of channel modification.[4] In this case, a separate auxiliary or relief transport passage is created which is to aid a particular reach of the channel in passing flood flows. The diversion of flood flows may be accomplished by construction of cutoff channels or other forms of bypass conduit.

Several inherent limitations are associated with diversion of flood flows. These may affect the hydraulics of the natural watercourse or the degree of flood protection provided.

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[1]Shih, American Water Resources Administration, 1966, pp. 41-42.

[2]"Flood Control Method: Their Physical and Economic Limitations," 1940, pp. 273-274.

[3]For principles of channel equilibrium, see Luna B. Leopold, M. Gordon Wolman, and John P. Miller, Fluvial Processes in Geomorphology (San Francisco: W.H. Freeman and Company, 1964), chap. 7, pp. 198-328.

[4]Shih, American Water Resources Administration, 1956, pp. 41 and 42.

Diversion of flood flows will cause disruption to the hydraulic properties of the stream channel unless compensating measures are taken. Consequences of a cutoff channel may parallel those effects associated with improvements in channel flow capacity. Although the forces of change are restricted to the period of the flood event. This results from inoperation of the cutoff channel during normal or low stream flows. The disruptive effects may manifest themselves in terms of (1) increased stream channel slope associated with the cutoff channel and proximal reaches of the stream; (2) changes in channel sedimentation, erosion, and therefore, channel depth; and (3) subsequent readjustments in location of stream channel.[1]

Summary of engineering works. -- The overriding philosophy of all of the above engineering techniques is one of protecting property and a portion of the flood plain from the destructive forces of flood waters. This protection is secured up to a certain design limit or flood magnitude. The desire to protect certain portions of the floodplain from their intermittent but natural propensity to flood arises from (1) the degree of human settlement and development on the flood plain and/or (2) the desire to put the flood plain into more intensive (cultural) land use. This is the differentiating element which separates this philosophy from that found in the following sections.

Flood Proofing[2,3]

Flood proofing offers a significant contribution to flood loss management

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[1]"Flood Control Methods: Their Physical and Economic Limitations," 1940, pp. 275-276.

[2]The following discussion is abstracted from: Sheaffer, Flood Proofing: An Element in A Flood Damage Reduction Program, 1960.

[3]John R. Sheaffer, Introduction to Flood Proofing (Chicago: University of Chicago, Center for Urban Studies, April, 1967).

policies. At present, discussions found in the literature have been directed at exploring the array of elements available under a flood proofing program and at outlining the procedures an individual or firm should consider in adopting a flood proofing program. Elements in a flood proofing program are available to both existing as well as prospective developments. In general, however, the discussions in the literature have concentrated on detailing examples of flood proofing in developed areas or in structures where flood damages have been experienced in the past.[1] The examples relate how risks of flood loss were lowered through adoption of various flood proofing elements. The implication is then drawn for extrapolating such elements and actions to the initial or pre-construction development stage. Similarly, the procedures for selecting and securing flood proofing are oriented towards the individual decision maker. General inferences are made about incorporating the technique into a flood plain regulatory program, but little work has been done in this area. The potential for integrating flood proofing and building code regulations appears, on the surface, to hold considerable promise.

Flood proofing as a technique is oriented towards securing developments, already constructed or to be constructed, from future flood events and associated inundation. It shares some of the same applications as that of flood plain building code regulations.[2] The emphasis is placed upon securing or protecting developments already constructed or to be constructed from flood loss through alterations in structural design, building materials, construction techniques, arrangement of floor space, and location of equipment and building contents. This is in contrast to

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[1]Sheaffer, Flood Proofing: . . ., 1960, p. iii.

[2]Supra, pp. 44-49.

those techniques oriented towards preventing unwise development, i.e., flood plain zoning, floodway encroachment regulations, and subdivision regulations. Ideally, when considering flood proofing as a flood loss management device, a benefit-cost type of evaluation is conducted such that with flood proofing it can be demonstrated that previously unacceptable sites may now be utilized economically. The benefits of the site should clearly outweigh the costs of using the site due to the contributions of flood proofing or a combination of flood loss management techniques operating in harmony with flood proofing. In the case of flood proofing, this will be accomplished when the costs of such measures are more than offset by the reduced average annual flood damage risk.

Sheaffer classifies flood proofing into three broad categories: (1) permanent, (2) contingent or standby, and (3) emergency measures.[1] Permanent measures are those that become an integral part of a flood plain development. Contingent or standby flood proofing measures include an assortment of protective devices and techniques which are preplanned and specially designed for temporary incorporation or use in a development. Emergency measures, as such, are those which are those found expedient and quickly executed when flood threatens.

The quality of permanence is a desirable feature in a flood proofing program. This is particularly true where depending upon advanced flood warning is not necessary for technique implementation. This results from the minimal dependency upon human involvement and actions when flood threatens. In short, problems resulting from human error are diminished. This does not imply that there is no need for emergency personnel to standby in case of failures, or to implement provisional or emergency

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[1]Shaeffer, Flood Proofing: . . ., 1960, p. 3.

measures which are necessary to supplement the provisions of permanent flood proofing measures.

There are several stages in the construction of a flood plain development where permanent flood proofing features might be incorporated. The various stages include physical site preparation, building design, building construction, and organization of space or placement of contents. Discussion of and examples of each of these will follow.

Flood proofing measures involving site preparation include excavation and filling operations and/or the use of the natural topographical features of the site. Each approach is interrelated with building design and construction. However, excavation and filling stress manipulation of the site, while utilization of the natural features of the site emphasizes adjusting or tailoring the design of the structure to the site. Filling operations allow a structure to be placed above a preselected flood stage. Excavation operations are generally necessary to provide flood storage to compensate for displaced flood storage capacity resulting from the fill operation, or to provide catchment basins and channels for the altered surface runoff patterns. Utilization of site topographical features may include clustering or rearranging the contemplated developments so as to take advantage of the features of the site. This latter consideration emphasizes the interrelatedness of design development and site preparation in flood proofing.

Building design ideally will integrate the topographical features and advantages of a site with the purposes and functions of the structural use to be placed on the site. Besides taking advantage of elevated areas in a flood plain site, the building designer may raise the building by using stilts or by placing the main floor above service floors, such as parking levels or garages. The design feature of a raised main floor is not a new

feature, but has been utilized in all types of structures including residential, commercial, recreational, and industrial developments. The design of machinery and service equipment should also be such that their location in upper floors as opposed to the basement or ground level is possible. Design of building openings, such as entrances, windows, vents, utilities, conduits, and ducts can be altered, minimized, or given special consideration so as to reduce the need for contingent or standby flood proofing measures. A further consideration of utilities involves the movements of sewage, floor drainage, and foundation drainage. Design of drainage systems are extremely critical when considering foundation and floor design. Consideration of hydraulic pressures and movements will influence the design tolerances and materials needed in constructing various structures. This again points out the need and importance of integrating site physical features and building design.

Incorporation of flood proofing features generally occurs in the building construction or remodeling stage. The design features of the structure will likely specify use of particular flood proofing materials as well as protective devices and structures. The use of special building materials to reduce flood damages can be adopted where flood waters are expected to reach or enter a building. Use of water resistant building materials such as special grades of (or treated) plywoods and plasters; metal doors, door jambs and window frames; reinforced glass blocks (as opposed to panes of glass); and specially treated tile adhesives or flood coverings may reduce flood losses and facilitate post flood cleanup. The closure of openings through sealing of unnecessary doorways, windows, and vents is a means of reducing or eliminating much of the flood water that might enter a building. Further, the sealing of foundations through use of waterproof membranes and sealants, such as hydraulic cement, epoxy paint,

and similar waterproofing materials are used to reduce seepage or entrance of water. Such applications of sealant are conditioned upon the ability of the foundation walls to withstand the increased hydraulic pressures. Concurrently, introduction of a subdrainage system, sump, and sump pump will reduce exterior foundation water pressure and drainage, and thereby relieve seepage. However, consideration must be given to the changes in soil conditions and load bearing capacities prior to altering existing foundations or in planning a new building foundation. Provision of non-return valves on sewer and water lines and elimination of gravity drains are usually necessary to prevent backup of water in such lines or to prevent rupture of such pipes in the building. To allow for water backup, ruptured lines, or entry of flood waters in general, protective structures may be constructed around critical machinery and equipment located at or below ground level. Such structures act like little levees within the building, such that critical services as electricity, elevators, and heating may be maintained in case of intrusion of flood water.

Organization of space and the placement of contents are also design related functions. Location of machinery and equipment in upper floors or levels is a recommended procedure. In the case of existing structures, this may be impractical, but for new structures it should be feasible and practical. The location of stock and other building contents may be arranged such that the more valuable goods and stock susceptible to flood damage may be located on upper levels. Such measures are closely allied to contingency or emergency measures as contrasted to structural modifications, but are still classified as a permanent measure where the arrangement of flood space and contents is set.

Contingent or standby flood proofing measures include an assortment of adjustable or movable measures which approximate functions performed

by permanent measures. Instead of sealing necessary entrances and openings, temporary closures are designed and constructed such that they can be put in place when sufficient advance flood warning is given and personnel trained for such duties are on hand. Such temporary closures may consist of hinged, sliding, or removable flood shields which may be fitted over display windows, loading docks, entrances, vents, etc. Where one-way or non-return valves on utility pipes and lines are not appropriate, gate valves or cutoff valves may be appropriate. As in the case of one-way or non-return valves, those lines containing cutoff or gate valves, must be able to withstand the buildup of hydrostatic pressures. If outside utilities are cutoff, then provisions for standby utilities as portable power generators and pumps will be needed to continue essential functions as lights, pumps, elevators, blowers, or other operations. One other flood proofing measure classified as a standby measure consists of encasing valuable machinery with a protective coating. The appropriate means of providing the protective coating includes waterproof polyethylene or vinyl film, plastics, grease, or parafin. The latter measures for mothballing machinery would seemingly border on being emergency measures.

Emergency measures, as such, are those which are found expedient and adaptable within limited periods of time to buildings and building contents which are threatened by flood waters. Examples cited are protective films of polyethylene sheeting, sandbagging of entrances, or evacuation of building contents to upper levels or other locations. Some question may exist as to the appropriateness of classifying evacuation of building contents as a measure for flood proofing. Notwithstanding such questions of classification, it can be suggested that such a measure does reflect the integrative elements of flood proofing with such other techniques as evacuation. In any event, emergency measures are dependent upon

adequate advanced flood warning, trained personnel, and updated emergency plans and procedures. These are required for smooth and efficient placement of flood proofing materials or movement of stock and other transportable property.

Flood proofing is dependent upon adequate and easily comprehended hydrological data. Inadequate data or misconceptions of flood hazard and risk will likely frustrate the adoption of flood proofing. As in flood insurance, the flood plain occupant must be aware of the flood hazard and deem it necessary to take protective action. Accordingly, he must view flood proofing as an appropriate and economically feasible protective action. Assessment of feasible measures will be influenced by the existence of other flood loss programs, their cost sharing policies, and the presence of regulatory policies. Such considerations would be particularly relevant in the case of building code regulations requiring flood proofing measures in all new or remodeled flood plain developments.

Generally, the requirements placed upon personnel and planning to implement flood proofing measures allow the element of human error to enter and pose a serious threat to successful flood proofing programs. This is particularly true in the case of contingent and emergency flood proofing measures, where sufficient flood warning, updated flood proofing plans and procedures, and adequately trained personnel are required.

Shaeffer discusses several additional potential limitations or drawbacks to flood proofing. These concern such factors as (1) complexity of ownership, (2) changes in ownership, (3) structural limitations, (4) false sense of security, (5) conflict with flood control project justification, (6) contribution to discouraging sound land-use planning programs, (7) dependence upon flood warning, and (8) residual damages.[1] The weight

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[1]Shaeffer, Flood Proofing: . . .," 1960, pp. 27-36.

given to each of the limiting factors varies by factor. In fact, several countering or contrasting arguments to selected factors have been expressed in the literature. Specifically, other references suggest factors five and six may be developed such that they operate in a supportive manner.[1,2] And while, Shaeffer later concluded that flood proofing

> can generate a false sense of securing and discourage the development of needed flood control or other actions. Indiscriminately used, it can tend to increase the uneconomical use of flood plains. Applied to structurally inadequate buildings, it can result in more damage than would occur if the buildings were not flood proofed.[3]

His conclusions were not meant to negate the value of flood proofing. Rather he wished to sharply point out the need to carefully develop, encourage, and apply private or public programs of flood proofing.

As noted, other references temper several of the limiting factors suggested by Shaeffer. Hypotheses have been offered in the literature which suggest that flood proofing and flood insurance should have a particularly complementary relationship; thus countering factor six above. Under this hypothesis it might be found that when one program is made available or encouraged, the development or adoption of the complementary program will be facilitated.[4] This is particularly evident in terms of general adoption of flood proofing measures in flood plain areas. Such actions could lead to less restrictive land use controls in flood plains and could serve to lower premium charges where flood insurance is available.

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[1]Krutilla, "An Economic Approach to Coping with Flood Damage," 1966, pp. 186, 189.

[2]Kunreuther and Shaeffer, "Economically Meaningful Flood Insurance Rates," 1970, pp. 660.

[3]Shaeffer, Introduction to Flood Proofing, 1967, p. 1.

[4]Krutilla, An Economic Approach to Coping with Flood Damage," 1966, p. 188.

Evidence was offered to show that economic considerations can be a crippling limitation to flood proofing. It has been suggested that the actual costs involved in flood proofing may prove to be a significant limitation. This would especially occur when the resulting benefits of flood losses prevented are not greater than the costs of flood proofing. In contrast, another argument can be made that suggests the question of economic limitation may actually be one of disparate cost sharing policies. This latter consideration is visible in terms of factor five, as listed above. For example, selection of flood loss management techniques which lower flood losses to the individual flood plain occupant but do not assess the individual for the whole or sole cost are thought to be favored over techniques, like flood proofing, which place the burden of costs upon the property owner or flood plain occupant. This problem was confronted in flood insurance. Marketing problems were anticipated where flood plain occupants are offered policies whose premiums reflect the actuarial based flood risk. In flood proofing, the costs may be particularly burdensome when trying to flood proof existing structures. The generalization is not as applicable in new building construction where the substitution of materials is possible at the outset. Although in terms of flood proofing residential structures, Sheaffer suggested:

> Residential construction does not lend itself readily to flood proofing because of the extensive use of materials that do not impede the passage of water. Moreover, houses are seldom designed to withstand any significant horizontal pressures.[1]

This conclusion, however, does not resolve the question of economic limitations. It deals principally with existing design practices and uses of materials and does not forthrightly discount new practices because of their costliness. Quite the contrary, examples of housing designs or

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[1]Sheaffer, Introduction to Flood Proofing, 1967, p. 45.

construction measures are illustrated by Shaeffer in his book which may be employed for flood proofing a home. Thus, some clarification or further study of flood proofing in residential construction is indicated.

Flood Warning

Another technique available for reducing flood losses is flood warning. The concept is simple. The threat of an impending flood event is disseminated throughout the threatened community lying in flood hazard area.

> With advance warning of impending floods, they [the flood plain occupants] are able to evacuate potential flood areas, to protect property by temporary measures--such as, barriers, sandbagging, and coating machinery with grease--and to reschedule critical operations. Agencies with responsibilities for relief and rehabilitation of flood ravaged areas are able to stockpile supplies and equipment in strategic locations, assign relief workers, and arrange temporary housing and financial assistance for victims.[1]

To the degree that advanced flood warning allows temporary evacuation and emergency flood proofing, it can serve as a means of reducing flood losses.[2]

Techniques for developing a flood warning system involve coordinated planning and cooperation between the various levels of public organization and private activity.[3,4,]

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[1]U.S., Department of Commerce, Environmental Sciences Services Administration, Weather Bureau Office of Hydrology, A Plan for Improving the National River and Flood Forecast and Warning Service (Washington, D.C.: Government Printing Office, 1970), p. 5.

[2]The interrelationships and dependence of selected flood proofing measures and temporary evacuation upon a flood warning system is recognized, *supra*, pp. 112-113 and *infra*, p. 119.

[3]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 36-37.

[4]U.S., Department of Commerce, Plan for Improving Flood Forecast and Warning Service, 1970, p. 4.

Fundamental to any warning system is the ability to collect and analyze meteorologic and hydrologic data. Subsequently, any projections of flood threat must be capable of being disseminated through reliable communications systems. Finally, with such warnings communities should be prepared to implement local plans for flood loss minimization. This entails emergency evacuation, flood proofing, and flood fighting.

There are several potential limitations in a flood warning system.[1] Deficiencies or limitations in data collection and analysis, time constraints, inadequate communication systems, and inadequate or inactive emergency flood preparedness plans can frustrate the successful development or use of a flood warning system. Inaccurate or inadequate weather forecasts and hydrologic data are frequently the initial obstacles to developing a reliable flood warning system in a community. Where streams have a "flashy" nature, time may limit or preclude effective use of a flood warning service. This can also present problems in terms of available communications systems. Finally, the absence of emergency plans or the age of emergency plans may serve to erode or minimize the potential contribution of a flood warning system.

Evacuation and Relocation

Evacuation measures were listed under emergency flood proofing measures. They have been equally, if not appropriately, treated in the literature as a separate technique; discussions which treat evacuation and relocation of property as a separate flood loss management device. The common thread integrating various measures grouped under such a separate technique is the objective of removing property susceptible to incurring flood damage. Discussion of evacuation as a technique usually includes

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[1] *Ibid.*

temporary as well as permanent measures for removing property from flood hazard areas. In this discussion, special attention will be given to acquisition measures for removing or clearing developed areas in a flood plain. Specifically, attention will be directed at the power of eminent domain and its use in a few public programs which may be applicable and appropriate to flood plain land use management considerations.

The underlying philosophy in evacuating or relocating flood plain property is one of removing damageable property prior to a flood event such that the potential for flood damage is eliminated. Of immediate concern in such a technique is the consideration of cost. Are the costs incurred in evacuating the flood plain justified by the benefits obtained from precluding flood damages and flood losses? Further, do other techniques exist which may achieve the same reduction in flood damage and loss at a much reduced program cost?[1] Such considerations are not unique but are similar to those present in many of the foregoing techniques. However, under this technique the question of cost appears to be central to the philosophy of the technique.

When considering permanent measures of evacuating, the hypothesis is that the costs involved in removing existing developments from the flood plain are justified by the benefits resulting from the precluded flood damages and losses. The definition of the costs which need to be evaluated would seemingly entail a rather extensive accounting system and calculus. In part, this is attributable to considerations of the invested capital or sunk costs of the existing development for which returns are

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[1]Such questions are exemplified by provisions established in the Flood Control Act of June 28, 1938, 52 Stat. 1216, 33 U.S.C. 701 i., wherein". . .evacuation of a portion or all of the area proposed to be protected. . ." by a proposed levee or flood wall project may be initiated, if the costs of evacuation do not substantially exceed the costs of the proposed project construction. Evacuation of the area would replace and ideally be lower than the costs of the engineering works of protection.

normally required from the operation or utilization of the development to recover the original investment. To such investment considerations, there are now being added the costs of removing and/or relocating the development. In turn, these considerations and costs must be compared to and evaluated in terms of the alternative costs of the anticipated average annual flood losses which will result from continuing the land use in the flood plain location under study. Further, it must be established that alternative arrangements to that of evacuation do not exist which can minimize or preclude flood losses to the development at a lower flood loss management program cost. For example, the costs of physically protecting the development must exceed the costs of evacuation before the latter might be considered. This would be true of conventional engineering works of protection, e.g., levees and floodwalls; as well as, building modification through flood proofing measures.

There are an array of measures and policies available for encouraging or bringing about evacuation of flood plain property. Temporary evacuation of the flood plain can be achieved through transportation of removable goods and materials to other locations for temporary storage outside the flood plain. Permanent evacuation can be accomplished by the abandonment of the existing structures and/or relocating the business or land use activity outside of the flood plain areas. Measures for bringing about permanent evacuation include various acquisition techniques, urban renewal programs, income tax policy, and rebuilding finance policies.

Temporary or emergency evacuation measures are dependent upon a well designed and developed public flood warning system. The amount of advance flood warning available will largely govern the scale of evacuation allowable. In addition, to the requirement of adequate advance warning, carefully drawn plans and personnel trained for evacuation activities are

essential to effectuating emergency evacuation. With such emergency measures, the goal is to reduce as much of the potential damage as possible. Accordingly, two corollary assumptions or considerations accompany the use of emergency evacuation measures. (1) There will likely be some damage potential not amenable to reduction through temporary evacuation measures. Thus, some flood damage and loss will be experienced when flooding occurs. (2) The costs of evacuating and rescheduling operations are presumed to be offset by the damage and losses precluded by temporary evacuation. Such a presumption needs careful evaluation. Similarly, the degree of residual flood damage potential not affected by temporary evacuation measures must be ascertained and compared with the potential flood damage precluded through evacuation.

Permanent evacuation of the flood plain involves relocating existing developments out of the flood plain.[1] The basic measures for bringing about permanent evacuation of a flood plain area involve land and property acquisition. In general, this necessitates acquisition of complete title to the land. This is largely attributable to the developed state of the flood plain and the accompanying requirements of receiving income returns or compensation for that capital which was invested to achieve the developed state. Accordingly, some of the interests available for acquisition in a flood plain predevelopment land use management program are not as appropriate. Here, acquisition of fee title is the initial and requisite goal. Through the process of acquisition, the required management interests in flood plain property may be achieved and exercised. This enables and facilitates the relocation or abandonment of existing developments in those acquired portions of the flood plain.

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[1]Vernon Phillip Deines, An Investigation of Town Relocation As A Part of Flood Control Planning, Thesis for Master Degree in Regional Planning, Kansas State University. Reprinted as Special Report No. 50, Engineering

Acquisition of fee title may be accomplished through negotiated purchase or by condemnation which utilizes the power of eminent domain. The two processes of securing title indicate differing conditions of acquisition. Negotiated purchase implies an elective or subscriptive decision by the flood plain property owner. Condemnation indicates the element of compulsion is now present in the flood plain property owner's consideration of relocating his business or land use activity. In general, use of such powers of condemnation are in accompaniment to a public program which necessitates complete compliance in order for the program to be implemented. In the case of flood plain management objectives in a postdevelopment land setting, the appropriate public program will often be urban renewal.

The consideration of eminent domain and public programs brings about the need to distinguish between private and public actions. A flood plain property owner may evacuate from the flood plain by relocating outside of the flood plain. However, in the process of relocating, the original flood plain property owner may sell the problem property to another party. The subsequent buyer may become a flood victim and sufferer. In turn, the transferral of flood hazard burden will be dependent upon the subsequent use and flood loss management techniques adopted in the new use. Accordingly, the original property owner may achieve relief from flood losses by evacuating the flood plain; but, the subsequent property owner may be inheriting the same flood hazard with the acquisition. Consequently, the prospects for flood damage and loss continue to exist. The fact that there will likely be an analogous flood loss risk faced by the subsequent property owner is suggested by the negotiated purchase. It is unlikely that

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Experiment Station (Manhattan: Kansas State University, December 28, 1964), pp. 150ff.

a developed property will be purchased and subsequently retired to a less productive use, due to the implicit loss on the investment associated with such actions.

The public sector however may elect to bear such losses on investment in lieu of the intermittent demands for flood fighting and flood relief which accompany a flood. Such a loss on investment may result when the public purchases developed flood plain property and then retires such property to non-income or a low flood damage risk land use.[1] In some cases the land will be reused but not necessarily redeveloped, as in land taken and cleared for reservoir storage areas or impoundment areas.

The public is faced with the decision of retiring or converting developed flood plain areas on a piece-meal basis or an areal basis. The parcel approach is associated with a voluntary, negotiated acquisition program. Evacuation on an areal basis may necessitate a compulsory program employing the powers of eminent domain. In communities where the flood damage potential is largely centered in a few developed properties, negotiated purchase of such properties might be appropriate. Or, if by chance such individual properties lie in sectors which are under consideration for urban renewal or for some other public improvement program, then eminent domain may be enlisted in acquiring such properties when the negotiated sale is not obtainable. On the other hand, where the flood damage potential is distributed among the structures within an area, a comprehensive public program may be developed which converts these areas by condemnation, relocation, and/or redevelopment. Such areas are often characterized by deteriorating property due to the frequent occurrence of flood events.

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[1] Ed. Note: If the land is redeveloped instead of retired from productive use, then the focus is changed and a new program and management technique is now being considered. Redevelopment efforts will be treated shortly, in a following section.

Discussion of eminent domain in the flood plain literature generally treats its existing usage in the context of public works programs.[1,2] Utilization of eminent domain in bringing about evacuation of the flood plain is frequently encountered in developing engineering works of protection. Use of the power is also found in property acquisition phases or urban renewal programs, highway construction programs, and other public work programs. However, such discussions of the use of eminent domain do not focus directly on the issues of evacuation, but on the use of condemnation in assisting in the attainment of other program objectives. As a result, program objectives and measures can become confused.

In physical works of flood prevention, the use of eminent domain is utilized only where it is necessary in acquiring right of way to construct the engineering works. Evacuation is necessitated for the construction of works of improvement and associated elements, as in providing land area to be inundated by a reservoir storage pool. Although, provisions do exist which allow for acquisition of property where protection is being considered through a "flood control" project and where it is found that acquisition and evacuation would not be significant more costly than the costs of providing the works of improvements.[3,4]

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[1]Murphy, Regulating Flood-Plain Development, 1958, pp. 113-122.

[2]Wertheimer, Flood-Plain Zoning, 1942, p. 41.

[3]Supra, footnote 1, p. 118.

[4]Ed. Note: This provision has not been utilized to any significant degree. Murphy, Regulating Flood-Plain Development, 1958, pp. 113-119; and Deines, Town Relocation Planning, 1964, pp. 150ff. This may, in part, be attributable to benefit-cost considerations, i.e., the costs of evacuation should not be (substantially) greater than the costs of physical protection which in turn must be less than the benefits received from protection. Consequently, the costs of evacuation should not exceed the benefits of protection, despite the fact that the benefits of evacuation may not be comparable to the benefits of protection.

Similarly, urban renewal programs may use eminent domain to acquire blighted areas in order to redevelop the area. The redevelopment process may have elements of evacuation and relocation in them; but, there is also the expectation of subsequent land use, which may necessitate structural developments. While questions concerning the advisability of redeveloping a blighted flood plain area need resolving, such redevelopment actions will more appropriately be reviewed under other philosophies than that of true evacuation. That is, evacuation measures are only a transitional element and not an independent program objective where eminent domain (or negotiated purchase) is used in redevelopment programs.

Consequently, little discussion of eminent domain as a measure for achieving evacuation technique objectives was uncovered. The reasons for such deficiencies are not well documented.[1] However, limitations inherent in the power of eminent domain may suggest reasons why it has been little discussed as a means for evacuating developed flood hazard areas.[2,3,4]

Provisions in the 5th and 14th Amendments to the Constitution of the United States enjoin the taking of private property for public use without due process of law and just compensation. Neither the Constitution nor the Congress have specified what constitutes just compensation. Con-

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[1]Murphy draws a conclusion that the social pressures against evacuation in terms of relocation are sufficient to all but eliminate this as a consideration. Murphy, Regulating Flood-Plain Development, 1958, pp. 117-119 and 147.

[2]Barlowe, Land Resource Economics, 1958, pp. 517-524.

[3]Beuscher, Land Use Controls, 1964, Chap. 10, Sec. 1, citing Emily Dodge, "Acquisition of Land by Eminent Domain."

[4]U.S., Congress, House, Committee on Public Works, Study of Compensation and Assistance for Persons Affected By Real Property Acquisition in Federal and Federally Assisted Programs, Committee Print No. 31, 88th Congress, 2d sess., Dec. 22, 1964, pp. 51-93, 168.

sequently, principles evolving from court decisions have set down minimum standards for determining just compensation. The provisions of the 5th Amendment as interpreted by the Supreme Court, require compensation for the value of the property taken, but do not require compensation to the owner for losses or expenses incidental to the taking. Although, some exceptions exist to the general rule of not compensating losses and expenses incidental to the taking. In any event, the requirements of just compensation are generally fulfilled by the cash payment of the market value of the property taken. By their nature, such payments pose significant costs to an evacuation program employing the power of eminent domain. Consequently, the requirement of just compensation and the market value standard for establishing compensation payments impose inherent limitations on evacuating the flood plain through condemnation measures.

Further, it may not be appropriate to consider the use of eminent domain as a measure to effect evacuation except in the context of its application to other programs.[1] This results from the Constitutional requirement that acquisition of property through eminent domain must be for public uses. Unless and until evacuation is declared a public policy and the evacuation of the flood plain through land acquisition and clearance can constitute a public use; the use of eminent domain and general property acquisition will only be indirectly available through other programs, such as in urban renewal, highway development, and engineering works of flood improvement.[2] The establishment of such a public program and use is

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[1]This is evidenced by Deines's review of various relocations of developed areas caused by water resource projects. Most were due to intentional flooding resulting from a water resource development project requiring impoundments or flood storage areas. This is a contrast to the normal focus of preventing floods through project construction. See Deines, An Investigation of Town Relocation, 1962, pp. 92ff.; and pp. 136ff.

[2]This was brought out in a discussion of urban renewal, where in part it was stated: "The concept of public use is no longer confined,

a legislative responsibility. The appropriateness of eminent domain for attaining the program objective of evacuation should not be a judicial question as long as the policy declaration clearly states the need and purpose of land acquisition in attaining the objective. On the other hand, it may be necessary to establish the validity of evacuation as a public use.[1]

Professor Barlowe lists three additional problems to be considered in addition to those above dealing generally with justification of public use and determination of just compensation.[2] The other three considerations suggested relate to (a) delegation of authority, (b) procedure in condemnation, and (c) amount of property to be condemned. The last consideration poses possibly the greatest problem of those listed. The problem of how much land to condemn has two facets with which to deal. One facet concerns a typical issue confronted when condemnation is employed in various public programs. What should be done with those parcels of land for which only a portion is needed. In many cases if only the portion needed is taken, the remnant may be damaged or rendered valueless. Or conversely, the owner of the remnant may experience a wind fall benefit or gain due to the benefits associated with the public project requiring

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. . . Rather, it has generally come to be synonymous with public purpose. . . Although some courts upholding redevelopment statutes have indicated <u>that clearance of land is alone sufficient</u> to constitute such a public purpose, it seems that the publid purpose is not fully accomplished until adequate provisions have been made to insure that the area does not return to the condition of a slum." (Slum here would be causally related to flood hazard.) Wilton S. Sogg and Warren Wertheimer, "Legal and Governmental Issues in Urban Renewal," in <u>Urban Renewal: The Record and the Controversy</u>, James Q. Wilson, ed. (Cambridge: The M.I.T. Press, 1966), pp. 146-147.

[1]U.S., Congress, House, <u>Study of Compensation For Real Property Acquisition</u>, Public Works Committee Print No..31, 1964, pp. 51-53.

[2]Barlowe, <u>Land Resource Economics</u>, 1958, pp. 520.

that portion of the condemned parcel. Several guiding principles have been set down as a result of litigation initiated to settle such questions. However, questions still remain over what constitutes damaged realty as opposed to personalty; specific as opposed to general benefits; causal relationships between the process of partial takings and claimed damages; and other questions. Consequently, these questions still can cause uncertainty as to the application and sustainability of condemnation actions.

The second facet is not restricted to only condemnation but to any consideration of acquiring and evacuating flood plain property. It relates to the special considerations of the flood plain and precedes any question of partial takings. The means of deciding what land and property should be evacuated needs to be developed. In large part this will be a function of merging economic and hydrologic considerations. As seen in the above regulatory techniques, the probability nature of flood risk and economic loss presents some initial problems. Further, problems stem from the need to develop a calculus for determining when it is advantageous to purchase a property and bring about its abandonment as compared with other techniques involving protection and prevention of flood damage. Efforts to develop such a calculus need further development and exploration in the literature.

There are two secondary measures which can be of assistance in encouraging evacuation of the flood plain. Income tax policy and rebuilding finance policies might exert some influence in decisions concerning the restoration of a flood damaged development or the relocation of such development. These will be briefly treated here to show their relevance. Further detailed treatment will follow in subsequent sections.

Income tax policy affects the continued use of a flood prone development through provisions for deducting flood losses. The number of times such

deductions may be made might be limited to a set number of successive flood events. Or, the amount of each successive deduction might be limited by a regressive scale or accumulative, aggregate amount. The goal of such policy adjustments would be to discourage continued use of frequency flooded land areas and thereby facilitate abandoning such land areas. By constraining allowances for claiming flood loss deductions, some of the burden for occupying an uneconomic land area is placed back upon the occupant. The ability to continually defray losses or minimize the losses by spreading the burden would hopefully be discouraged through such adjustments in the provisions for income tax deductions. As it stands now, income tax policy relating to flood losses is essentially a form of flood relief. The capability of expanding this role is suggested above.

The adjustment of rebuilding financial policies is a simple extension of the adjustments available for loan and credit policies applicable to new developments. Review of applications for rebuilding or restoration financing could include procedures for evaluating flood risk and the associated implications for defaulting in the repayment of loans or extended credit. In this light, policies might be adopted which would encourage applicants for rebuilding or restoration financing to consider relocating the damaged or destroyed development out of the flood plain. These policies should be accompanied or integrated with flood relief policies, such that the latter policies also encourage consideration of evacuation, as well as pose as a means of obtaining relief from flood losses.

Redevelopment

In some instances it may not be appropriate to try and secure existing developments through flood proofing, nor to simply evacuate the flood

plain permenently. Rather, it may be justifiable to encourage the redevelopment of flood plain properties. Any new flood plain redevelopment must take into consideration the flood hazards in addition to the intended improvements over the existing land uses. As such, the redevelopment technique employs measures which are available and applicable to other recommended flood loss management techniques.

Land acquisition measures are among those measures receiving considerable attention which have already been found applicable elsewhere. Some of the acquisition measures were discussed at length in the predevelopment section. In addition, the power of eminent domain was discussed above under the evacuation technique. In the chronological placement of technique, evacuation and redevelopment measures follow those acquisition measures employed in a predevelopment setting. At the same time, the redevelopment philosophy distinguishes itself from either predevelopment acquisition or evacuation in the level of land use activity allowed or sought. A further distinction should be drawn between redevelopment measures and the rehabilitation, repair, or modification of existing structures.[1] The latter grouping does not necessitate acquisition, demolition, or removal with a subsequent new development. Considerations of rehabilitation, or the like, in a flood plain perspective are analogous to, or essentially the same as, considerations of flood proofing. They do not necessitate the measures generally implied with redevelopment.

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[1]Under Urban Renewal three processes are embraced: redevelopment, rehabilitation, and/or conservation. See Housing Act of July 15, 1949 (as amended), 63 Stat. 413, 42 U.S.C. 1960. Code enforcement in the act is in part being translated into the goal of conservation. See also Sogg and Wertheimer, "Legal and Governmental Issues in Urban Renewal." 1966, pp. 127-128; and Otto A. Davis and Andrew B. Whinston, "The Economics of Urban Renewal," in Urban Renewal: The Record and the Controversy James Q. Wilson, ed. (Cambridge: The M.I.T. Press, 1966), pp. 64-65.

Some qualification might be registered to the above observations in that redevelopment does not always entail, nor necessarily require a change in ownership. Existing land owners may find it advantageous to abandon existing land uses and shift to alternative uses through redevelopment processes which initiate new uses which have lower flood damage potentials and costs.

However, it appears that such shifts in land use via a redevelopment process will likely entail changes in property ownership. Some means of amortizing or writing off the original capital investment is usually necessary prior to investing more capital in redevelopment. In contrast, permanent measures of flood proofing (rehabilitation) of existing developments utilize additional amounts of capital to secure the existing capital investment. A means of writing off or liquidating existing investments is through sale transactions, wherein the acquiring property purchaser absorbs the existing investment, initiates demolition, and redevelops the property.

The principal means of pursuing the redevelopment strategy, as advocated in the literature, is through urban renewal.[1,2] As was found under the predevelopment section on acquisition, there are many references in the flood loss management literature that advocate the application of urban renewal to flood plain management; but there is little detailed development in the literature devoted to application of the technique in a flood loss management context. Of some assistance is the plethora of literature dealing with urban renewal. Consequently, as in the aforementioned section on acquisition, reliance is placed upon abstracting

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[1]Murphy, Regulating Flood-Plain Development, 1958, p. 107.

[2]Sogg and Wertheimer, "Legal and Governmental Issues in Urban Renewal," 1966, pp. 127-128.

elements from programs developed under a different perspective than that being discussed here. While this presents problems in developing the technique discussion, it again underscores the interdependency and integrative qualities of the techniques and programs being discussed. As it stands now, the thrust of the literature is to suggest the broadening or clarification of urban renewal program development so as to take into adequate consideration flood hazard and the associated hydrologic concepts. Such a thrust is in contrast to an attempt to try and amend urban renewal techniques directly to the flood loss management program.

Redevelopment as a technique and urban renewal measures in particular may be adopted by private individuals and groups. However, certain inherent limitations and obstacles cause it to be principally the province of the public sector with secondary private subscription. The inferred limitations can be countered by the public power of eminent domain and the public's ability to generate large amounts of capital necessary to compensate owners of condemned or purchase property.[1]

Consideration of redevelopment as a technique in flood loss management carries flood plain management to one end of the management range. The range is delimited through the application of acquisition measures, wherein predevelopment acquisition marks one boundary and redevelopment bounds the other extreme. Predevelopment acquisition is generally characterized by a preventative orientation to development. Evacuation motivated acquisitions have a reverse development orientation. Redevelopment initiates a program of evacuation which is followed by a program of controlled development. As indicated, the programs are characterized by their noted orientation; which at the same time makes allowance for considerable integrating of techniques. For example, predevelopment

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[1] Ibid, pp. 127-128.

programs of flood plain acquisition may be complemented with carefully exercised proprietary rights, such that controlled development occurs. Conversely, redevelopment may be undertaken such that large expanses of undeveloped or preserved open areas result. The distinction in orientations of the three programs might be attributable ultimately to the costs of acquisition and consequent pressures to utilize the lands acquired to offset the program costs.

The techniques involved in redevelopment, especially under urban renewal, are dependent in part upon the management objectives attached to the program. Private redevelopment efforts will likely require returns to the capital invested, and therefore necessitate selection of income producing redevelopment projects which will generate revenues greater than the anticipated overall program costs. On the other hand, the public sector may be willing to absorb some of the capital investment costs resulting from property acquisition and subsequent redevelopment into low income producing land uses; as opposed to trying to completely recover evacuation and redevelopment costs through revenues from property taxes, leases, or income producing activities. Consequently, to account for this, Davis and Whinston suggest that the social benefit to be derived from playgrounds, parks and public buildings (a form of low or non-income producing land uses) should be estimated in a manner that will allow them to be considered as revenues so that they may be compared to the expenditures involved in the redevelopment process.[1] In either private or public undertaking, the flood loss management objectives of minimizing flood losses and fostering economic development necessitate that benefits from reduced flood losses be maximized or that the subsequent

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[1]Davis and Whinston, "The Economics of Urban Renewal," 1966, pp. 65-66.

flood damages as well as redevelopment costs be minimized. Ideally, this could be done in a way that would allow comparison of different flood loss management techniques.

It will be noted that redevelopment efforts, especially those initiated through urban renewal measures, actually encompass and integrate a number of identifiable flood loss management measures. A list of measures which must be enlisted in order to implement redevelopment plans, includes: acquisition, finance, zoning regulation, building code regulation, flood proofing, and insurance. Accordingly, it can be expected that the costs entailed in redevelopment which are allocable to reducing flood losses may be (1) considerable, (2) difficult to segregate out, and (3) not necessarily comparable to other flood loss management techniques.

Limitations with redevelopment as a flood loss management technique may include many of those found in the discussions of the above techniques whenever such techniques are involved in a flood plain redevelopment program. Further, there are limitations and problems frequently associated with urban renewal programs used as a means of redeveloping an area. These include enabling powers, finance, acquisition, dislocation, and control of redevelopment.[1]

Enabling powers must be granted by the State to its local political units or their delegated authorities prior to their exercising urban renewal measures. The limitations in the enabling provisions will dictate what measures are and are not available for usage in redeveloping a

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[1]For a complete treatment, the collection of papers in James Q. Wilson, ed., Urban Renewal: The Record and the Controversy (Cambridge: The M.I.T. Press, 1966) is particularly informative. Particular reference here is to Sogg and Wertheimer, "Legal and Governmental Issues in Urban Renewal," 1966, pp. 126-188.

blighted flood plain area. Further, the provisions will likely govern what criteria may be used in determining those areas to be qualified for urban renewal. It would seem particularly valuable to have reference made to program capabilities in covering blighted areas resulting from flooding.

Financing redevelopment proves to be a severe limitation for both the private and public sectors. The initial costs of acquisition and demolition are usually substantial. This is particularly troubling due to their preparatory nature. Subsequent costs include those costs incurred in providing new or additional services and improvements to the land as well as those encountered in developing and operating new structures. Also included are the costs incurred in financing a redevelopment and the burden of property taxes or tax revenues foregone.

Problems with urban renewal acquisition include securing negotiated purchase, appropriate use of eminent domain, procedural delays, property market values, and what properties and interests therein should be acquired and secured. These have been covered at length in the preceding discussions on evacuation and on acquisition.

Problems of dislocation are possibly the most pervasive and disturbing problems associated with urban renewal or dislocation in general. They arise from the involuntary sale of properties and the subsequent forced relocation of former owners or tenants. By the nature of urban renewal programs, the people least able to afford relocation are involved. Quite often shelter and business operations can not be found on an equivalent economic basis. Those dislocated face higher costs of shelter and unfavorable business opportunities.[1,2]

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[1] Ibid.

[2] U.S., Congress, House, Study of Compensation For Real Property

Control of redevelopment is particularly relevant to flood loss management considerations. It is at this point that the success or failure of redevelopment in terms of reducing subsequent flood losses is largely secured. If the public redevelopment or urban renewal authorities turn to the private redevelopers as the source of new investment, some means of assurance is needed that low flood damage risk developments will result. To a large part, this is where application of (1) regulatory measures, as flood plain zoning, floodway encroachment regulations, and building codes; (2) flood proofing; (3) financial policies; (4) tax policy; and (5) flood insurance are most influential or supportive in precluding future flood losses. In the end the desired results are those that relate to the second basic objective of flood loss management; encourage economic utilization of flood plains wherein flood damage potential is minimized and accounted for through various contingency programs. The extent and nature of the proprietary interests reserved by the public will affect the application of other techniques for regulating and/or managing the flood plain.

Rebuilding Finance

Rebuilding finance may be viewed as (1) a separate technique, (2) a component in other techniques, and (3) an extension of building finance policies. In terms of being a component in another technique, it is an element in a redevelopment program. Similarly, it may be utilized in encouraging evacuation. Or, it may be a means of obtaining a form of relief in recovering from a flood disaster. On the other hand, rebuilding

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Acquisition, Public Works Committee Print No. 31, 1964, is particularly instructive in this area.

finance may be appropriately considered an extension of predevelopment building finance policies. This would be analogous to applying such predevelopment techniques of floodway encroachment regulations, flood plain zoning , or building codes in an already developed area. Finally, the treatment of it as a soparate technique might be justified on its potential for reducing flood losses through application of conditional clauses in loan review procedures. In essence, its classification as a separate technique is not as important as recognizing the further contributions it can make in reducing flood losses to those contributions of predevelopment building finance.

There is justification in separating rebuilding finance measures from the class of relief measures such that their potential contributions in reducing flood losses may be developed separately or in conjunction with other technique discussions. Under relief measures the focus is on recovering from flood losses with minimal hardship, as contrasted with the concern for preventing reoccuring flood losses.

There are several distinctions which appear to distinguish rebuilding finance as an element in the redevelopment technique from its functions as a separate technique. The initiating causes and/or sources may vary between redevelopment and rebuilding finance. The decision to initiate redevelopment often arises in the public sector and is imposed upon the property owner, as examplified by urban renewal. And while reoccurring flood damage may underlie the deteriorating state of a building or of a developed area, the existence of the blight is generally the primary stimulus for redevelopment. In contrast, rebuilding is generally initiated immediately after a flood occurrence and is an action initiated by the property owner. In the long run, the nature of and the level of rebuilding activity following reoccuring flood events may be a contributing factor

to ultimate redevelopment through urban renewal. This would be the case where minimal structural correction or preventative maintenance is undertaken in each successive rebuilding effort, and thus a blighted development ensues. A second distinction lies in the resulting land use following redevelopment and rebuilding. Redevelopment efforts generally result in different land uses or significantly altered means of securing the preceding land uses. Rebuilding efforts are generally individualized undertakings which focus on reinstituting the preexistent land use which has been damaged by a destructive flood event necessitating the rebuilding.[1]

Rebuilding finance is analogous to building finance in its potential for influencing the decision to (re)build in a flood prone area. It can easily be considered an extension of building finance due to similar criteria in reviewing loan or credit applications. Distinctions arise due to the postdevelopment-predevelopment timing of the loan application. Reflective of this are the additional considerations which are necessary under rebuilding financial applications to take account of loans outstanding on the preexisting development. The demands for repayment of the outstanding principal on existing loans will be compounded by an approved new rebuilding loan. Refinancing of the old loan might be an element in the new loan application. But it does not alter the considerations required to assess the security of the loan repayment, if the rebuilding effort occurs in the flood plain. In fact, it should heighten the considerations of loan risk relative to the probabilities of reoccurring

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[1]Ed. Note: The reason for this apparent distinction in reinstituting the pre-existent land use under rebuilding efforts and that of altering land use under redevelopment may be reflective of existing public program biases. Redevelopment through urban renewal allows the writing off previous investments. Rebuilding finance generally results in a new investment debt being placed upon the unamortized principal of the pre-existent investment which has just been damaged or destroyed by flood waters.

flood risk and the available preventative measures proposed to preclude flood losses.

Accordingly, by acquainting the rebuilding applicant with flood proofing measures and flood insurance during the loan application review stage, improvements may be incorporated in the rebuilding process and contingencies adopted for covering the remaining flood loss risks. Where flood risks are too great and pose a threat to the securing of the new loan, then rebuilding finance policies might be structured so they encourage as well as enable evacuation and relocation to another flood free setting.

The limitations with rebuilding finance are essentially the same as those discussed earlier under predevelopment building finance. Added problems may arise due to the need to evaluate outstanding credit, loan, or other financial obligations attached to the pre-existing development which has suffered flood damage. Any outstanding obligations on pre-existing developments should heighten the concerns for further loan security.

Flood Insurance

As indicated, flood insurance is ostensibly a means by which recovery from flood losses may be secured.[1] Its principal design is to provide compensation for flood losses if and when they occur. Insurance, per se, is not a means of reducing flood risk and associated potential flood damages. It may be modified or conditioned such that it brings about the required adjustments to reduce flood losses. However, it is designed ostensibly to provide compensation for flood losses and not for reducing damages.

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[1] <u>Supra</u>, pp. 81-82.

An extensive treatment of flood insurance has already been entered in a predevelopment section. Consequently, this discussion will highlight several points worthy of emphasis in presenting the essentials of flood insurance in a postdevelopment setting.

A desired goal in establishing a flood insurance program is the development of insurance premium rates which adequately reflect the actuarial based flood risk. At the same time it is desirable to have such policy premium rates set at a marketable level. In light of much of the uneconomic development in the flood plains, it is anticipated that problems will be confronted in selling policies at actuarial based flood risk premium rates. This implies the necessity of establishing a means of subsidizing the rates to enable the successful marketing of policies. At the same time, the potential exists for attaching various compulsory and conditional elements to flood insurance policies which would encourage adoption of techniques for reducing flood losses, e.g., flood proofing. Further insurance policy conditions could be developed in harmony with other techniques which would favor (1) the eventual evacuation of structures from high flood hazard areas and (2) proper design and construction of structures in rebuilding in lower hazard areas.

The most significant limitations foreseen for a flood insurance program involve the economic and technical ability to derive actuarially accurate policy rates. In addition, problems in marketing policies which carry high premium rates are predicted. Notwithstanding high premium rates, insurance companies or policy underwriters would still be faced with the risk of catastrophic floods which could easily bankrupt an insurance program, particularly during the early stages in the program. Regardless of the duration of the flood insurance program, the underwriters will always be faced with a need for unusually large reserves to cover

catastrophic events, or else have a means of reinsuring their own reserves.

Other Techniques

Financial Relief

Additional techniques in flood loss management exist which are not readily incorporated into the above predevelopment-postdevelopment dichotomy. Possibly the most developed and frequently practiced of these is that of public relief. The concept and practice of extending relief to flood and disaster victims is quite old. As a flood loss management device, it does not reduce flood losses materially; it redistributes the loss bearing over a wider populace than just those suffering from flood loss. In this respect it is similar to a subsidized flood insurance program. However, relief as currently conceived and practiced offers little in terms of sanctions which encourage or direct a flood victim to relocate outside of the flood plain. The tendency for relief programs is to help reestablish the family or business in its former location as opposed to encourage a possibly more dramatic relocation out of the flood plain or hazard area.[1,2,3]

The importance of flood relief in spreading loss bearing is recognized. However, the focus of this study is upon the array of techniques offering possibilities of reducing and managing flood losses. Accordingly, and in

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[1]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 30-31.

[2]U.S., Congress, House, Committee on Banking and Currency, Insurance and Other Programs for Financial Assistance to Flood Victims, A report from the Secretary of the Department of Housing and Urban Development to the President, Committee Print, 89th Cong., 2d sess. (Washington, D.C.: Government Printing Office, September, 1966), pp. 32-33.

[3]U.S., Congress, House, Report of the Committee on Banking and Currency, House Rept. No. 786 to Accompany S. 1885, 90th Cong., 1st sess. (Washington, D.C.: Government Printing Office, 1967). p. 8.

light of budget constraints this area of flood loss policy will be treated briefly in this study.

The preceding postdevelopment flood loss management techniques (flood proofing, evacuation, rebuilding finance, and redevelopment) are generally considered as appropriate measures for bringing about adjustments in land use in order that flood losses might be reduced or prevented. There are several flood relief measures which are applicable to the postdevelopment setting which do not necessarily focus on land use adjustments nor on reducing flood losses. Their principal concern is in providing assistance in the recovery from flood losses such that there is a minimum of disruption and hardship resulting from the flood event. The resulting overall effect is to minimize the burden borne by flood sufferers.

Relief as a technique includes a variety of measures for providing assistance and aid in recovering from flood losses. Recommended measures include grants, tax allowances, and low interest loans.[1] Grants and their equivalents may include money, supplies, provisions, equipment, medical attention, shelter, counseling, personnel, and other resources. Discussions of tax allowances stem from existing provisions in income tax policy allowing for deductions of disaster losses. Similarly, discussions of low interest loans generally relate to existing federal disaster loan assistance programs. The loans feature low interest rates and are often available when loans or extension of credit are not available through private or market sources. Both of these were discussed separately above as distinct techniques.[2]

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[1] Ed. Note: Subsidized flood insurance may also be viewed as a form of relief to the extent premium charges and the insurance risk pool need to be supported with public subsidies.

[2] Supra, pp. 57 and 127-128.

Grants are designed to provide quick or emergency recovery relief from flood damages. There is no expectation of repayment of money and resources granted. In those instances where personnel, equipment, and certain provisions are made available on a loan basis, it is expected that these shall be returned upon completion of the recovery work. Tax allowances provide a deferred manner for obtaining relief from incurred flood losses. The time period can be adjusted so that the goals of providing relief may be achieved. There again is no expectation of reimbursement of relief provided in this manner. There is the implicit expectation that through successful reestablishment of operations, tax revenues may again flow into the public coffers. On the other hand, low interest loans are designed to provide readily accessible capital so that recovery and reestablishment of operations can occur. With this though there is the expectation that the loans will be repaid under the terms specified.

Limitations associated with relief as a technique for offsetting flood losses stem principally from the orientation of such measures.[1] Their orientation and effect is to minimize the burden of disaster losses to flood victims. They are not directed toward bringing about land use adjustments which lower subsequent flood losses. The individual in effect is being relieved of the risk associated with his land use. If disaster strikes, the flood plain occupant can count on others helping him bear the loss.

Some of the relief measures have potential for modification such that they might be used in encouraging adjustments in flood plain land use.

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[1]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 30-31.

Modifications have been discussed earlier with respect to tax policy and building finance. Tax policy, as presently formulated, might be adjusted so as to encourage adoption of flood proofing, evacuation, relocation, or flood insurance. Similarly, revision of existing disaster assistance loan provisions might encourage adoption of one or more of the listed techniques. It is interesting to note that such policy adjustments have the implicit goal of eliminating the role of relief. They either encourage adoption of techniques for reducing flood losses or encourage the use of other means of obtaining relief from flood loss. The net effect is to return the burden of flood loss on the flood plain developer or occupant.

Education

The concept of education as a technique for reducing flood losses is elusive. It is frequently cited but seldom defined in the context of flood plain management. An apparent presumption in much of the flood plain literature is that a process of increasing the flow of information will result in an avoidance of further development in the flood plain. However, a broader interpretation and function can be ascribed to education as a technique.

Murphy commented that public awareness, understanding, and support are necessary for the successful enactment and implementation of the previously cited techniques.[1] Education as a technique in flood loss management, functions to provide information on the existence of the flood problem, nature of the loss problem, alternative solutions, and means of implementing solutions. This is particularly true in the second

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[1] Murphy, Regulating Flood-Plain Development, 1958, pp. 154-155.

management philosophy where alternative techniques are suggested for directing flood plain development. This can be illustrated in the case of flood plain zoning ordinances and floodway encroachment regulations. Public acceptance and continued support are necessary for the adoption and active enforcement of these regulations. Accordingly, education as a function and as a technique is looked to as a necessary element in the development, adoption, and enforcement of regulatory and subscriptive techniques.

Kates' findings, however, raise questions as to what are sufficient, as well as necessary elements, in an education program. The presumption that prospective flood plain occupants will avoid the flood risk if informed of the risk has not clearly been established. His findings suggest that flood plain development decisions are not properly understood; that the direct effect of an educational program on an individual's intention to build or reside in the flood plain is not clear. It is possible that it may have substantial value in achieving flood loss reduction. This will occur if an informed individual or public will avoid development in flood risk areas; or take the necessary precautions to minimize flood damage in their development on a flood plain. However, the validity of this latter argument is open to question. Further research is required in light of the information and observations reported in the study by Robert Kates.[1]

Technical Assistance

Technical assistance programs at the national and state level offer considerable potential in furthering the preceeding educational program and for assisting communities in the development of the varied flood loss

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[1]Kates, Hazard and Choice Perception 1962, Chap. I, pp. 8-9; Chap. II; and Chap. VI, esp. pp. 139-142.

management devices. The President's Task Force on Flood Control Policy gave emphasis to the technical assistance function in assisting local communities develop flood plain management strategies. The report noted that technical assistance would be particularly appropriate in aiding community development and adoption of floodway encroachment lines, flood plain zoning and special flood plain provisions in subdivision regulations and building codes.[1,2]

The recommendations identify federal and state government as the logical levels for developing and providing technical assistance programs. The reasoning behind such recommendations draw upon two principle observations. First, local units of government frequently do not have the expertise nor the resources to (a) conduct research, (b) collect the required data, and (c) utilize flood plain information in developing land use controls. Second, national and state governments have numerous agencies and units involved in collecting data pertaining to water resource conditions. Extensive planning and management programs pertinent to flood loss reduction exist in the federal government and frequently in the state governments. Accordingly, proposals for technical assistance suggest that the reservoir of information, personnel, and management experiences at the national and state levels should lend itself to providing technical services to local units of government.

Possible limitations might include extrapolation and application of information acquired in one program context to the needs of other programs. A reorientation may be required in interpreting and applying existing data

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[1] U.S., Task Force Report on Flood Control Policy, House Doc. No. 465 1966, pp. 34-35.

[2] Murphy, Regulating Flood-Plain Development, 1958, pp. 154-155, also drew similar conclusions in his earlier work.

to local flood plain management needs. Further, the different perspectives of lay and professional people at the local level may require different formats and language in technical assistance programs than that normally utilized by technical personnel involved in water resources research and management at federal and state levels.[1]

Considerable concern is registered with proposals of technical assistance that the services be limited and constrained to basic technical information, especially at the national level. Such concerns apparently forsee potential problems in providing technical assistance free from advocacy planning. This concern becomes sharper in light of the increasing strategy and technique employment of constraining grants of financial assistance with conditional provisions requiring local flood plain regulatory programs.

The justification for the concern apparently revolves around issues of separation of powers of government and basic philosophy regarding fundamental approaches for encouraging successful local management programs. This latter aspect may be illustrated by the basic differences in program implementation in the Soil Conservation Service and U.S. Corps of Engineers. A distinction is apparent in the emphasis placed upon local initiative as opposed to federal initiative in their respective flood control programs. Conclusions generally point to greater program success where local initiative is forthcoming.

Integration Through Community Land Use Planning

The integration of several flood loss management techniques can be advanced through a particular planning concept and process.[2] The concept

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[1] Kates, Hazard and Choice Perception, 1960, pp. 19-21.

[2] This integrative function is amply illustrated in U.S., Task Force Report on Federal Flood Control Policy, House, Doc. No. 465, 1966, pp. 25-26, 28-30.

and process referred to is comprehensive (land use) planning. As a process it is embodied in a plastic planning document; often referred to as a master plan, comprehensive plan, land use plan, development plan, or some variation of the preceeding terms.[1] The plan, irrespective of title, generally identifies the current projections of what should be forthcoming in terms of development and redevelopment of a community and its environs.

The plan, in and of itself, is not a sanctioning or enforcement document or instrument. It may be given significant weight and influence if it is officially adopted by the community legislature or planning department. However, it is usually recommended that the plan not be formalized into a rigid document, but allowed to be as flexible and plastic as possible. Thus it could be contrasted to such implementation documents and instruments as a zoning ordinance, zoning map, or an official map adopted by ordinance.

The planning concept and process achieves much of its integrative powers by acting as a prerequisite and precursor to many of the more applied engineering and land use management techniques. In terms of flood plain management it can relate considerations of engineering techniques with those techniques suggested for guiding or directing land use.

Included within the class of engineering techniques (identified as capital improvements in the plan) are the so called flood control or construction measures, e.g., reservoirs, levees, and channel improvements. Additional techniques which are appropriately tied to a community master plan can also be related to engineering considerations. The community official map and capital improvements development plan are the two chief relevant illustrations in this instance. At the same time they are appropriate, coincident, planning tools to such techniques as subdivision

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[1]Beuscher, ed., Land Use Controls - Cases and Materials, 1964, Chapter 10 "The Master Plan," pp. 153-180.

controls, land use zoning, property taxation, acquisition, and urban renewal. Each technique can be appropriately addressed or related to the community master plan, and frequently can be integrated with other techniques.

Little detailed treatment is given to flood plain management and land use planning in the flood plain literature. At best the community master plan is alluded to in discussions of flood plain subdivision regulations, zoning ordinances, acquisition, and urban renewal.[1] However, strategies and means of weaving flood plain land use needs through a community master plan are strikingly absent in the literature. Similarly, general discussions of land use planning give brief treatment to flood plain management needs.[2]

Several land use planning references suggest flood plain lands be identified as potential recreational and open space areas, or areas needing special zoning requirements, or some other special management consideration. Little is suggested in terms of relating flood plain risks in a comprehensive manner throughout the elements of the community master plan, e.g., land use projections, transportation systems, community, facilities, public improvements, redevelopment needs, or other general community design requirements and standards.

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[1]See for example the discussions of land use planning as related to subdivision regulations and zoning in American Society of Planning Officials, Flood Plain Regulations, Planning Advisory Service, Information Report No. 53 (Chicago: American Society of Planning Officials, August, 1953), p. 18; and Murphy, Regulating Flood-Plain Development, 1958, p. 46.

[2]General references are made concerning flood plain considerations in land use planning by (a) Jacob H. Beuscher, "The Land Use Plan" in Planning-1958, Selected papers from the National Planning Congress, Washington, D.C., May 18-22, 1958 (Chicago: American Society of Planning Officials, 1958), pp. 184-190. (b) Edward M. Bassett, The Master Plan, (New York: The Russell Sage Foundation, 1938), pp. 56-128.

A frequent element found in a community master plan is a land use plan. The land use plan reflects the general policies adopted by the community for the distribution, location, and extent of residential, commercial, industrial, and public uses of land. In terms of flood loss management the use to which flood plains should be made can be generally identified. Where residential, commercial, or industrial development is allowed, associated policies may be adopted. For example, the plan may call attention to the need to relate special building code restrictions or flood proofing requirements in flood plain areas. In contrast if extensive, open space, type land uses are planned; needs may be established for adopting special property taxation policies for this class of land.

In terms of implementation techniques, subdivision regulations, zoning ordinances and maps, building codes, taxation policies, acquisition plans, redevelopment plans, and special ordinances should reflect the basic flood plain development policies. Of particular importance, the zoning ordinance and map should give a precise reflection and definition to the general policies regarding land use in a flood plain. In this manner, zoning can act as an important implementation tool for attaining control over development and redevelopment of land uses in a flood plain. The other techniques as subdivision regulations, acquisition, property taxation, redevelopment, etc., need to be similar reflections of the land use policies in the community master plan. Accordingly, these various implementation tools must be compatible with each other, including the zoning ordinance. The degree of compatibility may be largely a function of the importance attached to the master plan in guiding the development of the various implementation techniques.

Another frequent element in a community master plan is a transportation system plan. In terms of flood loss management, the river and its

associated flood plain can be related to the transportation needs of the transportation community. Policies can be established with respect to the development and control of bridges, waterways, and waterfronts. Murphy's findings reflect the common occurrence in the local areas of bridge obstruction and constriction of the floodway.[1] This can be partially corrected by policies adopted in transportation planning and also in capital improvements planning. Such policies would be desirable corollaries to the general identification of transportation and locational benefits of the river and flood plain in terms of transportation needs. Policies regarding location of waterfront facilities, roads, railroads, and parking areas can also be established in the transportation element of the community master plan. The influences of flood hazard can thus be allowed for in such planning activities.

Two other elements frequently found in a community master plan are a community facilities plan and a public improvements plan. The former establishes the needs, policies, and general location for significant public facilities as schools, libraries, police and fire stations, civic and community centers, parks and other recreational lands. Public improvement plans identify similar needs, policies and possible locations for the various services and utilities, e.g., water, sanitation, drainage, communication, and power. The implications of flood damage and flood interruption to these community facilities and improvements can be evaluated and accounted for in the community plan.

Another plan element frequently encountered in a community master plan is the redevelopment plan. This generally pertains to rehabilitating, renovating, and/or rebuilding blighted developed areas in the community. Often large planning documents are developed for urban renewal programs

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[1] Murphy, Regulating Flood-Plain Development, 1958, p. 36-39; and figures 5 and 6.

as a supplement or a part of the community master plan. In any event, the contribution of flood events and continuing flood hazard to the decline and decay of community areas can be identified and accounted for in such planning documents. Subsequent redevelopment plans for land use in the flood plain portions of blighted areas should reflect the overall policies and objectives of the community master plan. And as pointed out in the discussions of other elements of the plan, the significance of the river and associated flood plain should be a factor and influence in the development of the policies of the community master plan.

Two significant measures not otherwise discussed in this study are available for translating the master plan policies into land use controls. The community official map and public control over investments in community facilities are potential measures for influencing development in a flood plain. The official map is not unique in its function, in that comparable functions can be served in subdivision controls and zoning ordinances. And in a similar vein, public control over government investment is not uniquely attached to the existence of a master plan. However, they are considered here as appropriate adjuncts to the discussion of community master planning.

The official map may be thought to be subordinate to and a specialized reflection of the master plan. It is precise and has a legally binding rididity similar to a zoning ordinance and map; but it is distinctly different in that traditionally it has been quite narrow in function. The official map has historically provided "the legal sanctions of a setback ordinance" in the planning of streets.[1] It precisely establishes existing and proposed right of way lines for community developments; the latter of which are principally street construction and park land preservation.

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[1]Beuscher, ed., Land-Use Controls-Cases and Materials, 1964, pp. 186, 205-2-6.

Upon identification of such right of way areas, the community can exercise its police powers in precluding structural developments from taking place in the area of the reserved right of way. In general, if the right of way, as defined, serves to seriously impair the use of the remaining property or presents a hardship to the adjacent land holder, then condemnation must be exercised as contrasted to application of the police power.

Professor Beuscher reported that three models are generally followed in developing an official map. The so-called Standard Act model requires payment for the land reserved in the right-of-way at the time of taking. On the other hand, the Nettman model and Bassett-Williams model allow initially for the use of police powers in the reservation of right-of-way. However, they both have provisions for hardship cases. And it is in the definition of hardship cases that they differ. Additional qualifications are also available to allow use of police powers in the enforcement of official maps; e.g., the concept of "first right of refusal" may be adopted.[1]

The practical application of this technique to flood plain management might be two fold. Control over placement of streets in the flood plain may be exacted. Those areas not suitable for street construction can be defined or labeled accordingly. Secondly, the official map may be used in conjunction with recreational land acquisition, zoning set-back requirements and zoning requirements relating to yard areas. Unfortunately such applications to flood management problems are not discussed in the flood plain literature.

The absence of literature discussion of these measures in flood plain management may reflect the limitations of the measures. In view

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[1] Ibid., pp. 205-206.

of the constraints attached to official maps; it may turn out that subdivision controls and zoning regulations may be more appropriate in accomplishing the purposes sought in flood plain management. Further research and study of this technique is clearly needed for further evaluation.

The second measure identified as an adjunct to considerations of the community master plan is community control over government investment in capital improvements. Such control is essentially a legislative function. However, planning and administration inputs to the legislative process are essential for prudent investment and spending. Accordingly, investment policies can be suggested in public facilities and improvements planning which reflect flood hazards and risk. Guidelines may be established whereby public investments shall not be made in structural development of flood plain areas without giving adequate recognition to flood risk. This function can actually be accomplished without a master plan. However, the effectiveness of such controls would seem to be enhanced by the presence of comprehensive land use planning.

CHAPTER IV

APPLICATIONS OF ALTERNATIVE TECHNIQUES IN MICHIGAN

Introduction

Discussion in the last chapter concentrated on reviewing in detail alternative policies for managing flood losses. Principle concern was given to discussing the objectives, approaches, and limitations of the varied alternative management techniques.

In the ensuing chapter, attention will be directed at reviewing the appropriateness and application of alternative techniques in Michigan. Where possible, existing applications of the various techniques will be indicated and reviewed. Principle concern is given to reviewing known examples of State and local applications of flood loss management techniques. Considerable attention is given to identifying State and local applications of compulsory techniques such as floodway encroachment regulations, flood plain zoning, and subdivision regulations. This special attention is reflective of the increasing application being given to these particular alternatives by State and local units of government.

The structure of the chapter will generally follow that established in Chapter III and outlined in Table I; although, some variation will be noted in the presentation of certain techniques. This can be attributed to variations in implementing flood loss management techniques by levels of government and not along strictly program lines.

Predevelopment Policies For Directing Land Use

Compulsory Regulations

Floodway Encroachment Regulations

Floodway encroachment regulations are appropriate measures for preventing flood losses from increasing in developed as well as undeveloped areas. Some inherent problems are posed in Michigan where weakly defined channel banks are frequently encountered. The poor visual definition of flood plain and floodway areas may be attributed in part for the encroachment problem. For similar reasons, it may be difficult to readily establish floodway encroachment lines. However, such a situation increases the need and furthers the justification for establishing flood plain and floodway areas, despite the hydraulic and hydrologic problems in defining such areas. This need has been recognized for some time in Michigan.[1]

General authority in Michigan for establishing floodway regulations lies at the state level with collateral authority arising at the municipal and county levels. Recent state legislation has mandated that the Michigan Water Resources Commission:

> Shall have control over the alterations of natural or present watercourses of all rivers and streams in the state to assure that the channels and the portions of the floodplains that are the floodways are not inhabited and are kept free and clear of interference or obstruction which will cause any undue restriction of the capacity of the floodway.[2] (Underlining added for emphasis.)

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[1]Gerald E. Eddy, Director of Conservation, and Chairman, Water Resources Commission, State of Michigan, "Basic Problems of Water Management in Michigan," in Proceedings of the Ninth Midwestern States Flood Conference. (E. Lansing: Michigan Water Resources Commission, 1954), p. 16.

[2]State of Michigan, Act No. 167, Public Acts of 1968, Sec. 2a, Michigan Compiled Laws of 1948 as amended, Sec. 323. 2a.

Local units of government consisting of counties, townships, cities and villages may also regulate floodway areas through adoption of appropriate ordinances. Article 7 of the Michigan Constitution of 1963 contains sections which establish general enabling powers for legislative functions in these lower units of government. In addition, such legislative powers are subject to specific constraints and prescriptions as enacted by the State legislature.[1] Accordingly, these legislative functions are spelled out more precisely in the appropriate state enabling acts concerning the organization and governance of the various local units of government.

As indicated, the State of Michigan has recently enacted measures to establish significant regulative powers within the Michigan Water Resources Commission for regulating the floodway areas of Michigan waterways. Under authority granted by Act 167, Public Acts of 1968, the Michigan Water Resources Commission has instituted a permit system whereby development in, obstruction of, or alteration of floodway areas can be reviewed and regulated. Act 167 ostensibly was designed to enable establishment of State floodway areas. However, the last section of Act 167 goes beyond the rest of the preceeding five sections and enables broad flood plain regulation. Included within these broad provisions, are powers to deny filling, grading, or any activity which will ". . . harmfully interfere with the discharge or state characteristics of a stream. . ."[2] Regulation of floodway areas is obtained through a permit system wherein the Michigan Bureau of Water Management reviews and makes

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[1]State of Michigan, Constitution of 1963, Article 7, Sections 2 and 8 pertain to Counties; Section 18 pertains to Townships; and Sections 21 and 22 pertain to Cities and Villages.

[2]Michigan, Act No. 167, Public Acts of 1968, Sec. 5b.

recommendations to the Michigan Water Resources Commission. The Commission in turn may deny or grant the permit.

Under the program, flood plain areas are to be established by contour lines using a hypothetical flood as a flood of record. A recurrence frequency of one percent or one in 100 years is used by the State of Michigan for the hypothetical flood of record.[1]

Local efforts to regulate floodway areas are present in Michigan. A precise assessment is not available as to the extent of floodway regulations at the local level. Fifteen communities are thought to have some provisions for regulating floodway encorachment.[2] This is contrasted with 105 urban communities identified as having stream flooding problems. The two figures are not felt to be inclusive. Eight of the fifteen communities with floodway regulations were not found on the listing of 105 urban communities with stream flooding problems. On the other hand, three urban communities known through other information sources to have provisions for regulating floodway areas were on the listing of 105 urban communities, but were not recognized as having flood plain regulations by the listing.

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[1]State of Michigan, Rules and Regulations of the Water Resources Commission, Department of Natural Resources, "Flood Plain Control," January 21, 1970, Rule R323.201(9).

[2]<u>List of Urban Places with Information about Flood Problems in Michigan</u>, January, 1967, Xerox copy obtained from Carl Argiroff, Chief, Flood Plain Management Services, U.S. Army Engineer District, Detroit Corps of Engineers, February 18, 1969.

Additional information concerning adoption of floodway encroachment regulations was obtained from (a) Carl Argiroff, Personal Interview, Detroit, Michigan, February 18, 1969. (b) Lawrence Witte, Personal Interview, January 29, 1969. (c) Flood Plain Information Files, Michigan Water Resources Commission, Lansing: August 31, 1971. (d) Personal correspondence with administrative officials in municipal units. Information was not obtained on flood plain regulations in the City of Mt. Clemens, the City of Utica, or Village of Bingham Farms.

Local efforts to regulate floodway areas in Michigan have followed two general forms of regulation: (1) zoning ordinance and (2) landfill ordinance. The Cities of Farmington, Grand Ledge, Lansing, Livonia, Southfield, and the Townships of Clinton (Macomb County), Meridian (Ingham County), Redford (Wayne County), Shelby (Macomb County), and Sterling (Macomb County) have included floodway regulations within their general zoning ordinance. The Township of Farmington (Oakland County) and the Cities of Detroit and Southfield have adopted fill ordinances, which regulate placement of materials in floodways. Analysis of both forms of regulation, suggests considerable variation exists in ordinance provisions at the local level in Michigan. Only the City of Detroit has adopted an ordinance which approximates a distinct floodway encroachment ordinance. The other communities have incorporated provisions for regulating floodway areas into more comprehensive legislative enactments.

The City of Farmington approaches floodway regulation through establishment of River Valley Districts in its zoning ordinance. The River Valley Districts are explicitly assigned to the upper River Rouge. In this manner, the restrictions are limited to regulating the flood plain of one watercourse under the provisions of the ordinance. A floodway zone is implicitly defined for a flood of 1500 cubic feet per second (cfs) which corresponds closely with the flood plain area of a flood experienced in 1947. The ordinance flood plain is concurrently delineated by reference to a flood peak discharge level of 3200 cfs. No dumping, filling, or locating of structures of any type are permitted below the line defined by the flood discharge of 1500 cfs as delineated on

the city zoning map.[1,2] The 1500 cfs flood peak discharge level corresponds to the flood of record, while the 3200 cfs flood level is a hypothetical flood "which may reasonably be expected at some time in the future."[3] Accordingly, it appears that Farmington has designated the flood plain of the flood of record as the ordinance floodway. The flood plain defined in the ordinance is that for a hypothetical flood which has not been experienced but is considered quite possible.

The City of Lansing has combined floodway regulation with floodplain zoning. The ordinance gives specific coverage to the flood plains of the Grand River, the Red Cedar and Sycamore Creek. A distinction is made between the flood plain and floodway in the ordinance definitions, but is subsequently lost in the text of the ordinance.[4] Restrictions are placed upon occupying, filling, or grading in the flood plain such that the impoundment capacity and flow of water in the flood plain will not be reduced. Some confusion develops in the text wherein flow of water is continually associated with the flood plain and not explicitly related to the floodway. Some notion of precision is attached to the flood plain by making the flood plain of "the fifty year frequency flood" the area subject to regulation. A comparable level of precision is absent in developing the floodway as an area of regulation. In any event, some attempt at floodway encroachment regulation is made, but the ambiguity

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[1] Farmington, Michigan Flood Plain Information Report on the Upper River Rouge (Detroit: U.S. Army Engineer District, Detroit Corps of Engineers, February, 1963), pp. A-15 to A-17.

[2] City of Farmington, Ordinance No. C-180-63, Amending Section 5.48 of Article III, Chapter 39 of Title V of the Code of the City of Farmington, May 6, 1963.

[3] Farmington, Michigan Flood Plain Information Report, 1963, p. A-17.

[4] City of Lansing, Ordinance No. 161, Amending The Code of Ordinances of the City of Lansing, adding new Article V, Sections 36-59 to 36-67, July 1, 1968.

of the ordinance makes it difficult to distinguish such regulation from flood plain zoning.

The City of Livonia combines floodway encroachment regulations within flood plain zoning.[1] Buildings, structures, obstructions, filling, and grading are prohibited below the high water level of record. In effect, the flood plain is treated as a floodway. The flood plain areas are delineated by flood lines in a report developed by the Engineering Division of the Department of Public Works. The ordinance apparently uses the flood of record as the basis for code enforcement. The frequency expectation and the magnitude of such a flood is not stated in the ordinance; rather the technique of adopting a flood map by reference is utilized. It would appear from the reference technique that the period for the flood of record will be limited to the period preceeding the date established by the report. It is not clear what effect a flood of greater magnitude than that of record would have on the ordinance, and its subsequent implementation.

The City of Southfield has enacted provisions for regulating floodways into both a landfill ordinance and a zoning ordinance. Provisions in the latter attempt ". . . to assure retention of sufficient floodway area to convey flood flows which can reasonably be expected to occur,. . ."[2] The floodway is not defined and any substantial distinction between it and the larger flood plain area is lost in the text of the ordinance. Restrictive regulations are applied such that the floodway area and the

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[1]City of Livonia, Ordinance No. 636, Amending Ordinance No. 543, The City of Livonia Zoning Ordinance, adding Article XXVIII, Sections 28.01 to 28.04, August 17, 1967.

[2]City of Southfield, Ordinance No. 718, Subsection (1) of Section 5.49, Amending the Code of the City of Southfield, adding Subsection (7) to Section 5.5 of Article 2, Chapter 45, Title V, and adding Section 5.49, August 31, 1970.

remaining flood plain area are effectively secured from obstructions to flood flows. The flood plain is defined as an area ". . . which would be covered by flood waters four (4) feet higher than those produced by a storm equal in intensity and character to the flood which occurred in April 1947. . ."[1]

Meridian Charter Township in Ingham County combines floodway encroachment regulations with flood plain zoning.[2] The floodway area is not referred to as such nor identified. Under Section 4.14.6 of the ordinance, filling, grading, structures, and obstructions are prohibited which would impede flood flow or reduce the impoundment capacity of the flood plain. Such uses may be permitted where flood flows would not be impeded or where compensating measures would be adopted for maintaining or improving the flood flow or storage capacity of the flood plain area. A flood of record is used as the basis for delineation of the flood plain and ordinance enforcement. The actual flood plain is delineated through use of a hydrological grade chart, and is adopted into the ordinance by reference.[3]

Five additional communities include floodway provisions in their flood plain zoning ordinances. As in the case of Meridian Charter Township, the five communities do not mention nor distinguish a floodway as such. However, each ordinance attempts to regulate buildings, structures, fills, and/or obstructions to prevent loss in flood flow capacity in the floodway. The regulations do not clearly distinguish between the different regulatory

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[1] Ibid., Subsection (7), Section 5.5.

[2] Meridian, Charter Township, Ingham County, Zoning Ordinance, Ordinance No. 30, Sections 4.14 to 4.14.6 as amended through July, 1967.

[3] The ordinance refers to Meridian Township Red Cedar River Flood Plain Map with further technical reference to the Michigan Water Resources Commission Red Cedar River Hydrological Grade Chart. See Meridian Charter Township, Zoning Ordinance, 1967, sec. 4.14.2 and 4.14.3.

needs of the flood plain ponding area and the floodway.[1,2,3,4,5]

The City of Detroit ordinance only regulates fill placed in the Rouge River Flood Plain. Accordingly only one watercourse is effectively covered by the ordinance. Fill in the floodway appears to be strictly prohibited, while fill in the flood plain may be allowed if a permit is granted by the Commissioner of Public Works. The flood plain and floodway are defined and differentiated in the ordinance; but the definitions lack precision. The flood plain includes that "area which has been covered by flood water from the Rouge River,. . ." and the floodway includes the channel and adjoining areas ". . . which are reasonably required to carry and discharge the flood flow. . ."[6]

The City of Southfield also regulates floodway encroachment through provisions in the City of Southfield Dumping and Soil Removal Ordinance.

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[1]City of Grand Ledge, Zoning Ordinance No. 156, XIII FP Flood Plain Districts, Sections 1300 - 1303, Adopted November 14, 1966, pp. 21 and 22.

[2]Clinton Township, Macomb County, Zoning Ordinance, Article XV, FP Flood Plain Districts, Section 1500 - 1503, date adopted not determined, pp. 16 and 17; xerox copy obtained from Flood Plain Information Files, Michigan Water Resources Commission, Lansing, August 31, 1971.

[3]Redford Township, Wayne County, Zoning Ordinance No. 152, Section 3.23, date adopted not determined, pp. 25 and 26; xerox copy obtained from Flood Plain Information Files, Michigan Water Resources Commission, Lansing, August 31, 1971.

[4]Shelby Township, Macomb County, Ordinance No. 1.11 to amend Shelby Township Zoning Ordinance, Adopted September 21, 1965, published September 30, 1965, Utica Sentinel.

[5]Sterling Township, Macomb County, Sterling Township Zoning Ordinance, Article XV, FP Flood Plain District, Sections 15.00 - 15.03, Adopted November 4, 1965; xerox copy obtained from Information Files, Michigan Water Resources Commission, Lansing, August 31, 1971.

[6]City of Detroit, Ordinance No. 784-F, Chapter No. 266, Sections 2(a) and 2(b), April 15, 1963.

Section II in part prohibits dumping

> . . . on the spillways or flood plains of any natural or artificial stream or water course, or any area between the upper and lower banks of such streams or water courses. . . .[1]

except where a permit is granted. The permit process requires a public hearing and demonstration that the fill "will not be detrimental to the public health, safety, preservation of natural resources or welfare." No provision is made for delineating the flood plain. The application of the ordinance appears to apply at best to the near and within channel banks area and does not apply to construction of buildings or structures. Its particular application appears to be superceded by the 1970 Flood Plain Zoning Ordinance.[2]

The Township of Farmington regulates some floodway encorachment through provisions of a land fill ordinance.[3] The fill ordinance is similar to that found in the City of Southfield. Section II of the Township ordinance prohibits dumping or filling in the spillways or flood plains of natural streams and artificial watercourses, unless a permit has been granted by the Township Board. The grant of a permit is dependent upon the demonstration that no detrimental effects will be posed to other property or public welfare. Definitions of flood plain and spillway are not present to indicate the potential extent of application of the provisions of this action. Further, the ordinance section only regulates dumping, filling, or grading operations in the flood plain, and does not regulate construction of buildings or erection of structures which could obstruct the floodway. Finally provisions in section 3 reduce the ordinance applications with a

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[1] City of Southfield Dumping and Soil Removal Ordinance, Ordinance No. VIII, Section II.c.(2)., February 9, 1959.

[2] Supra, p. 161, footnote 1.

[3] Township of Farmington Land Fill Ordinance, Ordinance No. 33, Adopted October 14, 1963.

number of exclusion clauses. For example, no permit is required where a landfill operation does not exceed 1,000 cubic yards. Or, no permit is required for grading land when it is ". . . carried on for the immediate use or development of the land. . ."[1]

In summary, regulation of floodway encroachments is evident in Michigan at both the state and municipal levels of government. The state has only recently embarked upon such a program with the enactment of the enabling powers under Public Act 167 of 1968. Municipal units of government have enacted various ordinances with provisions for regulating floodways for a longer period of time. (The City of Southfield fill ordinance was enacted in 1959, and several subsequent municipal ordinances appeared in 1963). The programs generally utilize a permit system of regulation. Only a few ordinances attempt to distinguish between a floodway and flood plain zone. Further, only two ordinances used such zones as a basis of permit review and enforcement. The flood plain fill ordinance of the City of Detroit and the zoning ordinance in the City of Farmington were the only ordinances which were found to actually make a substantial distinction between floodway area and flood plain area in the regulated use sections of their respective ordinances. Little field information was obtained for the various ordinances which would allow an evaluation of actual effectiveness of program implementation. However, enabling legislation and ordinance construction suggest that considerable variation in inherent program scope can be expected at the local level.

Flood Plain Zoning

The appropriateness of flood plain zoning in Michigan would appear

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[1] *Ibid.*

to be substantial for preventing increases in future flood losses, as well as for reducing the existing potential of flood loss. The prevention of increased flood loss can be aided by regulating land uses in flood plain zones. Concurrently, existing flood loss potential may be lowered over the years by preventing nonconforming land uses from reconstructing, redeveloping, or rehabilitating their structures or developments unless structural adjustments for flood hazards are adopted at such times. Accordingly, special zoning provisions appear to offer regulatory techniques for obtaining such reductions in flood loss potential.

Authority for flood plain zoning appears to be available at both the state and local levels. Land use zoning as generally practiced in Michigan has traditionally resided at the municipal level. Various state enabling acts have been passed to allow local units of government the opportunity to exercise land use zoning.[1] The State of Michigan has more recently enacted statutes and adopted policies which would allow flood plain zoning as well as other special purpose zoning by state regulatory and administrative units.

The extent of flood plain zoning in Michigan has not been widespread; although the recent enactments of the state legislature may alter such an assessment. State involvement in flood plain zoning originated in the Subdivision Control Act of 1967 and Act 167 of 1968. Section 194 (a) of

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[1]Some of the existing local zoning enabling acts are: (a) State of Michigan, City and Village Zoning Act, Act No. 207, Public Acts of 1921, Michigan Compiled Laws Annotated, Sections 125.581, et. seq; (b) State of Michigan, County Rural Zoning Act, Act No. 183, Public Acts of 1943, Michigan Compiled Laws Annotated, Sections 125.201, et. seq.; (c) State of Michigan, Township Rural Zoning Act, Act No. 184, Public Acts of 1943, Michigan Compiled Laws Annotated, Section 125.271, et. seq.

the Subdivision Control Act stipulates

> No buildings for residential purposes and occupancy shall be located on any portion of a lot lying within a flood plain, unless approved in accordance with the rules of the water resources commission of the department of conservation.[1]

One year later, even more restrictive and extensive zoning powers were conferred upon the Michigan Water Resources Commission by Act 167 of 1968. This act in part states that it is unlawful to occupy flood plain lands for residential, commercial, or industrial purposes unless a permit is obtained from the Michigan Water Resources Commission.[2] Such zoning restrictions appear to supercede local zoning provisions, in that the Commission is empowered to determine for official record the location and extent of flood plains, stream beds, channels, as well as the discharge and stage characteristics of defined floods.[3] This is coupled with the Commission assumed power of review of local regulations in terms of their definition of flood plain areas. This is evident in the rules and regulations adopted for administering the Subdivision Control Act of 1967.[4] Such review power confers to the Commission the authority to accept or reject a flood plain defined and adopted under local ordinance. If the local flood plain limit is rejected, the Commission may then impose a Commission defined flood plain limit.

The Commission has adopted as a standard a hypothetical flood having a recurrence frequency of once in about 50 years for reviewing subdivision plats.[5]

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[1]State of Michigan, Subdivision Control Act of 1967, Act No. 288, Public Acts of 1967, Section 194(a).

[2]Michigan, Act No. 167 of 1968, Section 5(b).

[3]*Ibid.*, Section 5(a).

[4]Michigan, Rules and Regulations of the Water Resources Commission, November 30, 1967, Part 3, Rule R.560.303.

[5]*Ibid.*

This recurrence frequency is different from that noted in the previous section. It was found that a one percent reccurrence probability was adopted for regulating floodway encroachments. The significance of this will be developed in the next chapter.

As noted in the preceeding section, at least 15 Michigan municipal units are thought to have some form of flood plain regulation. Ten of the communities are known to have flood plain zoning provisions in their zoning ordinances. Information for three communities; City of Southfield, City of Utica, and Village of Bingham Farms, was not obtained. The remaining two communities, City of Detroit and Township of Farmington, have special ordinances containing regulations pertaining to fill operations in flood plain areas.

There are some common program elements shared by the ten communities with flood plain zoning. In general, a special flood plain district or river valley district is established. Typically, a specified frequency flood or flood stage discharge level is utilized in defining the flood plain area. Within this area, certain uses are prescribed as allowable. Typically, open space, agricultural uses, storage areas, street and parking areas, and credits for lot area requirements in adjacent land use zones are allowed. Similarly, certain uses are typically prohibited as fills, buildings, structures, and other developments unless special permits are obtained. Special permits, when offered, usually require that the design and construction of a structure or building be secured from flooding. This usually implies fill operations to raise foundation and/or ground floor elevation above flood levels. In addition special use permits often require that compensating excavation and shaping of the flood plain be undertaken in order to preserve the flood plain storage capacity. Enforcement of such provisions is obtained through

the general zoning ordinance enforcement structure, which generally entails a permit and special permit system.

The principal variations in flood plain zoning provisions are found in (1) the method of delineating the flood plain area, (2) the types of uses allowed under special permit, and (3) the administrative body involved in granting special permits. Examples of the principle variations will be illustrated below.

In Michigan, most municipal units were found to either delineate flood plain areas by flood discharge peaks or by a prescribed frequency flood event. Seven municipal units specify a stage level or discharge capacity as a means for delineating the flood plain.[1] In contrast, the City of Lansing was the sole unit to specify a flood of a specific frequency expectation as a means of defining the flood plain.[2] However, five of the above seven communities also referred in some manner to a 1947 flood event. This often can be associated with implicit frequency expectations. As further evidence of this phenomenon, the sixth community, Shelby Township indicated a discharge level and then parenthetically identified it as a fifty year flood frequency. There were no examples of ordinance adoption of contour levels as a method of flood plain delineation. Two communities, the City of Grand Ledge and the Township of Redford, did not define the method to be used in delineating their

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[1]The seven municipal units and the ordinance citations are as follows: (a) Clinton Township, Zoning Ordinance, Article XV, F.P. Flood Plain District, Preamble Section; (b) City of Farmington, Ordinance No. C-180-63, Sec. 5.48; (c) City of Livonia, Ordinance No. 636, Sec. 28.01; (d) Meridian Charter Township, Ordinance No. 30, Sec. 4.14.2; (e) Shelby Township, Ordinance No. 1.11, Article 4; (f) City of Southfield, Ordinance No. 718 Sec. 5.5; (g) Sterling Township, Zoning Ordinance, Article XV.

[2]City of Lansing, Ordinance No. 161, Sec. 36.61

ordinance flood plain.[1] Finally, information was not obtained on three communities with flood plain regulations as applicable to flood plain zoning.[2]

Some variation was found between treatment of permitted land uses and special permit land uses among the various ordinances. The most restrictive flood plain zoning ordinance encountered was typically like the other flood plain zoning ordinances in that it permitted agricultural, recreational, and open space uses; public rights of way; and lot area credits within the flood plain area. Special permit uses were limited to fill type operations and to the construction of roads, bridges, and causeways.[3] Two zoning ordinances with more flexible and reasonable land use provisions allowed special permits for buildings which would otherwise have been allowed in the flood plain zoned area. The special permit systems specified certain performance requirements be met as a contingency in obtaining a special permit.

The City of Lansing and Meridian Charter Township made allowances for special design techniques which would not reduce the flood plain storage capacity or flow characteristics. Further, they required floor elevations to be at least three feet above ordinance flood level.[4] These two ordinances come closest to allowing flood proofed structures in flood plain areas. However, the design restrictions relating to preservation of flood plain storage capacity and to minimum floor elevations may

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[1]City of Grand Ledge, Zoning Ordinance No. 156, and Redford Township, Zoning Ordinance No. 152.

[2]City of Mt. Clemens, City of Utica, and Village Bingham Farms.

[3]City of Southfield, Ordinance No. 718, Sec. 3.

[4]City of Lansing, Ordinance No. 161, Sec. 36-63 and Meridian Charter Township, Zoning Ordinance No. 30, Sec. 4.14.5. Clinton Township attempts to make such allowances but is even less precise; see Clinton Township Ordinance, Zoning Ordinance, Sections 1501 and 1502.

restrict the forms of flood proofing available to qualify a building for a special permit.

Considerable variation exists in the administering body responsible for granting special permits. Of the five townships known to have flood plain zoning, three leave the final authority for special permit approval with the township board of supervisors;[1] one designates the township planning commission as the responsible unit;[2] and the remaining township delegates the responsibility to the township department of building and safety.[3] Of the five cities known to have flood plain zoning, three city councils reserved the authority for special permit approval;[4] one delegated the responsibility to the city planning commission;[5] and one delegated the authority to the City Engineer.[6]

In most instances, municipal planning commissions and engineering departments were granted powers of review and recommendation when they were not delegated the authority for granting special permits. Further, the right to require and specify field engineering data to be submitted by a permit applicant was typically granted to those municipal bodies having powers of permit approval or review. This seemingly would have

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[1]Clinton Township, Zoning Ordinance, Sec. 1502. Shelby Township, Ordinance No. 1.11, Article II, Sec. 11.01. Sterling Township, Zoning Ordinance, Sec. 15.02.

[2]Meridian Charter Township, Ordinance No. 30.

[3]Redford Township, Zoning Ordinance No. 152, Sec. 3.23. Note: Provision is allowed for Temporary Use Permits to be granted by the Township Zoning Board of Appeals.

[4]City of Lansing, Ordinance No. 161, Sec. 36-63. City of Livonia, Ordinance No. 636, Sec. 23.03. City of Southfield, Ordinance No. 718, Sec. 5.49.

[5]City of Grand Ledge, Zoning Ordinance No. 156, Sec. 13.01.

[6]City of Farmington, Ordinance No. C-180-63, Sec. 5.484.

the effect of keeping the burden of much of the technical and administrative cost upon the permit applicant. In the end, however, considerable differences existed in where powers of permit approval finally resided.

In summary, those Michigan communities which have adopted flood plain zoning provisions in their zoning ordinances share several common threads. The ordinance flood plains are typically defined by a prescribed stage discharge level which has an associated flood frequency expectation. Permitted uses tend to be quite restrictive and limited to open space or extensive type land uses. Special permits are granted for certain type land uses or adjustments where proposed designs assure the maintenance of existing flood plain storage capacity and floodway flow capacity.

Subdivision Regulations

The regulation of the subdivision and platting of land is an important and appropriate point in influencing land use and land development in the flood plains of Michigan. Four basic means of obtaining subdivision control have been identified by the Federal Housing Administration. These consist of (1) municipal ordinances, (2) planning commission rules, (3) state plat acts, and (4) Federal Housing Administration rules and regulations pertaining to F.H.A. insured loans.[1] In the case of the last technique, if a subdivider wishes his subdivision to qualify for F.H.A. insured loans, he must subdivide his land so as to meet F.H.A. standards. This aspect of subdivision control will be discussed later under the section devoted to building finance.

Several aspects of flood plain use and development can be influenced by controlling the subdivision of land lying wholly or partially within the

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[1] U.S., Housing and Home Finance Agency, Suggested Land Subdivision Regulations, (Washington, D.C.: U.S. Government Printing Office, Reprinted, 1960).

flood plain. The subdivision of land into residential, commercial, business, or industrial areas can be regulated, particularly, where significant numbers of new parcels of land would be created. Many of the utility, transportation, and public service systems which utilize land space can be utilized by subdivision controls in influencing subdivision and platting of land. Accordingly, subdivision and platting regulations, coupled with zoning regulations, provide substantial and significant tools for achieving the goals of flood loss management in Michigan communities.

General authority in Michigan for establishing subdivision and plat controls is substantial. Two types of authorities exist in Michigan: (1) mandatory requirements and (2) permissive or enabling powers.[1] A state plat act sets forth numerous mandatory requirements which must be met whenever a subdivision involving five or more parcels of land is proposed. The act further has enabling provisions which allow municipal units the right to establish by ordinance, more stringent requirements.[2] Several other enabling acts also provide for some subdivision and plat controls to be exercised at the local level by municipal planning commissions. Two of the acts require as a part of their enabling provisions that a comprehensive land use development plan be adopted as a prerequisite to a municipal planning commission exercising subdivision and platting controls.[3] A third act grants township boards of supervisors

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[1] Guiding Land Subdivision: Part I Procedures (Lansing, Michigan: Tri-County Regional Planning Commission, 535 N. Clippert Street, November, 1961) p. 21.

[2] Michigan, Subdivision Control Act of 1967, Sec. 259.

[3] State Of Michigan, City, Village and Municipal Planning Commission Act, Act No. 285, Public Acts of 1931, Sections 6, 13, 14 and 15; M.C.L.A. 125.36, 125.43, 125.44, 125.45

State of Michigan, Mapped Improvements Act, Act No. 222, Public Acts of 1943, Sections 1,2, and 3. Michigan Compiled Laws Annotated 125.51, 125.52, 125.53.

the power to establish planning commissions. If the township creates a planning commission under this act, then the commission may act as a service body on subdivision controls and plat applications.[1]

The extent of application of subdivision controls in Michigan is substantial. Actually, the application of such controls to flood plain lands and their related needs has been a recent undertaking at the state level.[2,3] The Subdivision Control Act of 1967, in part, conveys regulatory powers to the Michigan Water Resources Commission. If a proposed subdivision involves flood plain land, then the subdivider is required to submit a preliminary plat to the State Water Resources Commission for its approval of the proposed plat.[4] The Commission in turn has 30 days to approve or reject the preliminary plat. If the plat is rejected, the reasons for rejection of the plat must be given and the requirements which must be met for plat approval by the Commission must be set forth. Final approval of the preliminary plat can not be obtained until the Water Resources Commission grants its approval to the preliminary plat.

The rules and regulations adopted by the Water Resources Commission allow for recognizing flood plains defined by local ordinance or for the Commission to define the flood plain with a flood frequency interval of one in 50 years.[5,6] The rules further require that the applicant furnish three

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[1]State of Michigan, Township Planning Commission Act, Act 168, Public Acts of 1959, Section 12, Michigan Compiled Laws Annotated 125.332.

[2]Allison Green, State Treasurer, Department of Treasury, State of Michigan, "State Legislature Revises Plat Act," Michigan Municipal Review, September 1967, Vol. XI, No. 9 (Ann Arbor: Michigan Municipal League), pp. 230 and 238.

[3]Michigan, Subdivision Control Act of 1967.

[4]Ibid., Sec. 117.

[5]Michigan, Rules and Regulations of the Water Resources Commission, November 30, 1967, Part 3, Rule 560.303.

[6]Michigan, Subdivision Control Act of 1967, Sec. 105(F).

valley cross sections at selected distance intervals for any water course lying within the proposed plat. The Act itself requires that the flood plain be already shown in the proposed plat and labeled "flood plain area."[1]

The focus of the Subdivision Control Act is upon land subdivision for residential purposes; this is especially notable in the provisions regarding flood plain areas. The Act mandates that no building for residential purposes shall be located or any lot located in a flood plain unless approved by the Water Resources Commission. Notably lacking are provisions regarding subdivision parcels relating to commercial, business, or industrial land uses. It is conceivable that these might be involved to the extent that restrictive deed covenants must be recorded with the final plat application which assure that the flood plain will be left essentially in a natural state. Nevertheless, this provision can be countered by a subsequent clause which allows for the alteration of the flood plain if the discharge capacity is maintained and that any alteration of stream flow is not of an adverse affect on other riparians.[2]

Similarly, the adopted rules of the Water Resources Commission, reflect the residential bias. Building restrictions are set forth for residential structures and are absent for other types of structures. Such building restrictions are implemented by requiring restrictive deed covenants to be filed with the final plat. The rules of the Commission require such covenants restrict platted residential building lots in such way that:

1. They will be served by streets lying above flood elevation,
2. They will contain at least 3,000 feet of area at natural grade above flood level, or have residential buildings design of such a manner as to raise them above flood level,

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[1] Ibid., Sec. 138.

[2] Ibid., Sec. 194 (a), (b), and (c).

3. The residential buildings on such lots will have lower flood elevation at least one foot above flood level, and
4. The residential buildings will be flood proofed in specified ways.[1]

As noted above, substantial authority exists for municipal involvement in and adoption of subdivision controls. Indeed, the Michigan Subdivision Control Act of 1967 confers enabling powers upon local units of government for adopting more stringent subdivision controls. Moreover, various county agencies are mandated review and approval powers concerning subdivision plat applications by the Act. For example, the County Health Departments, Road Commissions, and Drain Commissions have such approval powers as to be of some relevance to flood plain regulation.[2]

The extent of municipal and county involvement in subdivision control of flood plain areas has not been established. Allison Green in 1967 asserted that less than one half of incorporated villages and cities in the State of Michigan have planning commissions or zoning ordinances. Even fewer of the preceeding communities were suggested as having subdivision regulations.[3] Of the latter group, no estimate was found which would relate the number of communities with subdivision controls to those communities including provisions for flood plain regulations.

Subdivision control ordinances were obtained from a few Michigan communities which are exposed to risks of stream flooding. From the selection, one municipal subdivision regulation was found with significant

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[1]Michigan, Rules and Regulations of the Water Resources Commission, November 30, 1967, Rule 560.304 (1) and 304 (2) (a) - (g).

[2]Michigan, Subdivision Control Act of 1967, Sections 118, 148(3), 167; 113, 142(e), 147, 164, 165, 183; and 114, 142(f) 146, 162, 163, 192 respectively; Michigan Compiled Laws Annotated Sections 560.118, 560.148(3), 560.167; 560.113, 560.142(e), 560.147, 560.169, 560.165, 560.183; and 560.114, 560.142(f), 560.196, 560.162, 560.163, 560.192.

[3]Green, "State Legislature Revises Plat Act," 1967, p. 230.

flood plain provisions.

The City of Lansing recently enacted new subdivision regulations which, in part, regulate subdivision of flood plains. The provisions are essentially a simplified reflection of the contents of the State Subdivision Control Act of 1967. The Lansing ordinance requires that no buildings can be placed in subdivided flood plains unless the subdivision and the buildings are in accord with the rules of the Michigan Water Resources Commission. Restrictions are also placed upon altering the natural flood plain. Such requests must demonstrate a design which will maintain stream channel discharge capacity and meet with the approval of the city planning board as well as the Water Resources Commission.[1] Other provisions within the ordinance relate to the reservation of public sites and open spaces. When the subdivision controls are correlated with the City of Lansing Master Plan, justification for reserving flood plain areas can readily be made.[2] In certain applications such reservations will require acquisition of the reserved flood plain areas within three years from the time of formally expressing the need for the reservation. This latter process will be explored subsequently under the section on land acquisition.

The City of Southfield also recently enacted new subdivision regulations. Under the new ordinance, general provisions are available for application to preservation of drainage and natural stream channels.

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[1]City of Lansing, Subdivision Regulations, Ordinance No. 156, Chapter 37 of the Code of the City of Lansing, Adopted March 18, 1968, Section 37-18.

[2]City of Lansing, Comprehensive Master Plan Lansing and Environs, Prepared by Ladislas Segoe and Associates, City Planning Consultants, Cincinnati, Ohio, adopted City Planning Board, Lansing, Michigan, December 3, 1959, pp. 42, 45, and 138.
City of Lansing, Subdivision Regulations, Section 37-25.

However, no precise or explicit recognition is given to flood plains. Provision is included for the dedication of "adequate barriers and easements" in order that natural stream channels and drainage may be maintained.[1] To what degree this can be utilized in regulating subdivision plat application in flood plain areas is not clear.

Building Codes

The appropriateness of construction and building controls in minimizing flood losses in Michigan appears to be justified. If the flood plain owner or developer desired to locate a structure in the flood plain, some safeguard could be secured concerning the construction of the structure through building code regulations. This presumes the owner and occupant or users of the structure will have provisions for bearing any subsequent flood loss in the event the structure still suffers flood loss. Building and construction controls should accordingly attempt to assure that the design and construction of the building does not obstruct flood flows and create an increased flood risk to occupants located upon other reaches of the water course. Further restrictions should be appropriately applied so as to secure the safety of inhabitants, occupants, and property contained inside the structure. However, these potential applications of flood plain building regulations are posed within the broader knowledge that building code regulations as a whole are characterized by technical and administrative problems. This results in the qualified statement as to the appropriateness of their employment in regulating flood losses.

Authority in Michigan for building and construction regulations lies essentially in state enabling acts allowing for local development and/or

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[1]City of Southfield, Subdivision Regulations Ordinance, An Ordinance for the Platting of Land, Enacted September 30, 1968, Article V, Sec. 521.

adoption of building regulations. Enabling acts exist which allow for the drafting and/or adoption of building codes by various municipal and county units. The enabling legislation for county and township units of government allows for the adoption of building codes with application and enforcement in the unincorporated county or township areas.[1] Incorporated city and village enabling legislation allows for adoption of building codes.

Extensive collection and review of building codes at the local level was not attempted. Further, the extent of building code adoption throughout the state was not found in available literature sources.[2] Accordingly, assessment of community or local building code provisions regarding flood plain structures was not possible. The decision not to collect local building codes resulted when general information concerning building codes was coupled with time and budget constraints. At such time, it became clear that further detailed inquiry into Michigan building code regulations would not be justified within this study.[3,4,5] On the other hand, several observations concerning flood plain building code regulations are possible.

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[1]State of Michigan, Act No. 62, Public Acts of 1943; M.C.L.A., Sections 125.251 - 125.258.

State of Michigan. Township Minimum Construction Act; Act No. 185, Public Acts of 1943; M.C.L.A., Sections 125.351 - 125.359.

[2]This is not true for six southeastern Michigan counties which had a detailed study of building code sponsored by the Metropolitan Fund, Inc., Regional Building Codes, 1966, pp. 7-8.

[3]U.S. Advisory Commission on Intergovernmental Relations, Building Codes: 1966, pp. 81-102.

[4]Allen D. Manuel, Local Land and Building Regulation, Prepared for National Commission on Urban Problems, Research Report No. 6 (Washington D.C., U.S. Government Printing Office, 1968).

[5]Regional Building Codes, 1966, p. 15.

The State of Michigan does not have a state building code.[1] It does have such specialized codes as plumbing and electrical codes which apply where such local codes are not present. In addition, there are several state agencies involved in specialized programs with regulations pertaining to building construction. The complement to a building code does exit in the State Housing Code.[2] It has some overlap with a building code but suffers principally from its inappropriate employment as a building code and from its datedness. Two sections worthy of note in the State Housing Code which may be of relevance to flood plains pertain to waterproofing residential structures.[3] The effect of the provisions resemble those found in the three model building codes and they give illustration to the existence of overlapping provisions.

A common practice for local units of government when adopting a building code is to adopt one of four model building codes.[4] However, none of the model codes include provisions which are uniquely applicable

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[1] Ibid.

[2] State of Michigan, State Housing Law, Act 167 of Public Acts of 1917; M.C.L.A., Sections 125.401, et. seq.

[3] Ibid., Sections 125.432 and 125.460.

[4] In southeastern Michigan, the most frequently adopted model building code is the Basic Building Code. This is followed by the Uniform Building Code and then the National Building Code. Not represented is the Southern Standard Building Code. See Building Officials Conference of America, Basic Building Code (Chicago: Building Officials Conference of America, Inc., 1970 edition). International Conference of Building Officials, Uniform Building Code (Pasadena, California: International Conference of Building and Officials, 1971 edition). American Insurance Association, National Building Code (New York: American Insurance Association, 1967 edition). Southern Building Code Congress, Southern Standard Building Code (Birmingham, Alabama: Southern Building Code Congress, 1957-1958 edition).

to flood plain areas. This deficiency can be rectified in that subsequent modification may be made in technical provisions by municipal or local units of government adopting one of the model codes.

There are some regulatory provisions in the three model codes adopted by Michigan communities which have some relevance to flood plain areas. The Basic Building Code has provisions for assuring that foundations and frames are weather tight and water proofed. Further, performance standards are also included which deal with securing the building from hydrostatic uplift and withstanding hydrostatic pressures on lateral walls.[1] The 1967 National Building Code has performance standards dealing with waterproofing foundation walls.[2] But, these do not specifically treat flood proofing measures or standards for buildings which locate in flood plains.

The need for special building code provisions in flood plains may not be so great in those communities which have stringent flood plain land use regulations, i.e., floodway encroachment regulations, subdivision regulations, and flood plain zoning. This stems from the fact that the effect of many of the special flood plain regulatory provisions adopted by Michigan communities prevent the building of structures in the defined flood plain. This was demonstrated in the previous sections. The City of Lansing and Meridian Charter Township demonstrate communities with somewhat more flexible flood plain land use regulations. Accordingly, some building code type provisions are included in their flood plain zoning provisions.[3] However, as noted, the provisions are rather limited

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[1] Basic Building Code, 1970 edition, Section 874.0 and 710.0, 710.1, and 710.3, respectively.

[2] National Building Code, 1967, Section 907.3.

[3] City of Lansing, Ordinance No. 161, Section 36-63. Meridian Charter Township, Zoning Ordinance No. 30, Section 4.14.5.

in scope. As a result they do not fulfill the needs of comprehensive flood plain building regulations.

The building code for the City of Lansing was consulted for possible flood plain code regulations. However, it was found that the Uniform Building Code was adopted and updated by reference. As a result, the 1970 edition was the current model code in force in the City. It was found that the few technical adjustments adopted by the City had no bearing upon flood plain management considerations.[1] Therefore, the building code provisions found in the zoning ordinance are effectively the only building regulations developed specifically with the flood plain in mind.

Subscriptive Regulations

Warning Signs

The appropriateness of warning signs as a flood loss management device is not clear. The lack of discussion in the literature and the absence of known examples of application in Michigan present problems in evaluating the technique.[2] Several potential applications of warning signs in publicly owned flood plain areas would seem justifiable. For example, placement of flood warning signs in public open space, parks, and right of ways located in flood plains would seem to hold potential for

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[1] City of Lansing, Lansing Uniform Building Code, Chapter 9, Sections 9-1, et. al., Adopted February 24, 1971. Note: This finding is in keeping with Murphy's 1958 findings. Communities irrespective, of whether they use a model code as a basis for their code development, were found to neglect flood problems. Murphy, Regulatory Flood Plain Development, 1958, p. 98.

[2] Murphy presents the only in depth examination of the technique. His findings are the basis for the assessment and ambivalent conclusion in this study. See Murphy, Regulating Flood Plain Development, 1958, p. 123.

alerting residents and visitors as to possible flood hazards. As such they would or could perform an education function.

The use and application of warning signs would seem to be especially available at the local level. However, the nature of the required authority, if any, to institute a flood warning sign program was not determined. Equally, experiences with flood warning signs in Michigan are not documented nor readily apparent.

Building Finance

As suggested earlier in Chapter III, the ability to control and influence building finance in the flood plain poses significant opportunities for directing development in Michigan flood plains. The potential for encouraging wise use and causing adjustments in design plans to reflect the degree of flood risk is possibly greatest under this technique. The timing of building finance and the leverage often associated with its denial and conferal contributes to its appropriateness as a policy and management technique.

Authority for including flood risk in credit review provisions by Federal agencies has been established. In contrast, policies of private banking and loan institutions at the local level in Michigan were not adequately documented. The latter is largely a reflection of limitations imposed due to time and budget constraints. However, some findings provided by Murphy in his national study may provide some relevant comment on what might still be expected in Michigan today. Banking and loan institutions were found to grant a loan in the absence of public guidelines if a period of 10 to 15 years could reasonably be expected to pass without damaging floods.[1] The existence and continuation of such policies at the

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[1] Murphy, Regulating Flood Plain Development, 1958, pp. 122-123.

local level in Michigan should still be documented before any final conclusions are drawn.

At the Federal level the Task Force Report on Federal Flood Control Policy indicated the Federal Housing Administration, the Veterans Administration, and the Farmers Home Administration all exerted influence in flood plain settlement through their respective areas of involvement with reference to financing of home developments. The Federal Housing Administration is cited as including flood hazard in their review of applications for mortgage insurance. The Veterans Administration ". . . is less searching in its review of applications for mortgage guarantees." While "the Farmers Home Administration expects its appraisers will consider floods along with other hazards."[1]

A recent executive order, prompted by the Presidential Task Force Report on Federal Flood Control Policy findings and recommendations, is causing adjustments in these financial institutions policies. Section I (2) of Executive Order 11296 states:

> All executive agencies responsible for the administration of Federal grant, loan, or mortgage insurance programs involving the construction of buildings, structures, roads, or other facilities shall evaluate flood hazards in connection with such facilities and, in order to minimize exposure of facilities to potential flood damage and the need for future Federal expenditures for flood protection and flood disaster relief, shall, as far as practicable, preclude the uneconomic, hazardous, or unnecessary use of flood plains in such connection.[2]

As the Executive Order is implemented such that it is in keeping with the intent of the document (Task Force Report) causing its promulgation, the resulting Federal leadership and policy adjustment will tend to preclude new,

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[1]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 27.

[2]U.S., President, Executive Order 11296, Federal Registrar, Vol. 31, No. 155, August 11, 1966, pp. 10663 and 10664.

uneconomical development on flood plain lands. Through conversations with field offices of the Federal Housing Administration and Farmers Home Administration a check was made on the Task Force Report findings and any subsequent developments arising from the issuance of Executive Order 11296. Basically the findings of the Task Force seem to still apply.

Federal Housing Administration

The Secretary of the Department of Housing and Urban Development issued a Secretarial Order so as to bring about Departmental implementation of Executive Order 11296.[1] The Secretary's Order states that in the administration of Departmental grant, loan, or mortgage insurance programs the administering offices are:

> . . .to take whatever action may be necessary to minimize the exposure of such buildings, structures or facilities to potential flood damage and, to the extent practicable, to preclude uneconomic, hazardous or unnecessary use of flood plains.[2]

Any project involving federal assistance that may be in the flood plain is to be questioned as to its economic justification in light of the flood risk. Engineering review of physiographic conditions, design criteria, and appropriateness of use to the natural environment is provided. Further, coordination with other Federal and State agencies which are involved in flood studies or work is suggested when information is lacking.

In discussions with a Federal Housing Administration official whose jurisdiction includes ten states with thirteen insuring offices that

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[1]U.S., Department of Housing and Urban Development, Secretary's Order No. 25, May 10, 1967, xerox copy furnished by Maurice Rapkin, Federal Housing Administration, Detroit, Michigan, February 17, 1969.

[2]*Ibid.*

include the Michigan area, it was learned that flood hazard had been a consideration in approving F.H.A. insured mortgages prior to the order. Active coordination with State and Federal Agencies had been going on prior to the issuance of Executive Order 11296. This in large part, might be attributed to Mr. Rapkin's intimate knowledge of the Corps of Engineers flood management program and understanding of engineering and hydrologic concepts. In response to a question, he indicated that there were few formal policy directives and program guides that dealt specifically with flood hazard considerations in reviewing F.H.A. mortgage applications. It appears that Executive Order 11296 and Secretarial Order No. 25 may have corrected this by stating more explicitly that flood hazards shall be a consideration in approving applications under H.U.D. assistance programs. This should facilitate the development of more uniformity and consistency in agency review procedures.[1]

Nevertheless, a great deal of informal regulative review is still present. This results from the reliance of loan officials upon being alerted to the fact that an application for a F.H.A. insured mortgage involves a development lying in the flood plain. In turn, this informational function is dependent upon field staff involved in site analysis and their ability to identify flood risk through their field inspection.

In reviewing F.H.A. mortgage applications the Federal Housing Administration will usually utilize Corps of Engineers criteria in reviewing the applications. This usually means that a 100 year frequency flood will be utilized as the determinant in the defining of the flood plain. In cases like Michigan, where the State or municipality has adopted

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[1]Maurice Rapkin, Zone Site Engineering Advisor, Federal Housing Administration, Personal Interview, Detroit, Mich., February 17, 1969.

a lesser frequency flood; it is indicated that the F.H.A. officials will come to an agreement with the State or local authorities as to the criteria which shall be utilized.[1]

It might be noted that the effectiveness of the program is significantly limited by the fact that only about 5 per cent of the new residential construction starts are insured by F.H.A. mortgages. A countering influence, is the counseling or advisory service provided by the F.H.A. to prospective subdivision developers. Where flood plain hazards are such that they will not meet F.H.A. requirements, the F.H.A. officials will inform the developer that his proposed subdivision development will not be qualified for F.H.A. insured loans. Advice and counsel will be given as to the necessary revisions in design and corrections in development which will qualify those areas found to be unacceptable by F.H.A. for residential development and occupancy. As noted earlier in the section on subdivision control, this constitutes a fourth avenue of subdivision control in Michigan.

Farmers Home Administration

The Farmers Home Administration was also contacted to review the findings of the President's Task Force on Flood Control Policy. A discussion with Farmers Home Administration officials involved in farm credit programs in Michigan substantiated the findings of the Presidential Task Force Report.[2] The Farmers Home Administration anticipates that the field personnel will evaluate flood risk when counseling credit applicants.

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[1]Rapkin, Personal Interview, February 17, 1969.

[2]Robert Abbott, Real Estate Loan Officer, Farmers Home Administration, United States Department of Agriculture, Personal Interview, E. Lansing, Michigan, February 24, 1969.

Formal directives with respect to evaluating flood hazard have not been issued in the past. Accordingly, much reliance is placed upon field personnel in evaluating flood risk during early reviews of credit applications.

Taxation

Taxation policies have been identified as having potential incentive effects upon flood plain occupance. Accordingly suggestions have been made in the flood loss management literature which pertain to adjusting and reforming tax policies. Authority for tax reform accompanies those levels of government vested with the powers to tax. At the national level, the federal income tax is singled out. At state and local levels, the property tax is identified as the appropriate tax measure needing reform.

At the federal level, the Task Force in Federal Flood Control Policy made general recommendations concerning federal income tax policies. At present, there are provisions for deducting flood losses in computing federal income tax liability. However, there is no limitation as to the number of times a flood plain property may qualify for flood loss deductions. The Task Force recommended that the Treasury Department should prepare legislation which would (1) provide limits in the number of times a property could qualify for a flood loss deduction, (2) create incentives for the relocation of obsolete and hazardously located property, and (3) create incentives for adopting flood proofing measures.[1]

The significance of such recommendations in terms of Michigan flood loss experiences was not studied. Further detailed inquiry might

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[1]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 31.

be justified at the national and state level in terms of Treasury Department tax policies and their influence upon decisions of flood plain occupants to continue in the flood plain. Inquiry might be made as to the existence of detailed proposals for and/or feasibility studies of income tax reform which would have direct applicability to flood loss management objectives. For example, have limits been worked out which would implement previous recommendations relating to limiting the number of times a business or commercial establishment could qualify for flood loss income tax writeoffs?[1]

Adjustments in property taxation policies at the state and local level have been mentioned in flood plain literature as a means of aiding flood plain management objectives. At the same time it is not well treated in the literature in terms of flood plain management objectives. In light of these limitations and those outlined in Chapter III, little can be concluded about its appropriateness for flood plain management in Michigan. No field investigation was undertaken to review property tax policies at the state and local level in Michigan. Further research is justified in this policy area in Michigan if only to establish property tax policies where restrictive land use controls are applied to flood plain tracts. Initial inquiry might start with property tax assessment procedures where flood plain zoning and subdivision regulations are administered. For example, do property tax assessment practices reflect restrictively regulated flood plain land use zones? Is the assessed value of land diminished or adjusted downward as a reflection of the limited development potentials of the flood plain site?

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[1]U.S., Task Force Report on Federal Flood Control Policy, House Doc. 465, 1966, Recommendation 7c, p. 31.

Acquisition

Public acquisition of partial or exclusive interests in portions of flood plains in Michigan appear to be highly attractive as a means of preventing further increases in flood hazard potential. The appropriateness of integrating acquisition programs for such purposes as recreation and open space with flood plain regulatory activities is becoming increasingly apparent at the Federal, State and local level. A recreational land acquisition program can be an important adjunct to flood plain zoning and subdivision regulation. Lands can be purchased within presently developed flood plain areas. This action can relieve potential pressures placed upon local government officials to allow variance or exceptions to restrictively regulated flood plains. The program at the same time allows the possibility of purchasing areas within developed areas that tend to be good recreational locations due to their riverine setting.

Various authorities and policies exist at the Federal level which pertain to acquisition of flood plains. Both the Department of Interior and the Department of Housing and Urban Development have financial assistance programs for recreational and open space land acquisition.[1] Specific provisions are included in the programs for encouraging acquisition of flood plains. An additional complementary policy to federal acquisition programs which have immediate application to flood plain lands exists in an executive directive relating to federal land disposal policies in flood plain areas.[2]

The Bureau of Outdoor Recreation in the Department of Interior administers the Land and Water Conservation Fund Act of 1965. The program

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[1] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 29-30.

[2] U.S., President, Executive Order 11296, August 11, 1966.

was established to encourage state comprehensive outdoor recreation planning and provide financial assistance for land acquisition and development. Accordingly, a prerequisite to receiving Federal financial assistance for land acquisition is the adoption of a state outdoor recreation plan. Policy provisions for planning and for acquiring flood plain tracts are incorporated as a part of the guidelines and program recommendations adopted by the Bureau.[1]

The 1966 Bureau of Outdoor Recreation Manual included flood plains in its listing of types of area receiving matching Federal funds for the acquisition of land to provide public outdoor recreation.[2] This specification may be coupled with more fundamental program objectives which attach prime importance "to projects in areas where concentrations of people live."[3] Accordingly, urban flood plain areas may qualify or receive more program emphasis in terms of coupling flood plains acquisition with recreational program fulfillment.

The guidelines in acquisition programs also illustrates the increasing reassessment and adaptation of various Federal programs in light of a broader Federal effort in developing a comprehensive flood management program. This is reflected in the Bureau's recommendation,

> Flood-plain zoning should be used whenever possible as a method to preserve attractive reaches of river and streams for public recreation in addition to the other benefits from such zoning.[4]

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[1] U.S., Department of Interior, Bureau of Outdoor Recreation, Outdoor Recreation Grants-in-Aid Manual-Outdoor Recreation-Land and Water Conservation Fund for America (Washington, D.C.: Government Printing Office, as revised June 2, 1966).

[2] Ibid., Section 640.2.1.

[3] Catalogue of Federal Assistance Programs (Washington, D.C.: Office of Economic Opportunity, Executive Office of the President, June 1, 1967), pp. vii and 701.

[4] U.S., Bureau of Outdoor Recreation, Manual, June 2, 1966, Section

The quotation and citation is included in part to illustrate Federal efforts to encourage broad flood plain management strategies. It is also offered to illustrate the potential for fundamental policy conflicts and misuse of land use regulations. This will be probed in more detail in the subsequent chapter. However, a conflict is visible here between the careful development of and use of the police powers and the more liberal application of police powers in securing a public use without bearing the costs.[1] In this instance, the costs of flood plain acquisition are avoided.

Acquisition of flood plain lands is also supported under the Housing Act of 1961 as amended in 1965. Communities must have comprehensive planning programs in which acquisition of open space is related to the master plan. Department policies do allow for incorporating flood plain management considerations. A Task Force Report on Federal Flood Control Policies indicated that the Department of Housing and Urban Development

> . . .in its planning agency letters and other information concerning open space acquisition, and in its research on acquisition programs, is calling attention to opportunities for flood plain acquisition.[2]

The application of this program is available for local, metropolitan, and regional planning and/or governmental units.

A second land acquisition program is also housed in the Housing and Urban Development Department. The Urban Renewal Program is administered in H.U.D. Its development and application will be deferred until

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(630.2.6E). The same policy is reflected in U.S., S. Doc. No. 97, 1962, p. 6.

[1]This can be seen by contrasting the views of William H. Whyte with the recommendations of the Bureau of Outdoor Recreation manual. Compare footnote number 4, p. 66, **supra.**

[2]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 29.

a later section on Evacuation and Relocation.

Policies and programs for flood plain acquisition are present at the state level. The Michigan Outdoor Recreation Plan lists two specific goals of relevance to flood plain management

> a. Take immediate action at the state and local levels to acquire obviously needed open space, inland and Great Lakes water frontage, flood plains and wetlands.
>
> b. Encourage watershed planning and zoning of flood plains for recreation use.[1]

The parallels in state and national policy are striking within this specialized area of acquiring recreation land in flood plains. This may be attributed in part to the fact that the Michigan plan was financed in part through Federal grants from the Urban Renewal Administration in the Department of Housing and Urban Development and from the Bureau of Outdoor Recreation in the Department of Interior.[2] Accordingly, federal program guidelines as outlined earlier appear to be reflected in policy development at the state level.

Limited information and experiences at the state level were obtained in terms of program implementation. Consequently, little can be related in this study regarding examples of flood plain land acquisition at the state level.

Limitations in time and budget prevented extensive field inquiry into local programs of flood plain acquisition in Michigan. However, some information was obtained on the recreation land acquisition program in the City of Lansing. The City has had a long and significant history, in

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[1]State of Michigan, Department of Conservation, Recreation Resource Planning Division, Michigans Outdoor Recreation Plan, Loose Leaf Bound, Subject Section: "Goals-A New Section In The Plan," March 1, 1967.

[2]State of Michigan, Department of Conservation, Recreation Resource Planning Division, Michigan's Recreation Future: A Current Statement From Michigan's Continuing Outdoor Recreation Plan (Lansing; Department of Conservation, September, 1966), pp. 2 and 17.

flood plain land acquisition and dedication for park and open space purposes. The early history is marked by generous benefactors making personal contributions of land or money. The more recent period appears to be marked by federal financial assistance in the form of grants under the Open Space Grant and Urban Renewal programs of the Housing and Urban Development. As of 1968, about one third of the parkland owned by the City of Lansing was situated in the flood plains of Sycamore Creek, Red Cedar River, and Grand River.[1]

Several forms of flood plain park acquisitions appear to be represented. The first part, Moores Park was obtained through the personal contribution of J. Henry Moore in 1908. The park land is located in the Grand River flood plain. Francis Park, also in the Grand River flood plain, was later obtained upon Mr. Moore's death. Gifts from his estate included Francis Park, Moores River Drive, monies for park development, and an on going trust fund for Francis Park development. Other later benefactors contributed to flood plain park land acquisition in similar ways to those of Mr. Moore. Additional flood plain park land has also been purchased from revenues generated by the operation of private and public golf courses. For example, the Red Cedar Golf Course and other open space lands were purchased in 1926 along the Red Cedar River through revenues generated by the Groesbeck Municipal Golf Course.[2]

The conditions attached to the private donations of flood plain park land were not noted in the file information. However, some evidence suggests that the gifts to the City may have included the conferral of

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[1] City of Lansing, Planning Department, Flood Plain Information Files provided by Mr. James Church, Planning Department, Personal Interview, Lansing City Hall, October 2, 1968.

[2] *Ibid.*

fee simple title or relatively unencumbered titles. This is suggested by the subsequent disposition of some park land without any apparent problems with reverter clauses and encumberances.

Currently, the City of Lansing is attempting to obtain additional flood plain areas. Recent city plans call for use of public funds in acquiring additional flood plain tracts.[1] In 1968, a $238,708 grant was awarded by the Department of Housing and Urban Development under its Open Space Program for the purchase of sections of Red Cedar flood plain lying beween Potter-Sycamore Parks and Fenner Aboretum. This acquisition was to consolidate public holdings in the area in anticipation of the development of a regional park.[2] In addition, City of Lansing Urban Renewal Projects numbers one and two were cited as including plans for open space and vistas lying along the Grand River down river from the E. Michigan Street Bridge.

Flood Insurance

Flood Insurance would appear to be an appropriate measure for redistributing flood losses in Michigan. It also holds potential for developing inducements for municipal areas with flood hazards to enact flood plain regulatory measures. However, information on such applications to Michigan flood plain areas is not easy to document. Some feasibility study work appears to have been conducted by the U.S. Corps of Engineers

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[1] Ibid. Note: File information indicated recent support for open space and recreational use of flood plains was recommended in

a. Lansing Urban Design Study of the Mid-Michigan Chapter of the American Institute of Architects;
b. Central City Development Plan of 1966;
c. Recommendations of the Mayor's Riverwalk Committee; and the
d. City of Lansing Master Plan, 1958.

[2] Ibid. Also see Lansing Planning Board, Red Cedar Basin Park Proposal (Lansing: Lansing Planning Board, July, 1966).

in the Grandville, Michigan area.[1] However, access to this information had not been achieved at the time of this writing.[2] Additional study work and references concerning applications or studies of flood insurance in Michigan were not uncovered.

In terms of existing flood insurances programs a federal flood insurance program was first authorized in 1956.[3] The program as then authorized never was implemented. The Congress withheld approval of appropriations when a satisfactory, implementation program was not developed.[4] Nearly a decade later, a study authorized by Congress and conducted by the Secretary of Housing and Urban Development indicated a workable program was thought to be now possible. Shortly thereafter, a draft of the National Flood Insurance Act was developed by H.U.D., introduced in Congress, and enacted on August 1, 1968.[5,6] The program is still in a developmental and trial stage. As of March, 1969 flood insurance policies were being test marketed in six communities; none of

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[1] U.S., Congress, Senate, Committee on Banking and Currency, Insurance and Other Programs For Financial Assistance to Flood Victims, A report from the Secretary of the Department of Housing and Urban Development to the President, Committee Print, 89th Cong., 2d sess. (Washington, D.C.: Government Printing Office, September, 1966), pp. 62, 68-69, 72-73.

[2] Ibid., Appendix C, "Flood Damage Risk By Location and Type of Property: Grandville, Michigan." Note: The Table of Contents for each of the ten appendices was included in the above cited report; however, it appears that the appendices themselves were given a much more restricted distribution then the main report, thus creating the problem of access to the information.

[3] Federal Flood Insurance Act of 1956, Public Law 84-1016, August 7, 1956, 70 Stat. 1078.

[4] U.S., Congress, House, Final Report on the Federal Flood Indemnity Administration, House Doc. No. 426, 85th Cong., 2d sess, July 28, 1958.

[5] U.S., Senate Committee on Banking and Commerce, Insurance and Other Programs For Financial Assistance to Flood Victims, 1966.

[6] Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, Public Law 90-448, August 1, 1968, 82 Stat. 572.

which were in Michigan.[1]

The National Flood Insurance program, as currently enacted, allows for a subsidized private-public flood insurance program. It allows for subsidized flood insurance premiums, full cost actuarial risk premiums, a federal reinsurance program, sanctions related to local land use controls, limitations on extension of flood insurance, and other controls related to securing a sound flood insurance program.[2]

The development of any flood insurance program is centered around the methods available for estimating flood risk premium rates. As noted earlier in Chapter III, there have been a number of methods proposed. The hydrologic or flood risk zone method was selected for the 1968 National Flood Insurance Program. The chief justification for such a selection results from the advantage of drawing upon existing data and technical methods used by existing agencies involved in flood loss management. This and other factors suggested such a method would offer sufficient discrimination in establishing premium risks while assuring relative ease of program implementation and administration. Chief limitations in this method relate to the limited number of flood zones identified, the reliability of hydrologic data, and the methods for extrapolating and projecting flood frequency and flood damages. The latter two limitations are inherent in any risk method selected. The first limitation is associated with questions of ease of implementation and administrative cost.[3]

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[1]Kunreuther and Shaeffer, "Economically Meaningful Flood Insurance Rates," 1970, p. 659.

[2]Housing and Urban Development Act of 1968, 82 Stat. 572; 44 U.S.C. 4013, 4014, 4015; 4017, 1055; 4001, 4101, 4102; 4013, 4021; and 4018, 4052, 4055, 4081, 4123, 4125, 4127.

[3]U.S., Senate, Committee on Banking and Currency, Insurance and Other Programs for Financial Assistance To Flood Victims, September 1966, pp. 50-59.

In Michigan a preliminary investigation of the hydrologic risk method as a basis of establishing premium rates was conducted by the Corps of Engineers in the Grandville, Michigan area. The Grandville study was actually part of a national study effort which evaluated the hydrologic risk method as a feasible approach. Little additional information was obtained on this particular study.[1]

Subsidized chargeable premium rates are authorized under the 1968 National Flood Insurance Program. This is to enhance and assure the marketability of flood insurance policies. The extent to which estimated risk premiums may be subsidized is to be determined by the Secretary of H.U.D. in light of marketing conditions.[2]

A reinsurance program is also provided to prevent failure of the flood insurance pool in times of catastrophic losses. This is to insure that the flood insurance program does not become bankrupt. The reinsurance fund is secured in part by reinsurance premium payments paid by the insurance companies marketing flood insurance policies. In addition, Congressional appropriations and borrowings against the Treasury can be utilized in further securing the reinsurance fund when necessary.[3]

Several restrictions are imposed upon the National Flood Insurance Program. Maximum policy limits are prescribed for the various general classes of structures, i.e., residential business and other properties which may eventually qualify for the program.[4] The ceilings on aggragate

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[1] Ibid., Appendix C, "Flood Damage Risk By Location and Type of Property: Grandville, Michigan." Note: Appendix C was not available due to limited printing and distribution.

[2] Housing and Urban Development Act of 1968, 82 Stat. 576, 577; 42 U.S.C.A. 4014.

[3] Ibid, 82 Stat. 577, 578; 583, 584; 42 U.S.C.A. 4051, 4055.

[4] Ibid, 82 Stat. 575, 576; 42 U.S.C.A. 4013.

liability per structure and contents have the effect of directing the program focus to small business operators, single family residences, or small multiple residential units. In effect, a policy of providing flood insurance to the small operator is established by adopting such program restrictions.

A second set of restrictions is established to limit the availability of flood insurance to those areas having strong flood plain land use control measures. Restrictions such as these are the principal justification and means of including flood insurance under the predevelopment classification of flood loss management devices. Additional applications to the predevelopment management setting can be established through credit lending programs. In the case of the latter, extensions and provisions of credit might be constrained or integrated with conditions requiring the availability of flood insurance.

In terms of National Flood Insurance, the Secretary of H.U.D. is authorized to establish criteria and guidelines which will encourage the adoption of state and local flood plain land use controls.[1] Under the 1968 Act, no new flood insurance coverage could be extended to any area not having effective flood plain land use control measures after June 30 1970. The date was extended to December 31, 1971 by a latter amending act.[2]

The effect of the land use control provisions would be substantial in terms of Michigan, if and when National Flood Insurance became available in the state. The provisions for flood plain management in the state Subdivision Control Act of 1967 and Act No. 167 of 1968 would appear to qualify the state for application of National Flood Insurance. At the

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[1] *Ibid.*, 82 Stat. 580; 42 U.S.C.A. 4101, 4102.

[2] Public Law 91-152, December 24, 1969, 83 Stat. 397; 42 U.S.C.A. 4012, 4022, 4102.

local level, the existence of flood plain zoning might be the essential land use control measure needed to qualify the local area for national flood insurance. The above is conjecture in the absence of recorded attempts by local areas in applying for flood insurance in Michigan. However, provisions in the Federal Act suggest that the above state and local land use control programs would be of an essential nature, and possibly a sufficient nature, to qualify local areas for National Flood Insurance.

In summary, flood insurance may become a significant flood loss management device in Michigan. Little experience with the program has been reported in this state. However, the National Flood Insurance Program enacted allows for significant sanctions and devices for encouraging the adoption of flood loss management devices as well as implementation of several such techniques at the state and local level. Accordingly, Michigan communities would be affected by such provisions when and if they sought coverage by the National Flood Insurance Program.

Postdevelopment Policies For Directing Land Use

Compulsory Regulations

As noted in Chapter III, many of the techniques developed under the predevelopment policy section have application in existing developed areas as well. Principle discussion of a technique under the predevelopment section reflects a greater contribution to flood loss management in a period of pre-land use development. Extended discussion of a technique in a postdevelopment context indicates that additional effectiveness in securing flood loss reduction can be obtained in developed areas as well.

It was suggested in the preceeding chapter that extensions of floodway encroachment regulations, flood plain zoning, and building code regulations can be applied to existing developed areas. In general,

such applications rely upon non-conforming use provisions which (1) may allow removal of hazardous structures or (2) establish stringent controls over extension, alteration, or reconstruction of existing non-conforming uses. Application of the first provision, may be appropriate in terms of floodway encroachment regulations. In contrast, controls over redevelopment, alteration, or extension of existing land uses are more appropriately considered under flood plain zoning and building code regulations. The distinction between removal policies and regulative policies results from the greater inherent dangers associated with nonconforming land uses lying in a floodway. It is in this area of the flood plain that existing structures can be identified as posing substantial dangers to other flood plain occupants. Accordingly, more stringent and forceful measures are justified.[1]

Identification and review of examples in Michigan of application of these nonconforming use strategies was not successfully achieved within this study.[2] It was concluded that extensive field work would be required to explore this aspect of land use control. As noted before, budget and time constraints imposed limitations on field work in this study. Consequently, research on applications of non-conforming use controls in Michigan flood plain areas will have to be deferred to subsequent study efforts.

An initial point of inquiry into applications of non-conforming use strategies might be a thorough review of non-conforming provisions in

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[1]Dunham, Flood Control Via the Police Power, 1959, pp. 1110-1111; see especially footnotes 35 and 40.

[2]Note: nonconforming use enforcement provisions in floodway encroachment regulations were found in seven states. These will be critically reviewed in Chapter V, Floodway Encroachment Section.

comprehensive building codes and zoning ordinances. Little information was contained on non-conforming use provisions in flood plain zoning ordinances as outlined earlier in this chapter. Such provisions need to be reviewed in the broader context of the parent or comprehensive building code or zoning ordinance. Specific application to flood plain settings could subsequently be reviewed in the field. A testable hypothesis would be that little use is being made of nonconforming use strageties in terms of floodway encroachment regulations, flood plain zoning, or building code enforcement in Michigan flood plains.

Subscriptive

Many of the voluntary or subscriptive land use management techniques, which are available for guiding land use prior to structural development are also available for postdevelopment settings. Taxation, acquisition, building finance and insurance programs all have potential applications in the postdevelopment flood plain setting. Additional techniques which have particular relevance to the postdevelopment setting include engineering works of protection, flood proofing, and evacuation.

The evaluation of many of these management techniques was limited or substantially deferred in this study. In most instances, the technique in question posed substantial problems in terms of field evaluation. For example, specific applications of acquisition programs, building finance policies, insurance programs, and flood proofing programs were either difficult to document in a comprehensive manner or else required extensive field surveys which would exceed budget and time requirements. Several of these areas would merit specific and isolated inquiry; e.g., acquisition programs, building finance, and flood proofing. Limited observations where appropriate, will be offered as to known applications or potential applications in Michigan.

Engineering Works for Flood Protection and Control

The employment of engineering works for flood protection and control has been well developed on a national scale. Various applications of the different control devices or measures can be seen in Michigan. The following discussions will (1) briefly relate the appropriateness of each of the measures, (2) present Federal and State authorities for undertaking flood protection and control measures, and (3) indicate the extent of application of these measures and present examples where possible.

Appropriateness of Techniques

Detention and Storage Measures. -- The practice of detaining and storing flood waters in reservoir structures is frequently employed as a flood loss management technique in the United States. At the same time, the technique has not been highly appropriate, nor readily adopted in the State of Michigan. Potential flood control reservoir sites in Michigan are (1) not prevalent, (2) nor usually located so as to be available for protecting downstream flood hazard areas, (3) and when present are frequently of too small a storage capacity potential to be of significant importance in reducing downstream flooding.[1]

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[1]Gerald E. Eddy, Director of Conservation, and Chairman, Water Resources Commission, State of Michigan, "Basic Problems of Water Management in Michigan," in Proceedings of the Ninth Midwestern States Flood Control Conference (E. Lansing,: Michigan Water Resources Commission, 1954), p. 17.

Otto H. Hall, Engineering and Architecture Section, Michigan Department of Conservation, "Some Engineering Aspects of Headwater Storage," in Proceedings of the Ninth Midwestern States Flood Control Conference, 1954, pp. 96-100.

Paul A. Herbert, Head, Conservation Division, Michigan State College, "Land Management as a Factor in Michigan Water Conservation," in Proceeding of the Ninth Midwestern States Flood Control Conference, 1954, pp. 79-82.

A.C. Nauman, Colonel, District Engineer, Detroit District, Corps of Engineers, "Flood Control in the Detroit District," in Proceedings of the Ninth Midwestern States Flood Control Conference, 1954, pp. 25-27.

Watershed Protection and Flood Prevention. -- A second approach to detention and storage of flood waters has been developed for upstream land areas. The approach involves the concept of controlling watershed runoff through management of land use coupled with small floodwater retarding structures. Such an approach has application and is appropriate for Michigan watershed management needs. Some question may exist as to the amount of flood prevention benefit obtained from such an approach. Nevertheless, a number of watershed protection and flood prevention projects have been initiated in Michigan utilizing flood protection as a basis of justification.

Channel Modification and Channel Diversions. -- Practices other than those related to storage and detention have also been developed. Techniques of channel modification and diversion are often instituted where the objective is to increase flood channel capacity and efficiency in carrying flood flows as opposed to detaining or storing flood waters.

Techniques for improving and adjusting floodway and stream channel capacities are often practiced in Michigan where physical regulation of flood flows is attempted. Their appropriateness may be attributed to the general character of Michigan streams. Slow, meandering, watercourses with weakly developed channel banks suggest the opportunity and need for channel modification in regulating flood water flows. This is especially true in urban areas, where the high costs of channel alteration and/or improvement might be favorably compared to the benefits of protecting high valued urban land areas.

General Authority

Statutory authority exists for pursuing engineering works for flood protection and control at the Federal level and within the State of Michigan.

Federal and Michigan statutes include both comprehensive and special purpose enabling acts for pursuing engineering works of flood protection and control. Upon evaluating the comprehensive enabling acts, it is evident that there is a general statutory distinction drawn in terms of program operations. This is especially evident at the Federal level when viewed in terms of the program activities of the Corps of Engineers and the Department of Agriculture. The Federal distinction is subsequently carried on through to the state level as evident in Michigan statutes.

As a result the following discussions will be separated into two divisions. The first division will treat the Federal and State authorities used in developing flood regulation reservoirs, channel improvements, and channel modification programs. The second division will give special treatment to the complementary watershed protection and flood prevention program. As a result, the discussion of detention and storage techniques is being divided into two separate program treatments; i.e., control reservoirs and watershed protection.

Reservoirs, Channel Improvements, and Channel Modification. -- Considerable authority exists at the Federal level for undertaking engineering works for flood protection and control. Federal responsibilities under these authorities are delegated to a number of Federal agencies. In the Great Lakes Region, such responsibilities are shared principally between the Corps of Engineers of the U.S. Army and the Department of Agriculture. Elsewhere, additional regional authorities exist, such as the Tennessee Valley Authority and the Bureau of Reclamation, which have authority or share responsibilities in terms of constructing structures for flood water protection and control. Further discussion of the two regional authorities will not be developed in this study as they are developed under separate legislation which is not applicable to Michigan

flood management needs.

General treatment of flood control structures under the program administered by the Department of Agriculture will be deferred to the section on watershed protection. At such time it will be shown that the Department of Agriculture does have authority for construction of similar engineering works for flood flow regulation in upstream reaches of watersheds. However, the program focus is viewed as being distinct in terms of real application. The Corps of Engineers program is often referred to as a downstream, mainstream, or main branch program. In contrast, the Department of Agriculture is responsible for upland and upstream watershed protection. The Corps of Engineers of the U.S. Army, as provided in Flood Control Acts of 1936 and 1944, is authorized to make improvements in rivers and other waterways for the purpose of securing flood control.[1,2] This has traditionally involved construction of dams, levees, and other retaining structures as well as modification of stream channels in terms of increasing their capacity to carry flood flows. The latter includes dredging to deepen, widen, and straghten river channels so as to increase their capacity to carry flood flows. In addition, bypass channels, conduits, and other methods of transporting water flows are utilized by the Corps of Engineers to divert flood flows or portions of them from areas desiring protection.

Procedures for authorizing a flood protection project are set forth under a series of Flood Control Acts.[3] Procedures set up in the act allow for local, state, Federal, and Congressional participation in initiating

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[1] Flood Control Act of June 22, 1936, 49 Stat. 1570, 33 U.S.C.A. 701b.

[2] Flood Control Act of December 22, 1944, 58 Stat. 887; 33 U.S.C.A. 701-1.

[3] Ibid. Illustrations of these can be found in Water Resources Development in Michigan - 1967, pp. i-vii.

project studies and subsequent review of study reports. In addition, the Corps has an elaborate internal review procedure, wherein, studies by the District Engineer are reviewed by the Division Engineer, the Board of Engineers for Rivers and Harbors, and the Chief of Engineers. The reports are transmitted to Congress along with the views of affected local and State interests, other appropriate Federal agencies, and the Bureau of the Budget. Subsequent Congressional authorization and appropriations were required to implement the Corps project responsibilities. Notwithstanding Congressional approval, actual project construction or Federal participation can not be undertaken until local interests are able to privide assurances that local participation requirements can be fulfilled.

Local participation requirements involve the so called "a,b,c, requirements" of the 1936 Flood Control Act as amended.[1] These requirements involve securing project rights of way, maintaining completed projects, and holding and saving the Federal Government free from damages due to project construction or operation. These restrictions are relaxed in certain situations, e.g., major reservoir developments, in interstate projects, and when land acquisition costs exceed project construction costs. In contrast, if channel improvement projects are involved, the restrictions are increased by requiring that local interests shall ". . . furnish assurances satisfactory to the Secretary of the Army that the required cooperation will be furnished" within five years of notification of such local requirements.[2]

Several other Federal authorities establish special flood control programs which supplement or extend Federal involvements in regulating

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[1] Flood Control Act of June 22, 1936, 49 Stat. 1571; 33 U.S.C.A. 701c.

[2] Flood Control Act of August 13, 1968, 82 Stat. 739, 33 U.S.C.A. 701c.

flood waters and preventing flood losses. A significant program in terms of Michigan experiences has been the Small Flood Control Project program. These projects are distinct from large projects which have to receive Congressional authorization before they may be executed. Section 205 of the June 30, 1948 Flood Control Act, as amended, grants the Secretary of the Army discretionary authority in terms of authorizing construction of small flood control projects of not more than one million dollars each.[1] Program limitations are present. The aggregate amount spent under this program may not exceed 25 million dollars in any one fiscal year. Additional limitations prohibit construction of small projects in areas to be protected by authorized projects. In addition, small projects are to be subjected to general flood control policy with respect to non-Federal obligations (the so called a,b,c, requirements) and benefit-cost analyses. Finally, such projects must afford the necessary flood protection without further need for additional or supplementary flood protection projects.

Additional complementary program authorizations allow the Corps of Engineers to undertake snagging and clearing operations. This is a form of channel modification or improvement. Section 2 of the August 28, 1937 Flood Control Act, as amended, allows up to 100,000 dollars per individual tributary to be expended for clearing operations which eliminate flood impediments as snags and other debris.[2] As in the Small Flood Control Project program this is a discretionary authority granted to the Secretary of the Army. An overall program limitation is established, however, of two million dollars per fiscal year.

A second minor program authority is found in Section 5 of the Flood

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[1] Flood Control Act of June 30, 1948 62 Stat. 1182, 33 U.S.C.A. 701s.

[2] Flood Control Act of August 28, 1937, 50 Stat. 877; 33 U.S.C.A. 701g.

Control Act of August 18, 1941, as amended.[1] This act authorizes emergency flood proection works and actions to prevent damages to public works as highways, bridges, and buildings. Again there is a program ceiling on expenditures of 15 million dollars per fiscal year; but, there is no apparent individual project or tributary limitation.

State authority in Michigan for undertaking construction programs involving flood protection and control projects consists of enabling and regulatory enactments. A regulatory act exists which establishes State control over dam construction. At the same time, several enabling acts allow for the State and a variety of its subdivisions to participate, sponsor, and/or maintain and operate Federal flood protection works of improvement. Other enabling acts allow for various subdivisions of the State to undertake some flood protection projects on their own account.

Public Act 184 of 1963 as amended confers regulatory powers upon the Michigan Department of Natural Resources.[2] Provisions of the act provide for instituting a State permit program applicable to all dams constructed in the State having an impoundment area of more than five acres. Such a permit system allows for evaluation and approval by the Department of all proposed dams in the State. Engineering review, study, and evaluations are provided for in the permit review process and subsequently during dam construction. The only exempted authority under provisions of the act are public utilities which are regulated by the Public Services Commission.

Other regulatory powers were conferred upon the Water Resources Commission under Act 167 of 1968.[3] One focus of this act in terms of

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[1] Flood Control Act of August 18, 1941, 55 Stat. 650; 33 U.S.C.A. 701n.

[2] State of Michigan, Act No. 184, Public Acts of 1963, Michigan Compiled Laws Annotated 281.131, et.seq.

[3] State of Michigan, Act No. 245, Public Acts of 1929; as amended by Act 167, Public Acts of 1968, Section 2a; Michigan Compiled Laws Annotated 323.2a.

flood loss management has been one of floodway regulation to prohibit obstructions in floodways or reductions of floodway flow capacities.[1] A second focus however, has been the designation of the Commission as the principle State agency for cooperating and negotiating with local and Federal governments and agencies in terms of flood prevention projects. Such legislative policy confers principle responsibility upon the Commission for coordinating local, state, and Federal flood prevention engineering programs.

A general enabling act was enacted in 1952 which allows for local participation in Federal flood control, drainage control, and beach erosion projects.[2] In essence, Public Act 278 of 1952 grants enabling authority to counties, townships, incorporated cities, and incorporated villages for fulfilling the a,b,c requirements of the 1936 Federal Flood Control Act, as amended. The State act allows the above local units of government to sponsor requests and participate in Federal flood control projects; acquire the lands and rights of way required; and contract with the Federal government in order to furnish the assurances required to qualify for Federal flood control project assistance.

Several sections of the Drain Code enacted in 1956 have provisions for drainage districts and other water management districts participation in Federal flood control projects. Drainage districts of varying geographical size and Water Management Districts can acquire lands and rights-of-way and otherwise meet the Federal a,b,c, requirements of local participation in flood control projects. In addition, both forms of management district have powers to assess and tax the district's residents in order to finance local

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[1]This was discussed earlier under Floodway Encroachment Regulations; <u>supra</u>., pages 83-92.

[2]State of Michigan, Act No. 278, Public Acts of 1952, <u>Michigan Compiled Laws Annotated</u> 281.601, <u>et. seq</u>.

requirements.

Water Management Districts have the additional authority to purchase flood prevention construction programs on their own account. Construction program plans and project designs are subject to Water Resource Commission review and approval. Nevertheless, the water management districts have considerable authority for instituting engineering works of flood prevention and protection. Powers to condemn land and to access and tax property provide essential powers for undertaking such construction programs.

Additional authorities exist which enable home rule cities and fourth class cities to construct, operate and/or maintain certain flood control or prevention works. Incorporated cities of the fourth class (populations of less than 10,000) are empowered to construct, operate, and maintain levees, basins and canals upon lands under control of the city.[1] Home rule (charter) cities are also empowered to establish, construct, operate, and maintain levees, embankments, and public works. Both city forms have powers of eminent domain which allow acquisition of property for public uses such as public structures, improvement of water courses, and other necessary public uses which relate to flood protection.[2] More careful analysis of these authorities and other authorities is needed to clearly define the weaknesses and limits of some of these authorities. This is particularly true of those enabling acts which provide for local construction, operation, and maintenance of public works projects. It will not noted later that significant use has not been made of these authorities which allow for local construction projects. This may reflect weaknesses in the (1) provisions

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[1]State of Michigan, Act No. 215, Public Acts of 1895, Sec. 1 as amended; Michigan Compiled Laws Annotated 97.1.

[2]Ibid., M.C.L.A. 105.1 and 117.4c.

of enabling acts and/or (2) program funding sources and arrangements.

Watershed Protection and Flood Prevention. -- Several authorities exist at the Federal level for participating in watershed protection and flood control. In terms of Michigan flood plain management needs, only one of these authorities has practical application. Two other authorities exist, but subsequent project authorizations have not included any Michigan watersheds. Accordingly, brief treatment will be given first to the two limited authorities. This will be followed by extended treatment of the specific authority having relevance to Michigan watershed management needs.

The first Federal flood prevention watershed program authorization was established under the Flood Control Act of December 22, 1944.[1,2] This act authorized Department of Agriculture involvement in basin wide watershed improvements where they supplemented and complemented Corps of Engineers mainstream flood water control works. Eleven basin projects were initiated under the auspices of the Department of Agriculture as provided for by this act. As of mid year 1966, the combined projects had an estimated total Federal cost of about 425 million dollars. Approximately, 61 per cent of the over-all program was complete at that time; with individual projects ranging between 47 to 100 per cent of completion.[3] No Michigan watersheds were included within the eleven projects.

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[1] Flood Control Act of 1944, Public Law 534, 58 Stat. 905, not classified to the U.S. Code.

[2] U.S., Congress, House, Committee on Appropriations, Subcommittee on Department of Agriculture and Related Agencies Appropriations, Hearings before a Subcommittee of the Committee on Appropriations, 90th Cong. 1st sess. (Washington D.C.: Government Printing Office, 1967), pp. 540-541.

[3] Ibid., Table (not numbered), p. 542.

A second Federal authority exists for assisting watershed protection measures which include flood prevention benefits. The Act of April 27, 1935 is cited as the authorizing authority for establishing 62 pilot watershed projects.[1,2] Actual program initiation was not started until Fiscal Year 1954 when appropriations were first made available for the projects. Nevertheless, the program was completed by June 30, 1970, with 54 projects carried through to completion and 8 projects abandoned. This necessitated a total appropriation of slightly less than 45 million dollars.[3] None of the 62 original pilot projects involved Michigan watershed areas.[4]

The third Federal watershed protection authorization was developed in 1954.[5] The Watershed Protection and Flood Prevention Act provided for Federal assistance in developing small watershed projects in upstream areas. Program authority under this act has had a more general application and greater availability throughout the country than programs authorized under the two acts cited just above. Accordingly, the act constitutes the relevant Federal authority in Michigan in terms of seeking Federal assistance for watershed protection and flood prevention programs. It is important to note that the Watershed Protection and Flood Prevention Act

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[1]U.S., Congress, House, Committee on Appropriations, Subcommittee on Agriculture, Hearings before a Subcommittee of the Committee on Appropriations, 92d Cong. 1st sess. (Washington D.C.: Government Printing Office, 1971), p. 508.

[2]Act of April 27, 1935, 49 Stat. 163; 16 U.S.C.A. 590.

[3]U.S., Congress, Committee on Appropriations, Subcommittee on Agriculture, Hearings, 1971, Table (not numbered), p. 509.

[4]U.S., Congress, House, Committee on Appropriations, Subcommittee on Agriculture, Hearings, 1967, Table (not numbered), p. 500. Note: the 62 projects as authorized involved 33 different states, indicating a significant national program scope.

[5]Watershed Protection and Flood Prevention Act of August 4, 1954, Public Law 566, 68 Stat. 666; 16 U.S.C.A. 1001.

emphasizes and requires (1) an active involvement by the state and that (2) the local units of government must have program authorities and demonstrate strong interest to obtain Federal program assistance. In fact, much emphasis is placed upon local initiation of program requests and planning under this act.

The flood prevention program available under the 1954 Act focuses on (1) land treatment practices and (2) measures for storing flood waters.[1] The first focus centers on modification in cropping, forestry, and range management practices; land improvements, including drainage and irrigation measures; and other soil and water conservation practices. The second focus reflects the need for engineering devices for retaining and managing flood waters in upstream watershed areas. In order to accomplish these objectives, a complex array of public planning and management devices are authorized.[2] Such devices include planning services, technical assistance, installation services, application of land-treatment measures on Federal lands, and financial assistance in the form of loans, cost-sharing, and complete Federal assumption of cost bearing in certain instances.

The amended ct establishes several complicated formulas for planning, reviewing, approving, and financing proposed watershed projects. Briefly, a qualified local unit of government may apply for Federal program assistance through the state agency charged with supervision of such applications. Applications for Federal assistance are sent to the Secretary of Agriculture. If the proposed project does not include any single structure providing more than 2,500 acre-feet of total water storage capacity or a Federal cost sharing of more than $250,000; then the Secretary of Agriculture may

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[1] Ibid., 68 Stat. 666; 16 U.S.C.A. 1002.

[2] U.S., Congress, House, Committee on Appropriations, Subcommittee on Department of Agriculture Hearings, 1967, pp. 492-493, 496-497.

grant approval.[1] Work can then proceed if funds are available. On the other hand, if the proposed project includes a structure of more than 4,000 acre-feet of total water storage capacity, the Secretary (through the President) must seek review and comments from appropriate Federal agencies and project approval by resolution from both the Senate Committee on Agriculture and Forestry and the House Committee on Agriculture. If a project involves a single structure containing more than 4,000 acre-feet of total storage capacity, then the Committee on Public Works in the House and Senate assumes approval functions. All project plans are limited to watershed areas not exceeding 250,000 acres, detention structures of less than 12,500 acre-feet flood storage capacity, single structures of less than 25,000 acre-feet total storage capacity, and a variety of Federal cost sharing requirements.[2] In terms of flood prevention, all allocable project construction and engineering costs are borne by the Federal Government.[3]

Local units of government which qualify under the Federal Act for sponsoring an application for program assistance include (1) a state, (2) political subdivisions of the state (counties and other municipalities), (3) soil or water conservations districts, (4) other agencies fulfilling certain provisions of state law, and (5) non-profit irrigation or water development companies as approved by the Secretary of Agriculture.[4] Local

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[1] Watershed Protection and Flood Prevention Act of 1954, 68 Stat. 667, 16 U.S.C.A. 1005.

[2] Ibid., as amended by an Act of November 8, 1965, Public Law 89-337, 79 Stat. 1300, 16 U.S.C.A. 1002. This latter amendment moved the previous single structure project limit of 5,000 acre-feet of floodwater detention capacity to 12,500 acre-feet.

[3] Ibid., as amended by Food and Agriculture Act of 1962, 76 Stat. 609; 16 U.S.C.A. 1004(2) (B).

[4] Ibid.

requirements in terms of flood prevention provisions under the federal act include (1) acquisition of land, easements, and rights-of-way needed for structures and improvements, (2) securing the necessary water rights, (3) operation and maintenance of structures on private lands, (4) obtaining agreements to carry out and fulfill soil conservation requirements, and (5) repayment of any loans advanced by the Secretary for assisting local units in financing their share of the project costs.[1]

State authority for undertaking watershed protection and flood prevention measures in upstream areas of Michigan can be found under several acts. The principle authority is contained in the Soil Conservation District Law enacted in 1937.[2] Other more general authorities exist which allow municipalities and special use districts to participate in federal flood control projects. Municipal units receive general authority under Act No. 278 of Public Acts of 1952.[3] River Management Districts may participate under the Local River Management Act.[4] Drainage districts and Water Management Districts may also participate under the Drain Code of 1956.[5] It is significant to note that the involvement of drainage districts is often important in terms of having a joint sponsor with a soil conservation district. Drainage districts have been found to be complementary sponsoring agencies because of their powers to tax and assess

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[1] Ibid., 16 U.S.C.A. 1004(G).

[2] State of Michigan, Soil Conservation District Law of 1937, Act No. 297 Public Acts of 1937, Michigan Compiled Laws Annotated 282.1, et. seq.

[3] Michigan, Act No. 278, 1952, M.C.L.A. 281.621.

[4] State of Michigan, Local River Management Act, Act No. 253, Public Acts of 1964, Section 7, Michigan Compiled Laws Annotated 323.307.

[5] State of Michigan, Local Drain Code of 1956, Act No. 40, Public Acts of 1956, Section 428,429, 551, et. seq.; Michigan Compiled Laws Annotated 280.428, 280.429, 280.551, et. seq.

benefits. Nevertheless, while these powers are absent in soil conservation districts, the latter governmental units are the primary units required to sponsor watershed protection and flood prevention projects. This is principally due to their authority and responsibility in obtaining land treatment measures which are required in qualifying for Federal financial and technical assistance.[1]

As noted, principle authority in Michigan for carrying out watershed protection and flood prevention measures in upstream areas can be found under Act 297 of Public Acts of 1937.[2] The act enables the establishment of soil conservation districts as a governmental subdivision of the State of Michigan. As such their principle objectives are to conserve soil resources and to prevent and control soil erosion. As such objectives are fulfilled they serve "to preserve natural resources, control floods, prevent impairment of dams and reservoirs,. . .and promote, the health, safety, and general welfare of the people of the state."[3] In this manner, flood prevention and flood control under the act are considered ancillary benefits. As a result, the enabling powers are liberal enough to allow soil conservation district involvement in watershed protection and flood prevention projects.

Detailed provision for initiating and establishing soil conservation districts are provided in the act.[4] Broad authority and powers are available to establish soil conservation districts. Districts may develop

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[1]Eckhart Dersch, Assistant Secretary, State Soil Conservation Committee Personal Interview, E. Lansing, Michigan, November 1, 1971.

[2]Michigan, Soil Conservation District Law, M.C.L.A. 282.1, et. seq.

[3]Ibid., M.C.L.A. 282.2.

[4]Ibid., M.C.L.A. 282 (Preamble), 282.5, et. seq.

comprehensive plans for soil conservation in the district. They can initiate, acquire, own, operate, and manage soil conservation and erosion control demonstration projects. Districts may acquire, improve, and sell land in the district. They can conduct surveys, investigations, and research as well as disseminate information. Authority is granted under the act for the provision of machinery, supplies, and technical assistance by a district on terms established by that district. In addition, a district may participate in and assume responsibility for managing a state or Federally assisted soil conservation project. Further, directors of a district may require contributions, agreements, and covenants from district land owners prior to initiating or making available programs of benefit to the district. Other general or broad powers are also conferred such as the right to enter into contracts, adopt rules and regulations, power to sue and be sued, and other organizational powers.[1]

A state soil conservation committee is also created under this act. The act charges it with responsibilities for assisting, supervising, and regulating the establishment of state soil conservation districts. In addition, it is responsible for coordinating Federal and state soil conservation districts. The state committee may also offer assistance to district directors where appropriate; disseminate information and facilitate the exchange district program experiences; approve and coordinate programs of several districts; and to serve as a source of general information for the state in terms of soil conservation activities.[2,3]

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[1] *Ibid.*, M.S.L.A. 282.8.

[2] *Ibid.*

[3] Eckhart Dersch, Personal Interview, November 1, 1971.

Under the authority of this act the state soil conservation committee has assisted in sponsoring requests for Federal Watershed Protection and Flood Prevention program assistance. The state committee establishes priorities for project request applications and serves as the state representative during the application and negotiation of Federal financial assistance. This is of considerable importance in that at present Federal funds and technical assistance are instrumental in pursuing many soil conservation projects.

Extent of Program Application

Detention and storage structures (Federal). -- Notwithstanding the above enabling legislation and program authorizations, little use of Federal flood control reservoirs is evident in Michigan. This reflects the comments made earlier in this section regarding the appropriateness of this management technique. A review of 16 Corps of Engineers flood control projects in Michigan which have attained at least the stage of project recommendations, revealed only one recommended reservoir development

The one project, the Shiawassee Flats Project, as proposed, constituted an unusual flood control reservoir development.[1,2] The project involves a joint undertaking of the U.S. Corps of Engineers, U.S. Fish and Wildlife Service, and Michigan Department of Natural Resources. Such a cooperative effort is necessary in order to obtain multiple purpose benefits from the project. Under the plan for construction, a series of lateral, shallow water reservoirs have been proposed for storing flood waters and developing fish and wildlife habitat. Specifically, the reservoirs would lie in the Shiawassee Flats, a low, poorly drained area lying within the central

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[1] A.C. Nauman, "Flood Control in the Detroit District," 1954, p. 28-30.

[2] Water Resources Development in Michigan - 1967, p. 56.

Saginaw River Basin. (The area receives the discharges of the Cass, Flint, Shiawassee, and Tittabasassee Rivers, the four principal tributaries to the Saginaw River.) And it is because of such low relief, that much of the flood loss reduction benefits will be coupled with drainage benefits and wildlife habitat improvement.[1]

The estimated total first cost for just the Shiawassee Flats project was $11,0250,000 in 1954. By 1967 the estimated total first cost had risen to $19,924,000. Both estimates reflect a significant portion of the total estimated first cost for all improvements recommended in the Saginaw River Basin, which approximated $17,897,970 in 1954 and $27,414,000 in 1967. In each instance the bulk of the estimated costs were for flood control purposes. For the Shiawassee Flats project in 1954, the estimated flood control costs were $7,651,400 or about 69.4 percent of the total project costs.[2,3] Estimates were not given for the costs of reservoir development, although in this instance such figures might be difficult to interpret.

Other large scale applications of detention and storage reservoirs for flood control were not uncovered in Michigan. Small scale impoundments do exist and continue to be constructed; however, their principle justification and benefit lies in other areas, as will be demonstrated in the section on land treatment.

Detention and storage structures (Michigan). -- From information furnished by the Michigan Water Resources Commission staff and the Detroit District Office of the Corps of Engineers, it appears that little

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[1] A.C. Nauman, "Flood Control in the Detroit District," 1954, pp. 30-31.

[2] A.C. Nauman, "Flood Control in the Detroit District," 1954, pp. 30-31.

[3] Water Resources Development in Michigan - 1967, p. 57.

use has been made of various state enabling authorities which allow local construction of flood control projects. Only three communities out of the more than 100 Michigan communities known to have stream flooding problems were cited as having locally constructed flood protection projects which furnished a significant degree of flood protection.[1] The three communities listed were Grand Rapids, Trenton, and Wyandotte. Little further information was provided on these three local projects. Thus, it is not clear whether they include any reservoir operations, channel improvements, or channel modifications. Further, it is not clear what statutory authority was employed for the local construction project.

Channel improvement and modification. -- The extent of the application of channel modification techniques is exhibited principally through the programs of the U.S. Army Corps of Engineers. Everyone of the 16 flood control projects reaching at least a stage of project recommendation in Michigan has involved one or more measures of channel modification. (Consult table number 2). Eleven of the 16 recommended projects involved channel improvements which required channel widening, deepening, straightening, and clearing. Six projects involved construction or altering of existing levees, floodwalls, or dikes. And four of the projects involved construction of a diversion or cut-off channel to divert flood flows around an area desiring protection. As the total of the above three construction programs suggest, combinations of measures are often practiced in modifying floodways and channels for flood protection.

Consequently, it can be concluded that proposed applications of downstream flood protection engineering measures in Michigan has focused on

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[1]"List of Urban Places With Information About Flood Problems," January, 1967, pp. 3 and 11.

TABLE 2
CORPS OF ENGINEERS FLOOD CONTROL PROGRAM IN MICHIGAN[1]

River	Affected Communities	Nature of Proposed Protection	Estimated Cost	Status of Project
Clinton River	Mt. Clemens	Diversion channel	$ 1,136,000	Completed
Clinton River Red Run	Suburban Northern Detroit Area	Channel improvement	1,310,970	Completed
Estral Beach Lake Erie	Estral Beach	Raised dikes	131,200	Completed
Grand River	Grandville	Levees	1,835,000	Active authorization
Grand River & Red Cedar River	Lansing and E. Lansing	Diversion channel Channel improvements	19,510,000	Active authorization
Huron River & Silver Creek	East Rockwood	Raised dikes around small island	18,600	Completed
Kalamazoo River & Battle Creek	Battle Creek	Cut off channel Channel improvement	4,330,000	Completed
Kalamazoo River	Kalamazoo	Channel improvement		Construction near underway
Kaw Kawlin	Kaw Kawlin	Channel improvement	1,080,000	Construction near underway
		Snagging and Clearing	59,200	Completed

TABLE 2 -- Continued

River	Affected Communities	Nature of Proposed Protection	Estimated Cost	Status of Project
Prairie River	Burr Oak	Channel improvement Drainage improvement	27,500	Completed
River Rouge	Detroit	Channel improvement	21,000,000	Construction underway
River Rouge-Upper	Farmington	Channel improvement Snagging and Clearing	23,600	Completed
Cass River	Frankenmuth	Levee, Floodwall and Interior drainage	350,000	Construction underway
Flint River & Swartz-Thread Creeks	Flint	Channel improvement Levees	7,140,000	Construction underway
Shiawasee Flats	Saginaw	Reservoir, Levees Channel improvements and Drainage	20,924,000	Construction pending receipt of funds and local assurances
Sebewaing River	Sebewaing	Channel improvements and Dike removal	590,350	Completed

[1]Source: Water Resources Development in Michigan - 1967, pp. 39-41, 56-57, 59, 63, and 64.

channel improvement and/or modification in contrast to storage structures. A notable absence in proposed reservoir developments have been absent in the past. Further, the principle focus of downstream construction program authority continues to be at the Federal level. This is largely a result of the liberal financial assistance available for construction programs.

Watershed protection and flood prevention. -- Some data is available on the execution of Federal Watershed Protection and Flood Prevention programs in the State of Michigan. Sixteen projects involving nearly 500,000 watershed acres had been approved as of mid-year 1970. Total estimated Federal cost for the 16 Michigan projects was more than 6.6 million dollars. This constituted 39.2 percent of the total estimated project costs. Total cumulative Federal obligations for these projects was reported to be slightly in excess of 5 million dollars, or nearly 77 per cent of the total estimated Federal commitment.[1]

It is significant to compare some of these figures with the national figures. In particular, it was found that the 39.2 per cent average Federal project cost sharing was considerably below the national proportion of 58.4 per cent. On the other hand, the proportion (76.6 per cent) of committed Federal funds towards the 16 Michigan projects significantly exceeded the national average of 44.3 per cent.[2]

In light of the information contained in the data, a hypothesis concerning the importance of flood prevention measures and their adoption in Michigan may be developed. But, first, the above information needs substantial qualification. It should be noted that flood control is but one

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[1] U.S., Congress, House, Committee on Appropriations, Subcommittee on Agriculture, Hearings, 1971, Tables (not numbered), pp. 514 and 515.

[2] Ibid.

of several functions covered under the now heavily amended Watershed Protection and Flood Prevention Act. Additional policy areas of recreation, fish and wildlife development, industrial and municipal water supply, and agricultural water management (irrigation, drainage, and other agricultural supply and distribution uses) are incorporated into the Act. Also noteworthy is the fact that in these latter cases the Federal government does not absorb all the construction costs attributable to the respective purposes as it does in flood control. Accordingly, any conclusions drawn from the data will have to be tentative and general.

The figures reflecting the proportion of Federal cost sharing suggest that the amount of flood prevention included in Michigan watershed projects is relatively low compared to the national average. On the other hand, the State was doing better than the national average in terms of obtaining commitments of federal funding for the construction of projects within the state.

In conclusion, it is important to note that the Watershed Protection and Flood Prevention program embodies both flood management philosophies with respect to controlling flood waters and regulating land uses. That is, the program merges the concept of regulating flood waters with that of directing human activities on flood plains. In terms of the latter, the land and conservation treatment measures are developed in a different light than that normally viewed in regulating occupancy in urbanizing and settled flood plains. However, the elements of the two focuses are still present and offer an example of integrated flood loss management philosophy.

Flood Proofing

The land use management technique which poses possibly the greatest potential for reducing flood loss in existing developments is flood

proofing. However, little information was available at the state level or local level in terms of flood proofing. The few known examples of flood proofing by state and local officials were generally restricted to proposed new structural developments as opposed to modification in existing developments.

Two simple but effective applications of flood proofing measures were cited in the Cities of Lansing and Southfield. In Lansing, a recent request to build a small multiple dwelling apartment structure in the flood plain was reviewed. Approval was anticipated in light of the fact the architect designed the structure to be effectively secured from flood damages. The apartment parking area was located in the ground level of the apartment structure, while the first floor of residences was designed to be well above flood levels.[1]

Similar design concepts were involved in a proposed high rise motel structure in Southfield, Michigan. The first several levels of the structure would be devoted to parking area, while associated motel occupancy units would be located on upper levels above the reaches of flood waters. City approval of the building plans was being withheld ostensibly on the need for obtaining a reclassification of the zoning restrictions for the area in question.[2] Other examples of flood proofing were suggested. However, the techniques involved were restricted to land filling as a means of raising foundation and floor levels above flood levels.

The importance of flood proofing as a potential flood loss management device was established earlier. Accordingly, extensive field study

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[1]Plans reviewed in the Office of Building Inspection, City of Lansing (Lansing, Michigan: City Hall, September, 1971).

[2]Lawrence Witte, Personal Interview, September, 1971.

of the flood proofing techniques in terms of Michigan flood plain settings is thought to be highly justifiable. Various flood proofing measures could be evaluated in terms of potential for reducing flood losses. Further, the role flood proofing could play in encouraging adoption of other flood plain land use measures might also be evaluated. Evidence for this observation is present in the authorized National Flood Insurance Program. Provisions are included in the enabling act which allow adjusting chargeable flood insurance premium rates in light of the presence of flood proofing measures.[1] As such, the provisions are excellent reflections of the desired integrative and compatibility function needed in flood loss management device.

Evacuation and Relocation

As noted in Chapter III, evacuation measures may be of a temporary or permanent nature. Permanent evacuation from a flood hazard area may be accomplished on an individual basis or on community basis through a relocation process. The application of this latter process in terms of Michigan flood plain settings may be quite limited. In light of the observations made by Murphy and Deines,[2] and in the absence of documented attempts at permanent relocation by Michigan communities,[3] little time was given to pursuing field inquiry into this aspect of evacuation in Michigan. Accordingly, little could be concluded as to the appropriateness of this technique in terms of flood loss management in Michigan. Further study of this technique might be justified despite the prospects of encountering negative findings.

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[1] Housing and Urban Development Act of 1968, 82 Stat. 577, 42 U.S.C.A. 4015(b)(1).

[2] Supra, pp. 123-124.

[3] Lawrence Witte, Personal Interview, January 29, 1969.

Several authorities exist at the national and state level which can be drawn upon to encourage permanent evacuation and relocation from flood plain areas. Provisions exist in (1) Federal flood control legislation (2) Federal and state urban renewal programs, and (3) in the recently enacted National Flood Insurance Program for pursuing the permanent evacuation of flood plain areas. These three program authorities will be discussed below.

Permanent Evacuation Through Urban Renewal

Authority exists at the federal level and the state level for slum clearance and urban renewal.[1,2] These programs include general authority to assist clearance and relocation of blighted areas, and one contains more specific authority for assisting disaster stricken communities with urban renewal.

In particular, federal policies are set forth to encourage evacuation and relocation in flood stricken areas irrespective of previous urban renewal planning. This is reflected in Section III of Title III, Slum Clearance and Urban Renewal, Housing Act of 1956 which states:

> in the subsequent preparation of the urban renewal plan with respect to a project aided under this section, the local public agency shall give due regard to the removal or relocation of dwellings from the site of recurring floods or other recurring catastrophies in the project area.[3]

In addition, other provisions under this particular section relax general urban renewal program requirements in order to facilitate quick

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[1] Housing Act of 1949, as amended, Title I, Slum Clearance and Community Development and Redevelopment; 63 Stat. 414; 42 U.S.C.A. 1441.

[2] State of Michigan, Act No. 344, Public Acts of 1945, Michigan Compiled Laws Annotated 125.71, et. seq.

[3] Ibid; 70 Stat 1102; 42 U.S.C.A. 1462.

response and action to flood or disaster stricken communities. However, one major constraint which controls qualification for assistance under this section is the situation that the disaster must have qualified as a major disaster as declared by the President under Public Law 875 of 1950.[1] This has the effect of narrowing the application of this particular section to the less frequent or rare major flood events. Consequently, the potential application of this particular section of the urban renewal program in Michigan communities is significantly limited. On the other hand, the general provisions of urban renewal still allow considerable possibilities in terms of relocating blighted urban neighborhoods in flood plain areas.

Michigan as a state actually preceeded the federal government in terms of enacting authorizing legislation concerning urban renewal. Public Act 344 of 1945 created enabling authority for counties, townships, cities and villages to adopt urban renewal programs. Pursuant to such authority, a municipality may reduce or eliminate urban blight and factors contributing to blight by acquiring property by purchase, gift, exchange or dondemnation.[2]

No specific provisions are included in the Michigan Act which pertain to flood events as a source of blight nor to developed flood plain areas as an area qualified for urban renewal. However, the provisions of the enabling act are quite general by the nature of the act. Accordingly, the state act appears to be quite compatible with the federal act in this particular area, i.e., urban renewal in a flood plain setting.

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[1]Public Law 875, September 30, 1950, 64 Stat. 1109, 42 U.S.C.A. 1855a.

[2]State of Michigan, Act No. 344, Public Acts of 1945, Michigan Compiled Laws Annotated 125.71, 125.73.

At the same time, considerable latitude is available to local communities in conceiving and carrying out urban renewal. As a result, sufficient federal and state authority appear to be present to enable evacuation and relocation of blighted areas in flood plain sections of Michigan municipalities.

As noted, little time was devoted to pursuing field inquiry into technique application in Michigan. One potential application of permanent evacuation at the local level was uncovered. The City of Lansing has proposed comprehensive studies for two additional urban renewal areas as part of their Model Cities Program.[1] In general their urban renewal program appears to be redevelopment oriented. However, an element of permanent evacuation appears to be contained in proposed Urban Renewal Project Area No. 2. Permanent evacuation of some developed areas may result from the identification of river front areas in Urban Renewal Area No. 2 as desirable open space and recreation areas. In order to achieve such goals, acquisition of developed land will be required, a program of land clearing undertaken, and subsequent initiation of open space and recreational development. The recreation area when secured will serve redevelopment areas lying adjacent to such dedicated flood plain areas. Specifically, residential, commercial, and community college interests in existing Urban Renewal No. 1 and proposed Urban Renewal No. 2 will be served by the evacuated flood plain open spaces.

Permanent Evacuation Under the Flood Insurance Program

Particular attention should also be given to a second federal program which includes provisions related to flood plain evacuation. The recently

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[1]City of Lansing, Improving the Quality of Urban Life: First Year Action Plan (Lansing, Michigan: City Demonstration Agency, Model Cities Program, April, 1970), Section V, "Long Range Land Use Plan," pp. v-1 to v-6; v-10 to v-14; and accompanying plates.

enacted National Flodd Insurance Program provides authority for the acquisition of flood insured properties which have been substantially damaged in a flood event.[1] In this manner, a form of permanent evacuation may be encouraged and achieved. On the other hand, the implications of the damaged property acquisition provisions in terms of community or individual evacuation programs have not been clearly developed. Subsequent evaluation of such implications may progress as policies and guidelines for administering this program are established by the Department of Housing and Urban Development.

Authority for requiring damaged flood insured properties is granted to the Secretary of Housing and Urban Development. Provisions are also present for allowing the subsequent conveyance of acquired properties to state and local agencies through resale, lease, donation or other methods. Such conveyances can be made only after assurances have been given by the state or local agency to the effect that the conveyed property will not be used for purposes not approved by the Secretary for a period of at least 40 years.[2] While such policies do not constitute a restriction on the flood insurance program, they do reflect a stringent policy precedent in terms of federal-state and federal-local program leadership and partnerships in the flood plain management field. If the guidelines are developed such that permanent evacuation is encouraged, then this provision may offer a means of financing the conversion of heavily developed, high risk areas into low flood risk land uses.

Any assessment of the application of acquisition provisions under the National Flood Insurance Program for evacuation purposes in Michigan will

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[1] Housing and Urban Development Act of 1968, Title XIII, 82 Stat. 589; 42 U.S.C.A. 4103.

[2] Ibid.

have to wait until the insurance program is introduced in Michigan. In addition, further specific guidelines will have to be developed and adopted which translate enabling provisions in the act into Federal and state policy procedures for evacuating flood insured flood plain properties.

Permanent Evacuation Under Flood Control Legislation

A third federal authority which allows for considerations of permanent flood plain evacuation can be found in the Flood Control Act of June 28,[1] 1938. Restrictive provisions in the act allow consideration of permanent evacuation as an alternative measure only when levees or flood walls are being considered in flood control projects. In addition it must be established that the costs of evacuation will not substantially exceed the construction costs saved in not building the levees or flood walls. At the same time, substantial discretion is left to the Chief of Engineers in terms of implementing such provisions. The Chief of Engineers may negotiate. . . "agreements with States, local agencies, or the individuals concerned for the accomplishment by them of such evacuation and rehabilitation and for their reimbursement. . ."[2] Thus, authority for permanent flood plain evacuation is limited in its applicability under the Flood Control Act of 1938. Where applicable, however, it appears to offer some degree of latitude in terms of arranging for the process of evacuation. In fact, the House Committee on Flood Control recommended passage of the original legislation by noting, in part, that such measures presented possibilities for releasing evacuated flood plain areas for parks and recreational facilities.[3]

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[1] Flood Control Act of June 28, 1938, Public Law 761, Section 3, 52 Stat. 1216, 33 U.S.C.A. 701(i).

[2] Ibid.

[3] U.S., Congress, House, Committee on Flood Control, Comprehensive

Applications of evacuation under the provisions of the Flood Control Act of 1938 are not well documented. Murphy and Deines in their separate studies of this particular flood loss management technique did not uncover many applications of flood plain evacuation in general, nor many specific applications under the 1938 Act.[1] Applications in Michigan are now known or reported which can be related to this Act.[2] Accordingly, the extent of application of permanent evacuation under this program has been slight at best on a national level and are presumed absent within this state.

Temporary Evacuation

The application of temporary evacuation as a flood loss management device in Michigan may be more readily established than that of permanent evacuation. Frequent experience with temporary evacuation measures on a limited scale has been noted in Michigan.[3] At the same time, it is acknowledged that emergency preparation may be significant in reducing potential flood losses.[4] However, there are inherent limitations in evaluating this program with respect to local planning and program execution. Extensive field interviewing and survey work would be required to evaluate the status of such programs in Michigan. Budget and time

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Flood Control Plan and Works For Reservoirs, Levees, and Flood Walls, Report to Accompany H.R. 10618, House Rept. No. 2353, 75th Cong. 3d sess. (Washington D.C.: Government Printing Office, May 13, 1938), p. 7.

[1] Supra, footnote 4, p. 123; footnote 1, p. 124.

[2] Carl Argiroff, Personal Interview, February 18, 1969. Lawrence Witte, Personal Interview, January 29, 1969.

[3] Lawrence Witte, Personal Interview, January 29, 1969.

[4] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 469, 1966, p. 24, 36, and 37.

constraints precluded undertaking such field study work. Consequently, such study efforts have been deferred to future studies.

Authority for temporary evacuation measures appears to be largely a function of individual and local initiative coupled with federal and state technical and financial assistance. In terms of technical and financial assistance, the federal government has long accepted a role in providing emergency flood control assistance, evacuation, and relief. Accordingly, a significant technical assistance role has been developed in terms of aiding the temporary evacuations of flood threatened communities. Much of this assistance role is achieved through the Environmental Science Services Administration (ESSA) involvement in public preparedness for flood conditions. Here the basic objective and function of ESSA is to provide:

> Reliable and accurate forecasts of floods and flood stages (which) can be coupled with temporary evacuation to save lives and reduce property losses.[1]

The program is administered by the River and Flood Prediction and Warning Service of ESSA as an integral part of the new Nationwide Natural Disaster Warning System (NADWARN). The completion of the network was only recently achieved in FY 1968.

A smaller but important program allied to ESSA's forecasting and warning service is their furnishing information to be included in the Corps of Engineers Section 206 flood plain surveys. ESSA provides ". . . information on the existing and potential flood plain warning services available for each of these reports."[2] This serves an educational function

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[1]U.S., Congress, House Committee on Appropriations, Subcommittee on Departments of State, Justice, Commerce, The Judiciary, and Related Agencies Appropriations, Hearings before a Subcommittee of the Committee on Appropriations, Part 3, 90th Cong. 1st sess. (Washington, D.C.: Government Printing Office, 1967), p. 564.

[2]Ibid., p. 565.

as to the warning capabilities and services available to the local governments and their constituents.

Redevelopment

As in evacuation, the appropriateness and application of redevelopment measures in flood plain settings is difficult to assess in terms of Michigan. Little information was uncovered in the flood loss management literature. In addition, flood plain management personnel at the state level were not able to cite redevelopment efforts of any significant scale in flood plain areas within Michigan. On the other hand, the redevelopment efforts undertaken by the City of Pittsburg in the Golden Triangle area is an example that suggests the redevelopment concept merits further consideration in terms of application to Michigan flood plain settings.[1]

Authority for redevelopment measures can be found in several of the federal and state urban renewal enabling acts cited in the previous section. Redevelopment, appeared to be the general program goal under these original enabling acts.[2,3] it was the expected extension of slum clearance objectives under urban renewal. However, in terms of flood plain management needs, the specific policy provisions of Section III in Title III of the Housing Act of 1956, cited in the preceeding section on evacuation, tempered this general committment to redevelopment in favor of permanent evacuation in flood prone areas.[4] The net effect of such a federal policy might be a limiting one in terms of redevelopment of flood plains under urban renewal.

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[1]Murphy, Regulating Flood-Plain Development 1958, pp. 3-4.

[2]Housing Act of 1949, as amended, 63 Stat. 414, 416.

[3]Michigan, Act No. 344, 1945, M.C.L.A. 125.71.

[4]Supra, p. 81-82 and 138.

Similarly, other subsequent amendments to the 1949 Housing Act have resulted in broadening and diversification of emphasis in urban renewal enactments. Considerable importance has been attached to rehabilitation and conservation of existing developments under the more recent federal urban renewal acts. In effect rehabilitation and conservation are veiwed as more desirable alternatives, where feasible, to that of slum clearance and redevelopment.[1] Thus in terms of rehabilitation in a flood plain setting, the emphasis would seemingly be placed upon flood proofing existing developments during the process of renovation. (No field studies were obtained nor conducted to refine and validate this hypothesis). As a result, the diverse program objectives and methods under urban renewal do not allow drawing strong condlusions about the appropriateness of redevelopment and/or rehabilitation in (blighted) flood plain settings. This is especially true in the absence of empirical information.

In effect the contrast or distinction suggested between rehabilitation and redevelopment is that the latter entails a removal of the existing blighted land use with subsequent land preparation and eventual redevelopment of the urban renewal land. In terms of flood plains, this could mean redevelopment of such lands with new uses which incorporate adequate design and construction features or involve land uses which pose minimal flood risk in time of floods. Accordingly, the final effects of flood proofing and redevelopment are essentially the same; the steps involved though, are viewed as being different. In contrast, some of the early steps to evacuation with relocation and redevelopment are essentially the same, but the end result is significantly different.

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[1] Housing Act of 1954, Public Law 566, August 2, 1954, Title III, Slum Clearance and Urban Renewal, 68 Stat. 622.

Field observations and information concerning applications of redevelopment techniques in flood plain settings were not obtained. Comments on the application of urban renewal techniques in the downtown Lansing area were presented earlier in the preceeding section on evacuation. As noted in that section, flood plain sections in Lansing urban renewal areas will be essentially cleared of existing structures (permanent evacuation) and dedicated to open space and recreation purposes. At the same time, redevelopment efforts are directed at lands lying adjacent to the flood plain and do not include land within the flood prone area.

Rebuilding Finance

The significance of selective controls in rebuilding finance in Michigan flood plain areas is substantial. As pointed out in Chapter III, selective financial controls and loan review procedures can be utilized in encouraging better structural design and construction practices.[1] Flood proofing measures could appropriately be required as a prerequisite to approval of a rebuilding loan. Other controls can serve as inducements in relocating former flood plain structures prior to their reconstruction and reestablishment. Compulsory flood insurance coverage and required flood proofing measures could serve in such a manner. The principle limitation to obtaining such goals, especially the latter, appears to be the result of economic pressures brought on by time and capital investment commitments in the old, flood damaged structure.

Authority for rebuilding finance is shared by private and public

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[1] *Supra*, pp. 137-138.

credit institutions. The principle program which can be identified in the flood loss management area is the disaster loan program of the Small Business Administration. No field information was acquired in terms of the practices of private credit institutions in financing reconstruction of flood damaged properties. In addition little experience with the National Flood Insurance Program can be reported. As a result, the following discussion will concentrate on the Small Business Administration disaster loan program.

The Small Business Administration administers the disaster loans made available to independently owned and operated small businesses, along with home-owners, suffering substantial loss from a major disaster as declared by the President. Loans are made in order to rebuild and/or reestablish businesses and homes which have suffered damages from natural disasters including floods.[1]

The Small Business Administration administers a program involving loans to independently owned and operated small businesses. In the event a natural disaster resulting from a flood is declared a major disaster by the President of the United States, the provisions of the Small Business Act become relaxed. Disaster loans become available to individuals (including home-owners), all businesses, churches, charitable institutions, and non-profit organizations.[2]

The loans are made in order to rebuild and/or re-establish businesses and homes which have suffered damages from declared major disasters. Funds from the loans may be utilized in repairing or replacing damaged structures,

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[1] Small Business Act, as amended, 72 Stat. 384; 15 U.S.C.A. 631, et. seq.

[2] George M. Strong, Supervisory Loan Officer, Financial Assistance Division, Small Business Administration, Detroit, Michigan, Personal Interview, February 17, 1969.

and replacing lost or damaged furnishings, business machinery, equipment and inventory.[1] The loans may be used to pay existing financial obligations except some bank loans. Bank loans may be repaid if the bank is participating in the new loan, i.e., if the new loan is what Small Business Administration refers to as a participation loan. A further condition is that the bank's portion of the new (participation) loan must be at least equivalent to the amount which is being repaid on the previous bank loan.

The disaster loans are characterized by easy terms. The disaster loans carry low loan rates with a maximum ceiling of 3 per cent; an extended maturity of 30 years; and no loan limit. Other Small Business Administration loan programs may have interest rates as high as 5½ per cent; maturity periods of 10 to 20 years; and limits on loan sizes.[2,3] The Small Business Administration can also perform an analogous service to that of the Federal Housing Administration Mortgage Insurance program, in t hat the Small Business Administration can insure up to 90 percent of a bank loan. This is true even in those cases where the bank sets the interest rate on its loans above the Small Business Administration interest rate levels.

From conversations with a Small Business Administration loan official, it appears that the emphasis of the disaster loan program is replacement and/or renovation without significant allowance for upgrading or improvement

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[1] U.S., Small Business Administration, Small Business Administration-What It Is, What It Does, March, 1968 (Washington, D.C.: Government Printing Office, 1968), p. 10.

[2] Ibid., pp. 4-12.

[3] Small Business Act, as amended, Sec. 7(b)(1)(2)(4), 72 Stat. 384; 15 U.S.C.A. 631, et. seq.

of conditions over that which existed prior to a flood disaster. It was indicated that financial assistance for relocation is possible. It is not a stated policy objective and the degree to which it is encouraged is not clear. The loan official indicated relocation might be expected in individual, isolated cases. Where communities are involved, extensive evacuation was suggested as not practicable from an economic standpoint.[1]

In response to a question concerning the influences Executive Order 11296 of August 11, 1966 has had on the Small Business Administration Disaster Loan Program, it was indicated that it has had little effect. It was indicated that in the non-disaster loan programs, flood hazard and risk were already being evaluated prior to the Executive Order. In the 1950's, the focus of such reviews was on improper drainage and flooding due to intensive rainfall with little attention given to riverine flood situations. Subsequently, the focus was broadened to include riverine flooding such that areas were being evaluated prior to the 1966 Order.[2]

There is no coordination by the Small Business Administration with the Federal Housing Administration. This may be attributed in part to the independent nature of the Small Business Administration; i.e., it is not within the cabinet, the Small Business Administration disaster loan program is largely a relief function or post-flood approach to mitigating economic losses. This is in contrast to the Federal Housing Administration's program of passing upon proposed developments. (Although it is true they also administer insurance programs which entail the refinancing of old mortgages or of financing mortgages covering rebuilding, expansion, or

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[1]Strong, Personal Interview, February 17, 1969.

[2]*Ibid.*

improvement of existing developments). Consequently, the two programs are viewed by the Small Business Administration as having different objectives. In the case of agricultural disaster loans, the applicant is referred to the Farmers Home Administration.

Flood Insurance

As noted in previous sections flood insurance in terms of insurance principles is essentially a postdevelopment flood loss management technique.[1] Like flood relief, it does not achieve significant reduction in flood losses as such, but redistributes the loss bearing over a greater number of individuals than those immediately affected by any particular flood event. Its contribution in terms of reducing flood loss potential is derived from qualifications and sanctions attached to the insurance program. At the same time, the insurance principle which underlies flood insurance makes it a highly attractive device for offsetting and hedging against potential flood losses associated with existing developments. This appears to be especially true where public subsidies are involved in making flood insurance policies marketable. Such a conclusion appears applicable to Michigan flood plain management needs and highly appropriate in light of the existing developments in flood plain areas.

Discussion of the program, as presently authorized was given in a preceeding section. One aspect of that discussion can be reiterated here. The flood insurance program is directed at small business operators and residential property owners. For example, the ceiling on subsidized flood insurance coverage for business is $30,000 liability per structure and $5,000 liability per occupant for any contents. Similarly the ceiling

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[1] *Supra*, pp. 81-82 and 138.

on residences is $17,500 per dwelling unit or $30,000 per residential structure and $5,000 aggregate liability per dwelling unit.[1] Provisions are also included for any other properties which might become eligible as non-profit institution or public properties. In such an event, the ceilings applied to business structures and contents will apply to the added coverage classes. Such limits effectively secure the policy of directing the program at small residential units and business operations.[2]

Evaluations of the extent of application of flood insurance programs will have to wait until the currently authorized National Flood Insurance Program is made available and implemented in Michigan.

Other Techniques

Flood Relief

Flood Relief is frequently discussed in flood loss management articles. However, it is generally regarded as a means of mitigating flood losses of those caught in the flood plain by redistributing their loss bearing through the general public. This is accomplished through private and public grants of money, materials, labor and other forms of assistance which ease the loss burden of flood stricken residents and facilitates their return to a pre-flood condition.

Because of the redistributional aspects in loss bearing, relief is not considered as a means of reducing flood losses. Accordingly its appropriateness as a flood loss management device is not evaluated in the same light as those techniques discussed above. However, it should be recognized as a management device. Thus, as long as there are deficiencies

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[1] Housing and Urban Development Act of 1968, Title XIII, 82 Stat. 575; 42 U.S.C.A. 4013(b).

[2] Ibid., 82 Stat. 574; 42 U.S.C.A. 4013(a).

or gaps in community comprehensive flood loss management programs, there will be a corresponding need and demand for public relief.

Flood relief is not exhaustively covered in this study because of the minimal contribution it makes in terms of reducing flood losses. At the same time, it should be noted that there are numerous potential authorities and sources for flood relief. Two of the principle authorities will be discussed below. Program evaluations and history of program actions in terms of Michigan are not reviewed. This omission is not a result of the lack of available documentation of such activities; rather it is a reflection of time and budget constraints.

Disaster Relief

An Act of September 30, 1950 authorizes the President or agencies designated by him to provide disaster assistance in the event of a major disaster.[1] The 1950 Act specifies that the Governor of any state may request disaster assistance when a major flood event is experienced. And while the Act stipulates that a governor must certify the need for disaster assistance, final discretionary approval is left with the President. That is, the final determination is made by the President as to whether a major disaster as defined by the Act has occurred in such severity or magnitude that Federal help is warranted.

Once the President declares a major disaster, various Federal agencies may be called upon to provide relief in the form of technical assistance; loans of equipment, supplies, facilities, personnel, and other resources; and extension of credit. In order to facilitate provision of disaster relief the Office of Emergency Planning has been designated the coordinating

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[1]Public Law 875, September 30, 1950, 64 Stat. 1109; 42 U.S.C.A. 1855.

agency which will act on behalf of the President in organizing relief efforts. It selectively screens applications for disaster assistance before relaying them to the President for his declaration of a major disaster. And when a major disaster is declared, the O.E.P. administers the funds used for disaster relief and coordinates the activities of Federal agencies providing assistance.[1]

Authority to provide disaster relief at the state and local level is provided by the Civil Defense Act of 1953 as amended.[2] Under the original Act a State Civil Defense Agency was created to respond to hostile attacks and natural disasters. Under a later act, the agency was transferred to the State Police and the powers originally authorized by the 1953 Act were invested in the State Police.[3]

Powers conferred by the Civil Defense Act included the granting of emergency powers to the Governor and local heads of government during the declaration of a state of emergency by the Governor. The Act further enables the creation of county and local civil defense units. Under the Act such units are empowered to provide aid during a state of emergency. Such aid can be received from federal or private sources in the form of gifts, donations, grants; or loans of supplies, materials, equipment, money, and other resources. The Act does not specifically allow for the creation or funding of a state disaster fund. Rather, it appears to rely heavily upon the ability of the state to qualify for federal and private

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[1]U.S., Congress, House, Committee on Appropriations, Subcommittee on Independent Offices and Department of Housing and Urban Development, Hearings, Part 2, 90th Cong., 1st sess. (Washington, D.C.: Government Printing Office, 1967), pp. 47-50.

[2]State of Michigan, Civil Defense Act, Act No. 159, Public Acts of 1953, Michigan Compiled Laws Annotated 30.222, et. seq.

[3]State of Michigan, Act No. 236, Public Acts of 1962, Michigan Compiled Laws Annotated 30.310, et. seq.

assistance during times of natural disaster.

The amount of financial relief received or dispersed by civil defense units after serious flood events in the State of Michigan was not compiled. Such data may be compiled through contacts with civil defense offices. However, the general picture given by the Federal Office of Emergency Planning for the Great Lakes Region was one of relatively low involvement in terms of flood relief.[1] This picture was further substantiated by Mr. Strong of the Small Business Administration. He indicated that the Small Business Administrations has had only four occassions to draw upon its disaster loan program under a major disaster declaration in Michigan.[2] Moreover, tornadoes and high winds constituted at least two of the events which qualified for a major disaster declaration.

Flood Warning System

The existence of a decentralized flood warning system was cited as existing in the State.[3] However, no attempt was made under this study at acquiring information and evaluating the warning system. Such a study and evaluation would be a worthy undertaking. However, it was concluded such a study was precluded by the available resources.

Education and Technical Assistance

Education measures in flood plain management are most evident in technical assistance programs developed and sponsored by Federal and Michigan water resource management agencies. Discussions of applications

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[1] U.S., Congress, House, Committee On Appropriations, Subcommittee on Independent Offices and Department of Housing and Urban Development, Hearings, Part 2, 1967, pp. 47-49, Table (not numbered), pp. 50-51.

[2] Strong, Personal Interview, February 17, 1969.

[3] Lawrence Witte, Personal Interview, January 29, 1969.

of educational measures will be incorporated with technical assistance measures and will reflect this integration accordingly. Educational programs which are distinctly viewed as such have yet to be identified and studied in Michigan. Furthermore, the ensuing treatment of technical assistance and education will principally focus on the flood plain information study program of the U.S. Corps of Engineers.

Recent Federal involvement in guiding Michigan flood plain development has been evident through the preparation of flood plain studies. Federal flood plain information studies are directed at providing technical assistance in directing flood plain occupancy. In this manner, it is believed the second declared policy objective of achieving a more optional utilization of flood plains can be furthered by assisting State and local efforts in directing the development on their flood plains.

A recent, strong move by the Federal Government into this policy field is found in Section 206 of the Flood Control Act of July 14, 1960.[1] The Act authorizes the Corps of Engineers to compile and disseminate flood hazard information with an orientation of assisting local land use development decisions in flood plain and hurricane tide zones. Federal study work can only be initiated upon request from appropriate local governmental units. Approval of the requests by State coordinating agencies and the Chief of Engineers must be received before the district Corps office can begin a study. The role of the coordinating agency in each State is to pass on the request and assign a relative priority to each request.

Federal objectives in this program are:

1. To compile specific information on flood and potential flood hazards including identification of areas subject to inundation by various magnitudes and frequencies.

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[1] Flood Control Act of July 14, 1960, Public Law 86-645, Section 206, 74 Stat. 500, 33 U.S.C.A. 709a.

2. To encourage optimum and prudent use of the nation's river valleys by providing State and local agencies the basic flood data necessary for land use planning and regulation programs including preservation of adequate floodways and channel rights-of-way.

3. To publicize available information for the guidance of private citizens and interests on the use and hazards of using flood plain lands.

4. To reduce further expenditures for Federal projects to protect developments which in the absence of the information program, would be constructed or improperly planned.[1]

Other Federal agencies have been involved in flood information and technical assistance studies also. The U.S. Geological Survey is involved in flood plain mapping services.[2] One program in particular consists of outlining areas subject to occassional flooding. The program was recommended by the Task Force on Flood Control Policy with the suggestion that it be done with available information and without definition of frequency of flooding.[3] In this manner, it was hoped that a generalized definition of flood prone areas could be obtained in a relatively short period of time. Subsequent, more detailed studies could be undertaken which precisely define the extent, depth, frequency, and duration of flooding. This would relate to studies as those provided under the Corps Section 206 flood plain information study program.

Allied to the flood plain delineation program are the contracted services performed by the Geological Survey for other agencies. The Survey conducts water resource investigations for Federal and non-Federal agencies

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[1] Water Resources Development in Michigan - 1967, p. 65.

[2] U.S., Congress, House, Committee on Appropriations, Subcommittee on Department of the Interior and Related Agencies, Hearings before a Subcommittee of the Committee on Appropriations, Part I, 89th Cong., 2d sess. (Washington, D.C.: Government Printing Office, 1966), pp. 93, and 156-159.

[3] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 21-22.

and interests on a reimbursable basis. In Fiscal Year 1966 the Geological Survey serviced contracts for States, counties, and municipalities totaling 12.6 million dollars. The Survey described them as consisting

> . . . largely of inventorying and describing the water resources of selected problem areas and in studying technical aspects of specific water problems.[1]

A number of flood plain information studies have been requested by local Michigan governmental units. A listing of applications and state affixed priorities indicates that two urbanizing regions are principle centers for study activity. Southeastern Michigan and south central Michigan have demonstrated an active interest in obtaining flood plain information studies. Reports which have been completed as of June, 1971 include:

1. Upper River Rouge, Farmington, Michigan (1963).
2. Clinton River, Michigan, Main River, Main, Middle, and North Branches (1964).
3. Red Cedar River, Ingham County (1968).
4. River Rouge, Main Branch.
5. River Rouge, Upper Branch.
6. Grand River, Grand Ledge Dam to Dimondale Dam.

One experience was noted with the U.S. Geological Survey in providing flood plain delineation in Michigan.[2] The City of Mt. Clemens contracted with the U.S.G.S. to provide them with information regarding the definition of floods in Clinton River (North Branch and Middle Branch) and Harrington Drain. The resulting product was a topographical map with accompanying

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[1]U.S., Congress, House, Committee on Appropriations, Subcommittee on Department of the Interior and Related Agencies, Hearings, Part I, 1966, p. 83.

[2]S.W. Wiitala and Arlington D. Ash, Floods at Mt. Clemens, Michigan, Hydrologic Investigations Atlas HA-59 (Washington, D.C.: U.S. Geological Survey, 1962).

text which graphically delineated the flood plain for the flood of April, 1947. Also illustrated is the projected effect a completed cut-off canal would have on a flood of equivalent discharge to that of April, 1947. Other stage levels are related to recurrence intervals through a scaled figure. The study was later complemented by a Corps flood plain information study and was followed with the adoption of flood plain regulations by the City of Mt. Clemens.[1] However, no information was obtained for this community on its flood plain regulations. A case study would be valuable to obtain the experiences of this community in adopting flood plain regulations using U.S.G.S. and Corps of Engineers flood plain information.

It was found that a number of flood plain regulations had been adopted by communities as a result of flood plain information provided by the Corps of Engineers.[2] Some of the actions were taken during the conduct of the study and were initially based upon tentative study results. Additional enactments were also forthcoming upon completion and publication of these studies. The adoption of such ordinances has furnished evidence that such technical assistance programs do make a significant contribution to flood plain management. Such evidence reaffirms the findings of Murphy and others when they concluded that (1) the provision of technical information; (2) assistance in interpreting hydrologic data, and (3) assistance in developing flood plain planning and regulatory

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[1]Paul C. Bent, Assistant District Chief, Water Resources Division, U.S. Geological Survey, Lansing, Michigan, Personal Communication, February 25, 1960.

[2]Letters from Mr. Maurice Rapkin, Chief, Flood Plain Management Services, Detroit District, Corps of Engineers, Department of the Army to Mr. Bernard Giampetroni, Director, Macomb County Planning Commission, Mt. Clemens, Michigan, July 26, 1971; Mr. William Rowden, Assistant Director, Tri-County Regional Planning Commission, Lansing, Michigan, July 26, 1971; Mr. George Scrubb, Director, Oakland County Planning Commission, Pontiac, Michigan, July 26, 1971.

measures were essential in community adoption of flood plain management programs.[1]

Comments made by a Lansing city planner responsible for flood plain planning in the city further supported the justification for Federal and State technical assistance.[2] He noted that considerable assistance and cooperation was received from state flood plain management personnel in developing the city flood plain zoning ordinance. Assistance was of considerable benefit in interpreting hydrologic data and frequency expectations provided in Corps of Engineers flood plain information studies. The assistance was essential to the drafting of adequate flood plain definitions and provisions for establishing flood plain limits under the flood plain zoning ordinance.[3,4]

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[1]Murphy, Regulating Flood-Plain Development, 1958, pp. 149-153.

[2]James Church, Personal Interview, October, 1969.

[3]Ibid.

[4]Lawrence Witte, Personal Interview, January 29, 1969.

CHAPTER V

EVALUATION

How does flood loss management measure up in terms of program adoption, implementation, and success? Suggested techniques and measures for managing flood losses were explored in Chapter III. In particular, emphasis was placed upon those techniques directed at reducing flood losses. In the subsequent chapter, treatment was given to the appropriateness and extent of application of such techniques. Now it is appropriate to evaluate program adoption and make recommendations for program improvement when possible and/or further study where necessary.

Varying levels of evaluations will be found in each of the following techniques. Greatest attention is given to floodway encroachment regulations, flood plain zoning, subdivision regulations, and engineering works of protection. Such attention is given to these techniques because they have received the most attention in this state in terms of program execution. At the same time, some coverage needs to be given to several promising areas of flood loss management in Michigan. Techniques included in the promising category include acquisition, building finance, flood proofing, flood insurance, redevelopment, and comprehensive planning. In some cases, evaluation of these techniques may be limited in terms of present program execution. Nevertheless some specific consideration can be advanced regarding further needs for research, evaluation, and application. Techniques not mentioned in the above two listings will also receive brief comment. Much of the comment will reflect the lack of collected information

or absence of technique applications within the State of Michigan. Finally, two frequently overlooked techniques will be evaluated in terms of their application and contribution to overall flood loss management objectives. These two techniques are education and technical assistance.

Predevelopment Flood Loss Management

Compulsory Techniques

From the research and discussion presented in the previous chapter it is clear that much of the recent movement in flood loss management in Michigan has been in regulating the development of flood plains through applications of the police power. State involvement has focused on floodway encroachment regulations and subdivision regulations. Local programs of action have focused on flood plain zoning and to a lesser extent channel encroachment restrictions. In short, attention appears to be increasingly directed at compulsory flood plain management techniques by state and local governments in Michigan. Evaluation of some of the existing applications will be presented below.

Floodway Encroachment Regulations

A number of information sources were utilized in evaluating Michigan floodway management problems and needs. Current program information was requested from selected states in terms of their applications of floodway regulations. The states were contacted on the basis of prior knowledge of authorized floodway regulation. Studies and evaluations made by Dunham (1959), Morse (1962), Murphy (1958), Perry (1956), and others were used as the background base against which the current programs were evaluated.

Information was sought concerning adjustments in floodway regulatory programs which had occurred since the previous study work of the late 1950's and early 1960's. Requests were made for information concerning

program authorizations, causal basis for recent adjustments in program authorizations, program implementation, legal challenges, and experiences with program administration. The latter aspect emphasized the need for program cost information in defining or establishing floodway encroachment zones.

It was expected that information relating to historical problems and ensuing program adjustments in other states would be of substantial value in evaluating Michigan floodway management needs. It is important to note that at the initiation of this study Michigan was without any statewide floodway regulatory program. In June of 1968, a little over a year after the start of this study, floodway encroachment legislation was enacted at the state level. The legislative action changed the perspective for evaluating other state regulatory programs. Nevertheless, experiences of other states in floodway regulations were still felt to be potentially relevant in evaluating the new State of Michigan floodway management program.

The ensuing evaluation will focus on state and then local floodway encroachment regulations in Michigan. Principle attention will be focused at the state level on legal soundness, floodway criteria, program implementation, and administrative enforcement. Local program evaluations will be constrained to floodway criteria.

Authority for state floodway regulation in Michigan issues from Act 167 of Public Acts of 1968.[1] It is a relatively recent enactment when constrasted to the nine states known to have floodway or channel encroachment regulations. The states and their dates of legislative authorization include Connecticut (1955), Indiana (1945), Iowa (1949), Kentucky (1948),

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[1]Michigan, Act 167, 1968, M.C.L.A. 323.1, et. seq.

Massachusetts (1939), New Jersey (1929), New York (1956), Pennsylvania (1913), and Washington (1935). Strengths and weaknesses of these various programs were assessed to varying degrees by Dunham, Morse, Perry and others. Their reviews coupled with information obtained specifically for this study from seven of the nine states have provided a background against which the recent enactment in Michigan could be evaluated.

Michigan Act 167 of 1968 provided a much stronger and sweeping authority than those originally enacted in the other states. Integration of flood plain delineation with application of restrictive regulations in floodways is achieved under the Michigan act. Such an integration is reflective of recent amendatory actions taken in at least four of the above cited states.

Prior to the 1960's most of the floodway or channel encroachment regulations were quite narrow in authority and program application. A series of amendments in the 1960's altered this picture in Iowa, Massachusetts, New Jersey, and Washington wherein more rigorous regulation of floodway areas was combined with general flood plain delineation. Iowa in a 1965 amendment expanded the scope of its floodway regulations to include flood plain regulations under the original 1949 enabling act.[1,2] Massachusetts followed a different approach in which flood plain and floodway regulations were jointly authorized under special wetland protection and flood plain zoning acts. Such enactments serve effectively to complement the weaker Channel Encroachment Act of 1939.[3,4,5] A seeming weakness or

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[1] Letter from Othie R. McMurray, Director, Iowa Natural Resources Council, September 15, 1969.

[2] State of Iowa, Acts of 1949 (53 G.A.), ch. 203, sec. 18, as amended with particular reference to Acts of 1965 (61 G.A.), ch. 373, sec. 3; Iowa Code Annotated 454.35.

[3] Annotated Laws of Massachusetts, Vol. 3, ch. 91, sec. 12a.

[4] Letter from John P. King, Associate Commissioner, Department of

drawback to the Massachusetts approach is the large number of separate regional authorizations, each one of which provides for a number of water resource management functions.[1] In like manner, New Jersey has not liberalized nor strengthened its original Stream Encroachment Act of 1929.[2,3] The state did enact a Flood Plain Delineation Act in 1962 which corrects deficiencies in the 1929 Act but does not supersede the older Act.[4] The 1962 Act allows for a much broader, integrated flood plain and floodway regulatory program.[5] Finally, the State of Washington proceeded to extend and strengthen its floodway regulatory program by adopting more stringent and sweeping rules and regulations.[6] No new legislation was adopted; rather the rules and regulations were promulgated upon a more liberal interpretation and application of the old act of 1935.[7]

Public Works, the Commonwealth of Massachusetts, September 16, 1969.

[5]Letter from Clinton E. Watson, Resource Planner, Water Resources Commission, the Commonwealth of Massachusetts, September 16, 1969.

[1]Commonwealth of Massachusetts; Chap. 554 of Acts of 1961; Chap. 571 of Acts of 1962; Chap. 421, 426, 435 of Acts of 1963; Chap. 131, 220 and 768 of Acts of 1965; and Chap. 444 of Acts of 1968.

[2]Letter from George R. Shanklin, Director and Chief Engineer Division of Water Policy and Supply, Department of Conservation and Economic Development, State of New Jersey, November 12, 1969.

[3]State of New Jersey, Stream Encroachment Act of 1929, Revised Statutes 58: 1-26.

[4]State of New Jersey, Flood Plain Delineation Act of 1962, New Jersey Statutes Annoted 58: 16a, et. seq.

[5]Dirk C. Hofman, Supervising Engineer, Division of Water Policy and Supply, Department of Conservation and Economic Development, State of New Jersey, "New Jersey's Flood Plain Management Program Implementation in the Raritan River Basin," paper presented at National Meeting on Water Resources Engineering, American Society of Civil Engineers, New Orleans, La., February 4, 1969, pp. 21-23.

[6]Letter from Walter Bergstrom, Engineer, Operations Section, Division of Planning and Development, Department of Water Resources, State of Washington, September 16, 1969.

[7]Administration of State Flood Control Zones by the Department of Water Resources Pursuant to and under the authority of Chapter 86.16 R.C.W., Department of Water Resources Docket No. 68-9, February 27, 1969.

Dunham's review was the most penetrating for reviewing the constitutionality of floodway encroachment regulations. Michigan Act 167 appears to conform or answer the three fundamental criteria suggested by Dunham as essential to meeting constitutional requirements.[1] Requirements of due process, equal protection of the law, and considerations of federal supremacy appear to be adequately provided for within the act and within the adopted rules and regulations of the Michigan Water Resources Commission.

Dunham found weaknesses in floodway encroachment statutes in Connecticut and Indiana.[2] Both states enabling acts were found potentially deficient in fulfilling equal protection of the law requirements. In Connecticut the language of the 1955 Act was suggested as being to narrowly applied. The provisions of the act appeared to restrict regulations of floodway encraochments in those areas where flood control projects were being considered. It was argued the effect of such legislation could be construed as attempting to minimize future acquisition costs. In Indiana, the provisions of the 1945 Act were suggested as being pointed at regulating residential developments in floodway areas.

The Indiana Flood Control Act of 1945 was revised and amended in 1961.[3] Provisions of the Act were expanded and generalized such that any structure

> . . .by virtue of its nature, design, method of construction state of maintenance or physical condition, will constitute an unreasonable hazard to safety of life or property, and the same are declared to be and constitute a public nuisance.[4]

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[1]Dunham, "Flood Control Via the Police Power," 1959, p. 1121, *et. seq.*

[2]*Ibid.*

[3]State of Indiana, *Flood Control Act of 1945*, as amended, with particular reference to the *Flood Control Act of 1961*; *Annotated Indiana Statutes* 27-1101, *et. seq.*

[4]*Ibid.*

Mr. Robert F. Jackson in his letter stated

> We do not know if the articles cited in your letter had any bearing on the amendments made to the Flood Control Act in 1961. We are more inclined to feel that the changes were made to correct deficiencies or short comings that were experienced during several years of operations under the original act.[1]

Whatever the stimulus for causing the revision in the 1945 Act, the narrowness of statutory application discussed by Dunham appears to be corrected.

Connecticut's 1955 Stream Encroachment Act has also been revised. However the 1963 amendments did not alter the language which was of particular concern to Dunham.[2] Moreover, a Connecticut Supreme Court of Errors ruling upheld the constitutionality of the Connecticut Act in June, 1959. This unfortunately coincided with the time Dunham's article was published and therefore prevented his review of the ruling.[3] The decision is highly significant in that it was one of the few recorded cases directed at challenging the constitutionality of a floodway encroachment law. In its decision the court reversed the lower trial courts ruling. The unpublished lower court ruling was reported by Dunham to have concluded that the law was in fact attempting to save the government from the expense of acquiring property through unjust application of the police powers.[4] Unfortunately, this line of reasoning is not directly addressed in the review and ruling of the Supreme Court of Errors. The latter court overruled the lower trial court by noting that the plaintiff

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[1]Letter from Robert F. Jackson, Chief, Division of Water, State of Indiana, October 29, 1969.

[2]State of Connecticut, Public Act No. 435 of 1963, General Statutes of Connecticut, Title 25, Chapter 477, Sec. 25-4a (1963 supp.).

[3]Vartelas v. Water Resources Commission, 146 Conn. 650, 153A.2d 822 (1959).

[4]Dunham, "Flood Control Via the Police Power," 1959, p. 1125; Note: Footnote No. 46 cites Unpublished Opinion of Dube J., Court of Common Pleas, Judicial District of Waterbury, Conn., Docket No. 16.018, decided July 18, 1958.

had not exhausted all the remedies available to him. Moreover,

> The commission has, at most, refused its permission for the erection of a particular structure. Whether the plaintiff could build another type of structure --for example, one on piers or contilevers -- which would not impair the capacity of the channel in time of floods is a matter which the commission was not asked to, and did not, pass upon.[1]

In reviewing the background of the case, the Supreme Court of Errors made careful note of the need to distinguish between application of the police powers and eminent domain. It is in this discussion, that the Court comes closest to Dunham's point of concern when it found that the obvious purpose of the enactment

> . . .was to enable the water resources commission to forestall, by stream clearance, channel improvement and other flood control measures, a repetition of the havoc wrought in those floods of August, 1955. The legislation was an exercise of the police power of the state in the interest of public welfare.[2]

Because Dunham's argument is clear and forceful and in light of a careful reading of the 1955 version of the Connecticut Act, i.e., prior to the 1963 amendments, it is difficult to offer reasons for the Supreme Court of Errors avoidance of the issue concerning the discriminatory application of channel encroachment limits. Specifically, were channel encroachment regulations being selectively applied to only those reaches of the stream for which future public works for flood control? No comment is made anywhere in the discussion of the facts of the case concerning proposed public works for flood control which would involve the flood plain property being contested. Consequently, it may be found that a more liberal interpretation of the application of the provisions of the act is being sustained in regulating stream channel encroachments in general. In

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[1] Vartelas v. Water Resources Commission 153A.825.

[2] Ibid. 153A.824.

such an event, the equal protection of the laws requirement may be more closely achieved.

The Vartelas v. Water Resources Commission case is nevertheless highly significant to Michigan and other states where floodway encroachment, flood plain zoning, or subdivision regulations are being enacted and implemented. The Supreme Court of Errors carefully developed and followed the justification for applying police powers in regulating flood plain areas. The fact that the decision reaffirmed a questionable statute is not damaging, in that the argued weakness in the Connecticut statute can be easily corrected without altering the application or appropriateness of the ruling.

Neither of the two problem areas pointed out in Indiana and Connecticut acts have been found within Michigan Act 167. Encroachment as defined under the adopted rules and regulations applies to ". . .any structure, deposit, or fill, in, along, across, or projecting into any flood plain, channel or floodway."[1]

Nevertheless, a potential deficiency in the Michigan floodway encroachment regulatory program may be suggested. This pertains to the question of whether injunctive relief can be brought under the Act to remove an unlawful obstruction in a defined floodway. The Act allows for the commission

> . . .to bring any appropriate action. . . , either at law or in chancery as may be necessary to carry out the provisions of this act, and to enforce any and all laws relating to. . . the obstruction of the floodways of the rivers and streams of this state.[2]

In the event relief is available and can be sought from an obstruction which predates the enactment of Act 167, then questions based upon due

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[1]Rules and Regulations of the Michigan Water Resources Commission, January 21, 1970, R. 323.201.(5).

[2]Michigan, Act 167, 1968, Sec. 3.

process may be forthcoming in challenging such relief.

In contrast, it should be noted that other states provide more explicit statements of the enforcement and judicial remedies available for abating existing floodway encroachments. Connecticut, Indiana, Iowa, and Washington include specific provisions in their respective acts which authorize floodway encroachment abatement actions.[1] New Jersey and Pennsylvania have provisions for assessing fines against those who would permit or construct obstructions in the floodway without permit.[2] However, little comment was found or received which related experiences in taking such courses of action in any of these states.

Authority under Michigan Act 167 is granted for regulating the filling, grading, and construction of obstructions in the flood plain, stream bed, channel, or any stream in the state. Particular attention is given to establishing performance type criteria which state that harmful interferences with the discharge or stage characteristics of a stream are unlawful unless formally permitted by the State Water Resources Commission.[3] Precise definition of structures, flood plain areas, and hydrologic criteria are left to the Commission. This is somewhat unusual relative to other state authorities, wherein general definitions of regulated structures, flood plain, and/or floodway are set forth in the authorizing legislation. On the other hand, operational or precise definitions of

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[1] General Statutes of Connecticut, 25-4e. Annotated Indiana Statutes, 27-1117 and 27-1123a. Iowa Code Annotated, 455A.33. Annotated Laws of Massachusetts, Vol. 3, Ch., 91, Sec. 12A. Revised Code of Washington, 86.16.090.

[2] New Jersey Statutes Annotated, Title 58, Ch. 1-26. Pennsylvania Statutes Annotated, Title 31, Ch. 25, Sec. 682 & 687. Note: New Jersey allows each days continuance to constitute a separate offense. Pennsylvania provides for a maximum fine and/or imprisonment of up to one year.

[3] Michigan, Act 167, 1968, Sec. 5b.

these terms frequently do not result until rules and regulations are adopted by the regulating agency.

Operational definitions are established in the adopted rules and regulations for administering Act 167.[1] Criteria adopted for flood plain and floodway delineation in Michigan are quite inclusive in that extensive portions of natural flood plain areas are encompassed. An intermediate regional flood has been established as the implementation standard. The event is defined to have "a 1% chance of occuring or being exceeded in any given year."[2] Such a frequency probability achieves a high degree of flood plain area definition.

The form of the intermediate flood definition is significant and desirable in that it stresses the probability risk function associated with flooding as an event. The probability level, 1 percent is comparable to the 100 year flood reoccurance concept, but it avoids the stage-discharge levels often associated and specified with the latter notion. As noted earlier, frequency occurances of given flood discharges may be altered due to natural and human adjustments in river basins and watersheds. This is particularly true in urbanized areas and the smaller more frequent flood events. Thus, some of the distinction is lost between a probability function expressed as a percentage and one expressed in terms of a number of years with an associated stage-discharge level as more infrequent flood events are considered such as the Michigan intermediate flood. Nevertheless, the percentage probability expression remains a desirable method of expression.

Use of a 1 percent probability frequency level places Michigan among those states having more restrictive floodway definitions. Connecticut continues

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[1] State of Michigan, Rules and Regulations of the Michigan Water Resources Commission, Department of Natural Resources, Flood Plain Control, January 21, 1970, R. 323.201, *et. seq.*

[2] *Ibid.* R. 323.201.(8).

to use a flood event defined by multiplying the mean annual flood by an adjustment factor.[1] Murphy had indicated that in 1958, a factor multiple ranging from five to seven resulted in a flood frequency interval of 34 to 125 years.[2] Indiana did not have uniform criteria in 1958 and may still not have adopted any. Permit applications are reviewed individually and no floodway limits have been defined although they have been authorized.[3,4] Iowa until recently did not have any criteria established.[5,6] Now urban areas are subject to floodway limits defined by a regional flood concept. The relative frequency intervals of these were not specified. Rural or non-urban areas are subject to an individual project permit review criteria in which displacement or impoundment factors are considered in terms of backwater effects. Massachusetts operated under a weak criterion. The high water mark in the channel was defined as the channel encroachment limit under the 1939 act.[7,8,9] This criterion continues to be the basis for definition under the 1939 Act. More recent acts allow the flood plain and floodway to be defined in specifically authorized streams or river basins. However, no encroachment limits other than the high water mark are utilized

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[1]Letter from Robert A. McCabe, Hydraulic Engineer, Water Management, Water Resources Commission, State of Connecticut, November 5, 1969. Mr. McCabe noted that a factor of 3 times mean annual floods has been used in some cases since Murphy's writing.

[2]Murphy, Regulating Flood-Plain Development, 1958, p. 21.

[3]Ibid., p. 22.

[4]Letter from Robert F. Jackson, October 29, 1969.

[5]Murphy, Regulating Flood-Plain Development, 1958, p. 24.

[6]Letter from Othie R. McMurray, September 15, 1969.

[7]Murphy, Regulating Flood-Plain Development, 1958, p. 27.

[8]Letter from John P. King, September 16, 1969.

[9]Letter from Clinton E. Watson, September 16, 1969.

when defining floodway limits.[1] New Jersey, currently follows an approach similar to Connecticut. A mean annual flood multiplied by an appropriate factor to derive a design discharge level for delineating floodway and flood plain areas is used.[2] Formerly, a minimum channel encroachment zone was defined wherein an improved earth trapezoidal channel was assumed in defining an encroachment limit.[3,4] Experience demonstrated that channel improvements were not generally instituted and the associated encroachment limits were then much too narrow. Pennsylvania was reported by Murphy to have no set criteria in using an envelope curve method. Individual permit reviews were made with resulting encroachment limits falling in a 25 to 100 frequency range.[5] Assistant Attorney General Mapel registered some disagreement with Murphy's assessment in terms of interpretation of what constituted an obstruction and what was available in setting encroachment limits. Mr. Mapel indicated that the encroachment limits are "limited by statute to low water mark," and that attempts to extend jurisdiction into the natural flood plain were rebuffed by the Courts.[6] Further clarification of these remarks and assertion are needed to clarify the discrepancies. Washington was also cited by Murphy as employing no uniform criteria in defining encroachment limits. The resulting encroachment limits

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[1]Letter from John P. King, September 16, 1969.

[2]Hofman, "New Jersey's Flood Plain Management Programming," 1969, pp. 22.

[3]Murphy, Regulating Flood-Plain Development, 1958, p. 28.

[4]Letter from George R. Shanklin, November 12, 1969.

[5]Murphy, Regulating Flood-Plain Development, 1958, p. 27.

[6]Letter from Assistant Attorney General Carl R. Mapel, Jr., Water and Power Resources Board, Department of Forests and Waters, Commonwealth of Pennsylvania, October 30, 1969.

fell within a flood frequency range of one to 100 years. Since that time a more aggressive administration has adopted rules and regulations which establish a minimum frequency interval of 10 years and a maximum of 50 years for defining floodway encroachment limits.

A considerable range in channel and floodway encroachment limits is evident in other states. Murphy concluded that, in general, state restrictions were in themselves overly conservative using ". . .very low criteria for defining channel encroachment. . ."[1] Correspondence was initiated with the states reviewed by Murphy in order to update his evaluations. Some of the important changes and improvements were noted above. Nevertheless, there still appears to be a general need for improvement in the state of the art in those states reviewed in terms of adopting uniform criteria for delineating floodway encroachment limits.

As noted, Michigan may in fact be among the leaders in states having restrictive criteria for defining floodway encroachment limits. The significance of this may be heightened by the fact that Michigan streams and watercourses are generally noted for having weakly defined channel areas. As a result, floodway areas may encompass more of adjacent flood plain areas than floodways found in well dissected watersheds where topographical relief is more developed. On the other hand, it was noted that generally there were not significant differences between floodway areas needed to pass a '50 year flood' and a '100 year flood.'[2]

In this regard, it is important to note a subtle but significant distinction is present in Michigan Water Resources Commission administration of flood plain regulations. Principle concern is directed by the Michigan

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[1]Murphy, Regulating Flood-Plain Developments, 1958, p. 16.

[2]Lawrence Witte, Personal Interview, January, 1969.

Water Resources Commission at preserving floodway channel flows. Similar concerns are directed at fill operations or developments which threaten to materially alter flood plain storage capacity. Smaller fills in flood plain storage areas do not appear to be of primary concern. This in large part relates to the difficulties in evaluating minor flood plain fill effects on flood stage levels.[1,2]

A second important observation should be noted. There was little estimation or evaluation of the economic implications of varying floodway encroachment limits. Such work is absent in Michigan as generally elsewhere. Dunham presented some of the elements required in such an evaluative process, but his presentation was based largely on the presumption that such evaluations can be made. Specifically, his legal review directed attention at the question of precluding the development of floodway obstructions which posed large or hazardous external diseconomies.[3] In light of Dunham's work and others such as Murphy, it was quite surprising to find so little in terms of reported economic evaluation of the consequences of different floodway encroachment limits.

This latter observation is quite important in that it can be extended to the general area of flood plain management regulations. It appears that it is often concluded *a priori* that those areas which will be restrictively regulated are areas in which economic development could not be established or would result in large external diseconomies. Actually, not enough work has been presented to carefully document such conclusions

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[1] *Ibid.*

[2] Such problems are also recognized in the *Farmington, Michigan Flood Plain Information Report*, 1963, p. 20. The conclusion in that report suggested a different approach to all fills in the flood plain.

[3] Dunham, "Flood Control Via the Police Power," 1959, pp. 1103-1107.

in the general flood plain. In the floodway zone the ability to establish the external hazards to health and safety posed by obstructions to flood flows may be sufficient justification to bring about application of the police powers. Nevertheless, little work is actually available which establishes the economic implications of physically protecting flood plain and floodway areas as contrasted with the prevention of economic development under restrictive land use regulations.

Once floodway encroachment criteria are established, program implementation must be initiated. In this regard Michigan appears to be troubled by administrative problems similar to those experienced in other states. Murphy and Perry in separate studies noted that floodway encroachment limits were not effectively being implemented due to deficiencies in administrative staffing.[1,2] In effect too few resources were being provided by the state legislatures to fully implement the acts. Communication from Mr. McMurray (Iowa) and Mr. Bergstrom (Washington) indicate that the lack of financial resources and manpower continue to constrain full implementation of their floodway programs.[3,4] It is suspected that this assessment continues to be typical of the other states with floodway encroachment regulatory programs.

Such was the case in 1969 in Michigan when initial interviews were conducted at the Michigan Water Resources Commission.[5] Severe shortages

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[1]Murphy, Regulating Flood-Plain Development, 1958, p. 16.

[2]Joseph I. Perry, "Use of Zoning Principles in Flood Plain Regulations," Reprint in Journal Hydraulics Division of American Society of Civil Engineers, Vol. 82, No. HY2, Paper 957, April, 1956, p. 957/4.

[3]Letter from Othie R. McMurray, September 15, 1969.

[4]Letter from Walter Bergstrom, September 16, 1969.

[5]Lawrence Witte, Personal Interview, January 29, 1969.

in numbers of staff personnel curtailed the general flood plain management program and caused significant backlogs in permit reviews for subdivision plats as well as floodway encroachment permit applications. This also curtailed the amount of field inspection that could be undertaken. Subsequent additions of staff members has increased the capacity of the flood plain management section for processing permit applications. However, the number of applications have increased at such a rate that considerable time delays still result from continuing backlogs.[1]

Little has been done in Michigan in terms of establishing floodway encroachment limits along reaches of state watercourses. Such a failure is again reflective and is characteristic of the situation in other States. Only Connecticut and New Jersey were reporting success in moving ahead with the establishment of encroachment limits.[2] Massachusetts and Iowa related significant increases in authority for setting floodway encroachment limits, but failed to report on successes in establishing such limits.[3] Washington reported that 16 rivers had flood control zones established prior to 1935; but no further rivers had been zoned since then. Present energies were directed at just handling individual permit applications.[4]

It is interesting to note that one writer observed that the review and administrative order entered on each floodway encroachment permit was in fact a method of establishing encroachment lines. Mr. Dola of New Jersey

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[1]Lawrence Witte, Personal Communication, September, 1971.

[2]Letter from Robert A. McCabe, November 5, 1969. Hofman, "New Jersey's Flood Plain Management Program," 1969, pp. 22-23.

[3]Steven Dola, Flood Damage Alleviation in New Jersey, Water Resources Circular No. 3 (State of New Jersey: Department of Conservation and Economic Development, Division of Water Policy and Supply, 1961), p. 6.

[4]Letter from Walter Bergstrom, September 16, 1969.

noted "encroachment lines are essentially established each time a permit is issued. . ." While this is a novel argument it is believed that floodway encroachment limits defined for continuous reaches of a watercourse are a more desirable objective and practice. In part, this would facilitate the transfer and sharing of responsibilities between state and local areas.

Several states noted the importance of obtaining a cooperative and integrated approach to floodway encroachment regulation. Communications from Mr. McMurray in Iowa and Mr. Bergstrom in Washington emphasized the importance of such relations. Mr. McMurray noted that the revisions in the flood plain management program in Iowa allowed for local governments

> to administer local flood plain regulations without each individual construction project having to be approved by the Council, if the local regulations meet Council requirements. Such an arrangement removes a tremendous work load from the Council and distributes it among the various local communities where such administration logically belongs.[1]

Such an observation would seem equally applicable to the State of Michigan if more of the administrative burden could be shifted to local governments, more attention could be devoted to research, data collection, development of new techniques for defining encroachment limits, providing technical assistance, and reviewing local encroachment regulatory programs. Some information was available for the engineering costs in establishing floodway encroachment limits. Even less information was available on costs of reviewing and permitting individual floodway encroachment applications. In general, the above cited states reported that records of administrative costs in such programs were not kept or that the costs

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[1]Letter from Othie McMurray, September 15, 1969.

of separating out the various administrative duties of their staffs was not readily available.

Connecticut was the only state to have reported on the costs of establishing channel encroachment limits. Murphy in 1958 cited 2,000 dollars per mile of stream reach.[1] Pelletier in 1960 gave an estimate of 5,000 dollars per mile of stream reach.[2] He also gave a clearer breakdown of the aggregated estimate: 1,500 dollars per mile for the original channel survey, 12,000 dollars per mile for computations and study reports, 2,000 dollars per mile for surveys of final lines, and 300 dollars per mile for miscellaneous costs including advertising, printing, recording, and other costs. These averages were developed from 46.6 miles of completed river channel encroachment limits and 62.6 miles of river in process of having such limits defined. The aggregate costs were 350,000 dollars to date. At that time, between 1,250 and 1,300 parcels of land and 1,150 land owners had been affected. More recent cost figures were relayed on a graph forwarded with a letter from Mr. McCabe an Hydraulic Engineer with the State of Connecticut Water Resources Commission.[3] The graph plotted cost of encroachment line surveys, study, and mapping versus length of river. The costs were scaled in dollars per river mile. The graph revealed a range of slightly less than 5,000 to 15,000 dollars per river mile. It was suggested that there was a slight tendency for the costs per linear mile of reach to decrease as longer rivers were dealt with. Also, photogrametric topographical survey-line locations which were scaled from the map were consistently found near the 5,000 dollars per mile minimum range level. This was contrasted to ground topographic

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[1]Murphy, Regulating Flood-Plain Developments, 1958, p. 22.

[2]Charles J. Pelletier, Hydraulic Engineer, Connecticut Water Resources Commission, "Connecticut's Program for Establishing Stream Encroachment Limits," Paper presented before Thirty-Third Meeting Northeastern Resources Committee,

survey-line locations staked in the field. No further information was offered on these techniques.

Local floodway encroachment regulations in Michigan were earlier characterized as one of two types: (1) general landfill ordinances and (2) flood plain zoning containing floodway encroachment control provisions. In general neither ordinance approach evidenced a clear definition of the floodway concept, nor was there a clear distinction maintained between floodway encroachment zones and backwater storage areas.

Two of three communities adopted floodway encroachment regulations as a part of their comprehensive landfill ordinances. Fill ordinances in the City of Southfield and the Township of Farmington in Oakland County were found to be lacking in clear definition of floodway and flood plain areas.[1,2] Both ordinances prohibited dumping of materials in spillways, flood plains, or upper and lower banks of local watercourses. Spillways and flood plains were not adequately defined. The third area cited in the ordinance, upper and lower banks of a watercourse, offered somewhat more precision for delineating an area, but such criteria would effectively limit the regulations so as to constitute a channel encroachment regulation.

Only the City of Detroit evidenced an understanding of floodway and flood plain areas in its flood plain fill ordinance.[3] It came closest of all local Michigan ordinances reviewed for this study in approaching a distinct floodway encroachment ordinance. Nevertheless, the definitions

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Berlin, Connecticut, September 13, 1960, p. C-8.

[3]Letter from Robert A. McCabe, November 5, 1969, with graph enclosed plotting cost figures for the 1963-1969 period.

[1]City of Southfield, Fill Ordinance No. 718.

[2]Township of Farmington, Ordinance No. 33.

[3]City of Detroit, Ordinance No. 784-F, Sections 2(a), 2(b), and 5.

within the ordinance lacked some degree of precision in criteria for floodway delineation. It appeared that more precise definitions were provided by the City Engineer's Office in administering the ordinance. Limits of the flood plain and floodway apparently were available on maps in the City Engineer's Office which provided identification of such limits on individual parcels.[1] Little information was provided on actual operational criteria utilized in defining such zones.

Several limitations are discernable in the Detroit ordinance. The provisions of the regulations apply only to the reaches of the Rouge River lying within the City of Detroit. Only control over filling and placing of deposits in the flood plain and floodway is provided. Consequently, control over structural developments are not specifically provided for in the ordinance. Penalty provisions are available for fining and potentially imprisoning violators. However, provisions are absent in terms of obtaining abatement of fill obstructions.

No information was acquired on experiences in ordinance implementation and enforcement in any of the three cited communities. In light of the deficiencies in ordinance definitions, it is still possible to conclude that significant improvements in ordinance development could be accomplished through increasing the precision of the definitions.

The principle and pervasive weakness of all three acts is the restricted application of the controls. Each ordinance is directed at fill and excavation operations. None are specifically directed at controlling erection of structural obstructions in floodway areas. Accordingly, such local ordinances are not comprehensive enough in terms of attaining the objectives of floodway encroachment regulation.

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[1]Letter and attached materials from Guenther K. Weidle, Head City Planner, Current Plan Division, City of Detroit, February 26, 1969.

Similar deficiencies were found in flood plain zoning ordinances which included floodway encroachment limits. Most notable was the confusing or mingling of floodway and flood plain pondage zones. Many of the flood plain zoning provisions were in effect floodway encroachment regulations. As a result, excessively restrictive controls were placed on general development in flood plain pondage areas. It has been argued that restrictive controls as no filling and development of structures in the floodway zone appear sustainable.[1,2] However, their projection and application in the flood plain zone may be quite inappropriate. Such a statement is tempered by the fact that most of the reviewed ordinances allowed for granting of special use permits. Nevertheless, ordinances generally failed to clearly distinguish between encroachment zones and flood plain pondage areas.

One qualification to the above statement may be noted in the City of Farmington Zoning Ordinance. The flood plain provisions for the River Valley Districts maintain an implicit or de facto distinction between floodway and flood plain pondage areas.[3] However, the floodway area in the City of Farmington ordinance appears to be delineated by the flood plain area of the flood of record. That is, the floodway area required for the flood of record (1500 cfs) does not appear to be the basis for defining the ordinance floodway. Rather, the flood plain of the flood of record is used as a basis for defining the floodway. If this is an error or the result of a confusion of concepts the cause might be attributed to an

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[1] Dunham, "Flood Control Via the Police Power," 1959, pp. 1108 and 1110-1111.

[2] Vartelas v. Water Resources Commission 153 A. 824.

[3] City of Farmington Ordinance No. C-180-63. Floodway as such is not mentioned in the ordinance, but the development of the regulations are such that an implicit floodway area is created.

inadequate understanding of the line defined by a flood of 1500 cfs in a Corps of Engineer flood plain information study.[1] The result of this interpretation is one of applying floodway encroachment regulations to a flood plain zone defined by the flood of record.

The Corps of Engineers attempted an explanation of the consequences of fill operations in the floodway and flood plain. They aptly noted

> The channel and the flood plain immediately adjacent should not be encroached upon with any filling or structures which would tend to obstruct flood flows and raise upstream stages.[2]

It is in the continuation of their presentation that questions and problems emerge in terms of what constitutes appropriate development restrictions. They state

> Although small, more-distant filling in the pondage area may be less harmful in the immediate area, it should be recognized that numerous individual fills will in the aggregate, increase the flood problem downstream. The best rule is to avoid any filling of the flood plain which can be expected to be inundated.[3]

Their suggested rule if taken to literally by a community may result in no filling or structural developments in the flood plain pondage area. It is believed that such a translation, as evident in the City of Farmington ordinance, may be too extreme. Such a rule is based upon a

> premise that the existing regimen (flow characteristics) of the stream is the most severe that is tolerable by all of the inhabitants and users of the flood plain of the entire river,. . .[4]

What constitutes the criteria for "tolerable" appear to be elusive at present in light of the absence of economic data and analysis.

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[1] Farmington, Michigan Flood Plain Information Report, 1963, pp. 10, 11, 18, and 20; figure A-2, and plate 2.

[2] Ibid. p., 20.

[3] Ibid. p. 20.

[4] Ibid. p. 11.

As a general principle, the Corps rule obtains its justification for the assumed reason cited in the last quote. However, because it is frequently difficult to relate individual actions in a causal manner to increased flood damages affecting others, more discretion may be justified in applying the rule to flood plain pondage areas. The reasons for this were presented earlier and discussed at length by Dunham.[1] In the illustration at hand, the community not only prescribed restrictions on placement of fill in the flood plain but structures also. A complicating consideration here is brought about by the exact characterization of the zone lying below the 1500 cfs flood plain limit; i.e., Is it in fact a floodway zone? If not, where does the floodway encroachment limit terminate?

Part of the answer to the dilemma is found in the Special Use Permit concept as adopted in many of the ordinances reviewed earlier. Fills can be prohibited as a general rule. Some adjustment or flexibility may be allowed in granting a special use permit if "through compensating excavation and shaping of the flood plain, the flow and impoundment capacity of the flood plain will be maintained or improved."[2] Even this adjustment needs some qualification. Mr. Shanklin, Director and Chief Engineer of the New Jersey Division of Water Policy and Supply, commented that issuance of their permits will now be

> based on the existing natural channel in an effort to maintain the natural flood regimen of the stream. This is not to say that we will be eliminating channel improvements. We will however, require that channel improvements be done on a significant reach of stream. We will no longer permit improvements on a piecemeal basis, as this is what tends to aggravate flood conditions.[3]

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[1] *Supra*, pp. 34-37.

[2] City of Farmington Ordinance No. C-180-63, sec. 5.484(2).

[3] Letter from George Shanklin, November 12, 1969.

Emphasis in the quote related to channel improvements as they relate to flood flows. This should be the principle concern in floodway encroachments. Adjustments in flood plain storage areas may be more readily obtained on an individual permit basis due to the focus on displacement as contrasted to flood flows.

In a similar vein, flexible restrictions are required when considering structural developments in the pondage areas. Structures could be allowed where design features provided for flood proofing and/or structural adjustments which would minimize (1) displacement of flood plain storage area and, (2) potential inundation of building contents. In short, extreme restrictions may be unjustly applied under the guise of protecting the floodway, when in fact structural adjustments in a proposed building might accommodate the flood risk and still allow use of the flood plain pondage area. This brings us into flood plain zoning, subdivision regulations, building codes, and flood proofing.

Flood Plain Zoning

An evaluation of historical applications of flood plain zoning in Michigan must focus on the local unit of government. Flood plain zoning in this state as elsewhere has been chiefly the province of the municipal unit of government. More recent actions in other states as well as in Michigan suggest that such practices may no longer be solely developed at the local level. Hawaii has been a noted exception in allowing state level application of comprehensive land use zoning. Wisconsin has moved aggressively into flood plain zoning at the state level. Michigan has also evidenced movement into land use zoning in specialized problem areas as flood plains, shorelands, and recreational rivers.

Extensive inquiry was not made of other states as to their experiences with flood plain zoning. Considerable difficulty and costs were anticipated

if an attempt were made at surveying the experiences of other state municipal units in terms of their practices in flood plain zoning. Selected examples of such application, as reported in the literature, were utilized as a basis for evaluating Michigan municipal ordinances.

The flood plain management program in Wisconsin was investigated at the state level. Information was gathered after references to their program were made by several persons involved in water resources management. It was found that Wisconsin has established a significant compulsory local flood plain management program. The program is facilitated by a strong state technical assistance and review program which is designed to help local units of government adopt flood plain management programs as required by state law.[1] Consequently, principle focus under their program is directed at assisting local units in adopting local flood plain zoning ordinances. Flood plain zoning appears to be the key local action which is then followed and/or coordinated with such other recommended actions as subdivision regulations, building codes, sanitary regulations, flood proofing, acquisition, property taxation relief, and others.[2]

The Wisconsin Water Resources Act of 1965 required local adoption of flood plain zoning by January 1, 1968 (if technical data was available) which met or exceeded the minimum requirements established by the Division of Resource Development.[3] If local governments had not adopted such

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[1]James M. Lee, Supervisor, Flood Plain Shoreland Management Program, Division of Resource Development, Department of Natural Resources, State of Wisconsin, "The Answers to Your Questions About Flood Plain Management," Xerox copy of an article not identified by publication source or data.

[2]Wisconsin's Flood Plain Management Program (Madison: Division of Resource Development, Department of Natural Resources, State of Wisconsin November, 1967), p. 5.

[3]State of Wisconsin, Water Resources Act of 1965, Laws of Wisconsin, 1965, Wisconsin Statutes 87.30.

measures or their adopted measures failed to meet minimum requirements, then the Division of Resource Development will specify the required measures for the local unit. When complaints of possible violations of flood plain encroachments are received, the complaint is referred to the local enforcement unit for investigation and enforcement.[1] Reserved review and approval powers are retained by the State agency in this type of enforcement procedure. Similarly, such reserved review and approval powers are also maintained when local application are received for vacancies or conditional uses. The establishment of such procedures appears to be a reflection of a state policy of maintaining primary responsibilities for adoption and enforcement of flood plain zoning at the local level.

In order to achieve such a policy the State of Wisconsin has pursued a strong technical assistance function. A model flood plain zoning ordinance has been drafted and published for assisting local units of government in drafting their own ordinances.[2] In addition, minimum standards have been adopted and described by the Division of Resource Development.[3] Such standards must be met or exceeded by local ordinances as required by state law.[4] The state has responsibilities for coordinating federal and state resources for assisting the local efforts in drafting flood plain zoning ordinances and other complementary or supportive actions. Studies and surveys which provide the technical information needed for

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[1] Wisconsin's Flood Plain Management Program, 1967, p. 5.

[2] State of Wisconsin, Model Flood Plain Zoning Ordinance for a City or Village Using Engineering Information or Experience Flood Maps (Madison: Division of Resource Development, Department of Natural Resources, December 1, 1967).

[3] Wisconsin's Flood Plain Management Program, 1967, pp. 13-23.

[4] Wisconsin, Water Resources Act of 1965, Wisconsin Statutes 87.30.

proper local ordinance development are to be coordinated and conducted according to priorities established by the Division. Moreover, the Division is charged with the responsibility of continually updating t echnical information and transmitting such to local units of government with information on how to obtain further improvements in their local flood plain management.[1]

Several comments made by water resource management officials in other states give further evidence for pursuing an approach like that taken by Wisconsin. Mr. McMurray of Iowa expressed a commonly held notion that land use controls are appropriately the province of local units of government.[2] Manpower requirements in enforcing flood plain regulations are quite demanding upon state administrative staff. While such comments were made in the context of floodway regulations; they are equally valid for flood plain zoning. As a result local enforcement with state supervision appeared to be the more desirable policy.

To a certain extent, Michigan has moved into the area of flood plain zoning. Provisions of the Subdivision Control Act of 1967 and of Act 167 of 1968 provide limited entries into the field of flood plain zoning. Principle provisions of these acts relate to subdivision controls and floodway encroachment regulation; however, considerable overlap is found in the provisions with flood plain zoning. More precise definition of such zoning powers and illustrations of their application can be viewed in the adopted rules and regulations of the Michigan Water Resources Commission.[3]

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[1] Wisconsin's Flood Plain Management Program, 1967, p. 8.

[2] Supra, p. 266. For examples of Federal Policy declarations recognizing this view see Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, Section 1302(e); 82 Stat. 573.

[3] Supra, p. 256.

The effect of such legislation and administrative action is one of superimposing a state flood plain zone over the watercourses of the state. Where existing zoning ordinances are in effect, there is considerable likelihood of conflict in local and state allowed land uses. This is especially apparent where local zoning ordinances do not include flood plain zoning provisions. On the other hand, considerable dependence will be required of local governments in cooperating with the enforcement of such provisions. This is necessitated by the permit system which depends largely upon voluntary compliance of prospective flood plain developers. Local units of government are currently depended upon to refer prospective flood plain developers to the Michigan Water Resources Commission for a permit.[1] Further, the large man hour demands required in inspection of flood plains for violations of flood plain regulations creates a dependence upon local inspection due to limited state inspection staffs.[2]

Michigan has established some precedents for following an approach similar to that taken by Wisconsin. Passage of two water resource related acts strongly encourage local enactment of special zoning ordinances.[3,4] In the absence of such actions the state may step in and enact zoning rules and regulations for application in the local area. The subject areas involve (1) zoning rivers for recreational, scenic or wilderness purposes; and (2) zoning Great Lakes shoreland for protection from overdevelopment, hazardous

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[1]Lawrence Witte, Personal Interview, January 29, 1969.

[2]Letter from Othie R. McMurray, September,15, 1969.

[3]State of Michigan, Natural River Act of 1970, Act No. 231, Public Acts of 1970, Michigan Compiled Laws Annotated 281.764, et. seq.

[4]State of Michigan, Shoreland Protection And Management Act of 1970, Act No. 245, Public Acts of 1970, Michigan Compiled Laws Annotated 281.632, et. seq.

shoreline encroachments, and environmental destruction or deterioration. Like flood plain zoning, both programs have the advantage of narrowly defined spatial areas and associated land use objectives. They appear as potential exclusive zone classes or special strip zones. The distinction in the Michigan approach as contrasted with the Wisconsin approach is that flood plain zoning regulation is becoming the primary responsibility of the State of Michigan. The Wisconsin flood plain management program appears to maintain primary flood plain zoning development and enforcement responsibilities at the local level.

Local adoptions of flood plain zoning in Michigan were noted in the preceeding chapter. At least ten municipal units had adopted some form of flood plain zoning. Critical evaluation of these will be limited to criteria used in ordinance definition of floods and flood plains, prohibited and allowed uses, and some administrative procedures.

In general, little use of frequency expectations was found in the definition of flood events in municipal ordinances. Principal reliance in municipal ordinances was made of flood levels experienced in 1947, a period of significant flooding in much of southern lower Michigan. Average recurrence intervals assigned to the 1947 flood in the Upper River Rouge-Farmington area and the Red Cedar-Grand River Lansing area were 70 and 50 years respectively.[1,2] Because of the use of large flood events, little fault can be found with such practices in terms of possible unstable flood frequency expectations. As noted earlier, adjustments in frequency expectations are most noticable in smaller, more frequent flood events. That is, changes in natural and cultural factors are not as easily correlated or translated in the larger and more infrequent flood events.

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[1] Farmington, Michigan Flood Plain Information Report, 1963, p. 18.

[2] City of Lansing, Ordinance No. 161, Sec. 36-60 and 36-61.

At the same time, one note of caution should be entered in light of the limited stream records from which probabilities are computed. For example, incomplete or partial flood records in the Upper River Rouge date back to 1930, or about 40 years of record.[1,2] Somewhat more complete flood records have been kept for the Red Cedar River with its flood record dating back to 1911 or about 60 years. In either case, probability expectations computed for such infrequent flood events as those experienced in 1947, are less reliable than those developed for the smaller, more frequent floods. Thus, in the final analysis, it may be wiser to utilize a flood stage or discharge level as a basis for defining a flood event in a flood plain zoning ordinance.

Some questions may be raised about the intent of local ordinances in terms of securing open space objectives and in terms of unequal protection of the laws. Dunham expressed this concern by observing

> The basic evil of a classification which excludes private activity but which permits obstructions by government and public utilities is that landowners within the flood water area are forced to bear the external costs of the permitted activity while other persons, without cost, share in its advantages.[3]

The observation was significant because at least six municipal ordinances were found to specifically permit public utilities, bridges, roads, and other public buildings or structures.[4] However, each of the ordinances

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[1] Farmington, Michigan Flood Plain Information Report, 1963, p. A-15.

[2] Flood Plain Information Report Red Cedar River, Ingham County, Michigan (Detroit: U.S. Army, Corps of Engineers, Detroit District, March, 1968), p. 19.

[3] Dunham, "Flood Control Via the Police Power," 1959, p. 1129.

[4] Clinton Township, Zoning Ordinance, Sec. 1502.2. City of Grand Ledge Zoning Ordinance No. 156, Sec. 1300.3. City of Lansing, Ordinance No. 161, Sec. 36.62.d. Shelby Township, Ordinance No. 1.11, Sec. 11.01B.(3). City of Southfield Ordinance No. 718, Sec. 5.49. f. Sterling Township, Zoning Ordinance, Sec. 15.01.3.

specified that such developments and structures must be constructed in a manner that will not impair the storage and discharge capacity of the flood plains. Such performance criteria in effect preclude hazardous public developments. However, in light of the preceeding quote, such performance criteria would seem equally appropriate to private structural land uses. If any unequal protection of the law exists, it may be found in the application of such performance criteria.

In similar fashion, serious questions can be raised about the general regulation of permissible uses in flood plain zones. The tendency of local Michigan ordinances was to restrict land use in flood plain areas to open space uses. Little recognition of flood proofing measures as a means of securing potential developments was evident. Two or possibly three communities made some provision for flood proofing as a means of allowing for an otherwise prohibited land use.[1] As a result, greater attention needs to be given to flood proofing as a means of allowing prohibited structural land uses to be located in some flood plain settings. It may be possible to allow for land uses which would normally be compatible for the area when flood proofing is used in constructing structures. At present, most of the local Michigan flood plain zoning ordinances appear to be designed for the purposes of achieving community open space and recreation objectives at the expense of structural land uses which might be effectively developed with flood proofing measures.

It was found that municipalities did not as a general rule delegate such review and approval responsibilities to the municipal engineer or a

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[1]The City of Lansing, Meridian Charter Township, and possibly Clinton Township have ordinances which allow for development of flood proofed structures in their flood plain zones. City of Lansing, Ordinance No. 718 Sec. 36.63a.1. Meridian Charter Township, Ordinance No. 30, Sec. 4.14.5a. Clinton Township, Zoning Ordinance, Sec. 1501.2. See discussion, *supra*., pp. 170-171.

technically qualified body. Typically, the approach adopted was that of having the legislative body or planning department pass on special use permits. Such practices do not appear to be as desirable as those in which a technically qualified person or party grants such permits. Political pressures and technical considerations make this an extremely difficult function to perform effectively.[1,2] Consequently, leaving such review functions to a legislative body would appear to seriously jeopardize any hopes of effectively administering flood plain regulations.

Subdivision Control Regulations

Allison Green, Treasurer, State of Michigan, in 1967 noted that significantly less than one half of the incorporated villages and cities in the State of Michigan had enacted subdivision control regulations.[3] No real estimate exists as to how many of these communities provide for some flood plain regulation within their subdivision controls. Notwithstanding this, the State of Michigan assumed primary responsibility for subdivision control in the state under the Subdivision Control Act of 1967. Consequently, principle attention will be directed at evaluating the State subdivision control regulations.

Extensive state involvement in flood plain regulations is given under the Subdivision Control Act of 1967. Principle focus of the flood plain regulations under the act is directed at residential subdivision development. Regulation of industrial, commercial, or other non-residential subdivision developments are not specifically covered in the controlling act nor in the

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[1]Murphy, Regulating Flood Plain Development, 1958, pp. 81 and 85-86.

[2]Letter from Walter Bergstrom, September 16, 1969.

[3]Green, "State Legislature Revises Plat Act," 1967, p. 230.

adopted rules and regulations of the Michigan Water Resources Commission.[1,2] Some question may be raised as to why the controls should be so narrowly applied to "control residential building development within flood plain areas."[3] Dunham argued

> Where the objective is to protect health and property the basic question is whether the state may make some people safer than other similarly situated. To say that there is less need for protection for some uses than others will be legitimate if this is indeed a reasonable conclusion.[4]

It is possible that a conclusion was reached that industrial, commercial, or other non-residential subdivisions do not merit such controls as are applied to residential subdivisions. If such a conclusion was made it is not noted in the act nor easily documented elsewhere in background material. This is not to deny the possible validity of such a conclusion. However, a statement of such a conclusion and a presentation of its basis might clarify the question and establish the justification of discriminatory class regulations wherein only residential subdivisions are regulated in flood plain areas.

The Water Resources Commission adopted a flood frequency recurrence interval of one in 50 years for regulating proposed subdivisions.[5] This is not the same frequency expectation as that selected for floodway encroachments. While a reason for the differences in frequency expectations was not given, it was noted that the frequency expectation adopted for

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[1]Michigan, Subdivision Control Act of 1967, Sec. 102.

[2]Michigan, Rules and Regulations of the Water Resources Commission, 1967, R. 560.301, *et. seq.*

[3]Michigan, Subdivision Control Act of 1967, Preamble.

[4]Dunham, "Flood Control Via the Police Power," 1959, p. 1129.

[5]Michigan Rules and Regulations of the Water Resources Commission, 1967, R. 560.301, *et. seq.*

implementing Act 167 of 1968, was no longer controlling.[1] In effect, Act 167 has conferred more comprehensive regulation of floodway and flood plain areas in Michigan and is therefore now utilized in reviewing such subdivision permits.

The regulations are relatively restrictive. Allowances are made for structural land uses when the discharge capacity can be maintained. Provision is made for allowing excavation and shaping of the flood plain in order to meet such criteria. Similar qualifications or performance criteria were also encountered elsewhere in floodway regulations and flood plain zoning.[2]

Administration of the Michigan Subdivision Control Act of 1967 provides some interesting comparisons with flood plain zoning practices in Wisconsin. The Subdivision Control Act of 1967 delegates and allocates review and approval responsibilities among state and local units of government. Mandatory enactment of subdivision control regulations is not required of local units, but is provided for under enabling provisions of this act and others. As a result, the State must assume primary responsibilities in many cases in regulating new, proposed subdivisions. This is quite evident in terms of flood plain regulations. If local units have more restrictive regulations, some of the primary enforcement responsibilities can be transferred to the local unit. However, little success with such an approach in subdivision regulations has been noted yet. Principle responsibility for enforcing flood plain restrictions in proposed subdivisions developments continues to rest at the state level.

One other note relating to administration of the Subdivision Control Act of 1967 relates to the overlap with flood plain zoning, building code

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[1] Lawrence Witte, Personal Communication, September, 1971.

[2] <u>Supra</u> , pp. 168 and 273-274.

restrictions, and flood proofing measures. The adopted rules and regulations of the Water Resources Commission require that restrictive deed covenants be filed with the final plat.[1] The various covenants required relate to lot area and building site location requirements, building design, and flood proofing. Accordingly, some overlap and integration with zoning, building codes, and flood proofing is achieved. Integration of lot area requirements will in large part be a function of existing or proposed local zoning requirements. The minimum building site requirements of 3,000 square feet of natural grade land may pose some problems in some areas although provision of the alternative flood proofing building design would seem to relax potential conflicts in lot area requirements.[2]

Building Codes

Building codes have yet to be demonstrated as effective measures in regulating flood plain developments. This results from a number of factors some of which are interrelated. Nevertheless, their potential for special application in flood plain controls continues to be asserted and suggested in the literature.

In this study, little could be concluded in terms of Michigan experiences in applying building codes as a means of control in flood plain regulation, other than that the potential appears to be present in Michigan for such applications. As a result, a considerable amount of research effort is implied and needed in this area, at the national level as well as in the state, in order for significant development and implementation of flood plain building code provisions.

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[1] Michigan, Rules and Regulations of the Water Resources Commission, 1967, Rule 560.304(1) and 304(2)-(g). See also text accompanying footnote no. 1., p. 176, *supra*.

[2] *Ibid*.

A number of points need to be addressed or answered in such research efforts. Additional research is required in developing special performance criteria which can be incorporated into model building code standards. The four national model building codes do not at present have such criteria.[1] Additional study and research needs to be conducted in order to fit such flood proofing concepts as discussed by Shaeffer into building code provisions.[2] In Michigan it was established that a state building code does not exist. A Housing Law which does exist dates back to 1917.[3] However, provisions in the Housing Code as in the four model building codes, no not address themselves to flood plain building needs. Accordingly, further research is needed for evaluating the need for (1) a state building code or (2) a special flood plain building code. The latter might be drafted for state enactment or for model code purposes for local adoption. In addition, further study is needed in enforcement and administrative problems in building code regulations in Michigan. The results of a recent study of building codes in southeastern Michigan suggests that administrative problems in building code enforcement in general may be the ultimate constraint to obtaining flood plain development regulations under such a proposed technique.[4]

Two observations may suggest further testable hypotheses. First, flood proofing concepts need to be incorporated into building codes to enable successful code application in achieving flood plain management

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[1] Supra., pp. 180-182.

[2] Shaeffer, Flood Proofing, 1960. Shaeffer, Introduction to Flood Proofing, 1967.

[3] State of Michigan, State Housing Law, Act No. 167, Public Acts of 1971, Michigan Compiled Laws Annotated 125.401, et. seq.

[4] Regional Building Codes, 1966, Chap. 1, pp. 7-13; and pp. 22-24.

objectives. Second, the success of special flood plain building code provisions will only be successful to the extent that general building codes are implemented and enforced.

Subscriptive Techniques

Warning Signs

Evaluating the effectiveness of warning signs in flood loss management in Michigan is not yet possible. Applications of flood warning signs in this state have not been found. Murphy observed the employment of warning signs in other states and noted problems in maintaining such signs. He cited examples of local opposition to erection of warning signs near developed lands.[1] Wisconsin has recently recommended that flood limit markers should be set up to show "both the depth of inundation and the area affected."[2] Additional information on program administration and implementation was not obtained.

Consequently, little can be concluded about flood warning signs. They are frequently cited in the literature as an available measure. However, only Murphy's article was found to give any significant discussion to the measure. His findings indicate further study is needed before this measure can adequately be evaluated in a Michigan context. Case studies would appear to offer potential in relating Wisconsin experiences. In addition, research needs to be conducted on how such a measure might have application in an educational program, land acquisition program, and/or various regulatory programs. In light of some of Murphy's observations, a study is needed in evaluating possible interrelationships between flood plain warning signs and floodway encroachment regulations,

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[1] Murphy, Regulating Flood-Plain Development, 1958, p. 123 and 163.

[2] Wisconsin's Flood Plain Management Program, 1967, p. 23.

regulations, flood plain zoning, subdivision regulations, and/or building codes.

Building Finance

Financial policies of credit institutions were found to vary in treatment of flood plain risk in reviews of credit applications by public and private credit institutions. Significant policy declarations have been issued at the Federal level.[1] These have been followed up with strong to weak policy guidelines and/or field adjustments in Federal financial assistance programs in Michigan. At the same time no information was obtained on policies of private credit institutions in Michigan. The need for such information is considerable. This results directly from the importance of credit availability in carrying through flood plain development proposals.[2] Accordingly, additional study work is justified in this area.

A variety of study needs can be suggested. Several questions are appropriate in pointing out these needs. What information and technical assistance needs are required in reviewing credit applications for proposed flood plain developments? Where are the various points in credit application and negotiations in which leverage can be applied to obtain adequate recognition of flood risk? How can flood plain risk be translated into credit restrictions or credit terms when extending financial assistance? Finally, further detailed study of existing Federal and private credit policy and review criteria is needed in terms of Michigan flood plain management objectives. Insufficient information was acquired on actual field review procedures. Specifically, case study illustrations were not

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[1]Executive Order 11296, August 11, 1966, Section 1.2.

[2]U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 27.

obtained in this study.

Taxation

Little can be concluded about applications of special taxation policies in pursuing flood plain management in Michigan. Information on existing property taxation policies in restrictively regulated flood plain areas has not been acquired. Examples of special income or property tax policy adjustments have not been identified in Michigan.

Clarification is needed of how property tax and income tax policy adjustments can further flood loss management objectives in Michigan. A real need exists for a specialized study of taxation policy as it concerns flood loss management considerations. Significant limitations and administrative problems were noted in the development of this technique in Chapter III. Answers to and resolution of these problems are needed prior to suggesting adjustments in local and state tax policies. An important question which needs answering relates to the actual costs involved in a tax subsidy or concession. As was noted earlier in Chapter III a progressive weakening of the property tax system can occur with the granting of various property tax relief measures.[1]

Acquisition

Considerable attention is being given to the use of land acquisition measures as a means of obtaining control of flood plains. Typically, such measures are discussed in terms of advancing open space and recreation objectives.[2] In fact, detailed discussions of such measures were more

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[1] Supra, p. 64.

[2] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 29-30.

notable and advanced in the recreation and open space literature as contrasted to flood plain management references.[1] In this respect, the recreation and open space literature referred to flood plain management in a secondary or ancillary manner to the principle consideration of open space needs.

As a result, some attention should be given to the matter of differentiating between the two program objectives and noting the resulting implications. The principle concern suggested here is that it is possible for these programs to be in conflict. It may be discovered that not all flood plain land should be devoted to open space or recreational use. Conversely, not all open space needs can be met by acquiring flood plain tracts when possible.

Selected applications of acquisition measures have been noted in Michigan. Programs of both the Federal and Michigan governments were found to have applications for Michigan flood plain acquisition. No specific examples of flood plain tract acquisition for flood plain management purposes were obtained in this study. However, it was established that the State has adopted policies and programs which encourage flood plain acquisition. Principle authority was found in connection with the Michigan Outdoor Recreation Plan and program. At the same time, it should be noted that the principle state flood plain management agency, the Water Resources Commission, does not have similar powers for acquiring flood plain tracts.

Examples of local acquisition of flood plain tracts were noted in the Lansing area. Significant parcels of land lying in several flood plains

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[1]Examples of such treatments can be found in the following: Little, Challenge of the Land: Open Space Reservation, 1966. Whyte, Securing Open Space, 1959. Sussna, "Open Space Control," 1969.

were given to the City of Lansing in the early part of the 20th century. More recently, acquisition of flood plain tracts has required negotiated purchase and in the future may involve use of eminent domain. In all cases, the acquired tracts have been utilized for open space and recreational purposes. The principle limitation in such a program was found to be one of financial limitations.[1] Little problem was reported with earlier conveyances of property by gift; although, the actual method of conveyance was not always precisely noted.

It appears that this technique offers some real benefits in terms of flood loss management. However, little detailed information or comprehensive evaluation was available as to the complete benefits and costs of such acquisition programs. Such items as enhancement benefits, recreational benefits, reduction of possible flood losses, as well as land costs, property tax considerations, and constrained proprietary interests need a more detailed evaluation. Several case studies would appear to offer significant additional information as to the benefits and problems associated with various acquisition techniques in a flood loss management setting.

Flood Insurance

Actual implementation of flood plain insurance in Michigan has not been achieved as yet. Indications are that the program is undergoing development and marketing tests in six communities, none of which are in Michigan.[2] Additional information on experiences with the program has not been acquired. Nonetheless, some general problems can still be noted in the authorized program.

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[1]City of Lansing, Flood Plain Information Files, 1968.

[2]Kunreuther and Shaeffer, "Economically Meaningful Flood Insurance Rates," 1970, p. 659.

The hydrologic or flood risk method has been selected for the 1968 National Flood Insurance Program.[1] Principle justifications for such a selection relate to utilization of existing data and application of available agency technical skills. Two limitations which are characteristic of any risk method selected are associated with the reliability of collected hydrologic data and the subsequent methods used for extrapolating and projecting frequency probabilities for unmonitored streams. A third limitation associated with the particular implementing the act arises from the limited number of flood risk zones which can be identified for premium rate development. This latter limitation could be reduced according to Kunreuther and Shaeffer, if their proposed approach were applied.[2] However, the merits of either method must be evaluated in terms of program implementation. Consequently, more information needs to be acquired and evaluated in terms of program development, marketing, administration, and operating costs. Kunreuther and Shaeffer have suggested some tentative costs but little can be reported from field experiences.

It was found that some preliminary feasibility study work was done on establishing premium rates using flood plain field data from Grandville, Michigan.[3] However, the actual study materials did not receive wide distribution and were still being sought at the time of this writing. Little can be concluded about the Grandville study without actual access to it.

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[1] Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, 82 Stat. 572.

[2] Kunreuther and Shaeffer, "Economically Meaningful Flood Insurance Rates," 1970, pp. 663 and 665-666.

[3] U.S., Congress, Senate, Committee on Banking and Currency, Insurance and Other Programs For Flood Victims, 1966, p. 62, 68-69, 72-73. See footnote no. 2, p. 196, supra.

Additional study and inquiry is also needed in other matters. Inquiry needs to be made as to what additional measures or adjustments are required in existing State or local flood plain regulations in order to qualify for the National Flood Insurance Program. The Housing Act of 1968, as amended, requires that adequate State and local land use controls must be adopted and enforced before a community may qualify for flood insurance. Pursuant to this, the Secretary of Housing and Urban Development is charged with developing ". . .comprehensive criteria designed to encourage, where necessary, the adoption of adequate State and local measures . . ." for regulating flood plain development and occupancy.[1] The 1968 Act as amended stipulates that such adequate land use regulations will have to be adopted after December 31, 1971, in order for an area to qualify for flood insurance. Attention is directed here at the term adequate. Further inquiry is needed to determine what criteria the Department of Housing and Urban Development will adopt and use as a measure of adequate.

Postdevelopment Flood Loss Management

Compulsory Techniques

As noted in the preceeding chapter, many of the techniques developed under the predevelopment section have application in existing or postdevelopment areas as well. Principle extension of such applications can be achieved through non-conforming use provisions. Unfortunately, little information was acquired on such provisions, particularly in Michigan. As a result, little evaluation of such provisions can be undertaken here. A few observations and comments can be made.

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[1] Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, as amended, 82 Stat. 587. Note the word adequate was inserted in place of permanent by the December 24, 1969 amendment to the 1968 act; Housing and Urban Development Act of 1969, Sec. 410; 83 Stat. 397.

The existence of non-conforming use restrictions and provisions were noted in floodway encroachment regulations of at least seven states. Furthermore, at least four of the seven states had abatement powers over nonconforming floodway structural uses.[1] Little could be concluded from the comparative review other than that the Michigan Water Resources Commission appears to be lacking similar abatement powers as found in four of the states.[2]

Comment on flood plain zoning or building code employment of non-conforming use restrictions is even more sketchy. The model flood plain zoning ordinance developed by the Wisconsin Division of Resource Development does provide for extensive use of nonconforming use regulations and has enabling provisions for abatement actions. Significant alteration, expansion, remodeling or reconstruction of a nonconforming flood plain use under the model ordinance could not be undertaken until a permit was obtained pursuant to the provisions found in the model ordinance. However, information was not provided as to experiences with such provisions in Wisconsin. Further, such provisions were not spelled out in local Michigan flood plain zoning ordinance sections. It is expected that such provisions are spelled out in the general or enveloping comprehensive zoning ordinance.[3]

In conclusion, postdevelopment applications of flood plain regulatory measures needs further study. In this respect, concentration can be narrowed to the area of nonconforming use provisions. To what extent can nonconforming uses in a flood plain be regulated? Can they be abated through forced removal? Or are nonconforming use regulations restricted to

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[1] Supra, footnote no. 2, page 278.

[2] Michigan, Act No. 167, 1968, Sec. 3 and Sec. 5b.

[3] Model Flood Plain Zoning Ordinance for a City or Village, 1967.

rigid provisions which prevent significant alteration, remodeling, expansion, or reconstruction of the existing use without first obtaining a permit? It may be found that the answers to these questions may vary by flood plain area; i.e., floodway be contrasted with flood plain pondage area.

Subscriptive Techniques

A number of voluntary or subscriptive land use management techniques discussed in a pre-land development context are also available for use in a postdevelopment land use setting. Such techniques include taxation, acquisition, (re) building finance, and insurance. Additional techniques which particular relevance in a postdevelopment land use setting include engineering works of flood protection, flood proofing, and evacuation.

In this section principle attention will be devoted to engineering works of flood protection and control. Additional but brief discussion will be given to the other techniques cited. The briefness results from the lack of information as opposed to a reflection of technique insignificance.

Engineering Works for Flood Protection and Prevention

Engineering works for regulating and controlling flood flows has had some application in Michigan. Detention and storage reservoirs have not been generally available for downstream flood protection of urban areas. Channel improvements and modifications have been found to be more appropriate as engineering measures for achieving flood protection in Michigan. As a result a number of projects have been constructed, are under construction, and have been proposed in many urban reaches of watercourses in Michigan. In the rural areas, another program has been proposed and undertaken to obtain flood prevention benefits. In this

instance, applications of the Federal Watershed Protection and Flood Prevention program have been approved in sixteen project areas as of 1970.[1]

Some significant project benefits have been reported by the Detroit District Corps of Engineers as a result of channel improvement and alteration projects. The most significant illustration of project benefits was presented in the discussion of the channel enlargement and straightening project for the Red Run Channels north of Detroit. Total costs for the completed project were slightly more than 1.3 million dollars The project was completed in 1952 and has been estimated to have prevented more than 5.7 million dollars in net cummulative damages.[2] Other examples were present, but a summation of their figures would not be meaningful without more information on the accounting system and dates used in developing them.

Critical evaluations of engineering works for flood control are extremely numerous in flood loss and water resource management literature. Critical articles and analyses have covered a wide range of considerations including technique philosophy, project justification and implementation, benefit and cost analyses, equity, perception of protection, and many others.[3] Principle attention in this section will be briefly directed at

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[1] Supra, p. 224.

[2] Water Resources Development in Michigan - 1967, p. 41.

[3] Further exploration of these issues can be found in the following: Fox, "National Water Resource Policy Issues," 1957, pp. 476-477 and 481; Haveman, Water Resources Investment and the Public Interest, 1965; Leopold and Maddock, The Flood Control Controversy, 1954; Murphy, Regulating Flood Plain Development, 1958, pp. 131-132; National Academy of Sciences and National Research Council, Alternatives In Water Management, 1966, pp. 18-19; Gilbert F. White, et.al., Changes in Urban Occupance of Flood Plains in the United States, Department of Geography Research Paper No. 57, University of Chicago (Chicago: University of Chicago, 1958), pp. 227-228; Gilbert F. White, Choice of Adjustment to Floods, Department of Geography Research Paper No. 93 University of Chicago (Chicago: University of Chicago, 1968), pp. 14-16.

the problem of enhancement values and benefits. It was indicated earlier that increasing emphasis and dependence is being placed upon enhancement benefits in project justification. This has considerable significance in terms of evaluating alternative flood plain (development) management techniques in Michigan as well as elsewhere.

Irving K. Fox addressed the general problem in a 1958 paper on National Water Resources Policy Issues. He approached it from an equity consideration which is still relevant today. He found

> The issue has two aspects which may be expressed as follows: (1) to what extent is it equitable to provide flood control for the benefit of flood plain occupants at the expense of the general taxpayer? and (2) to what extent is it administratively practicable to undertake a flood management program of optimum efficiency when the beneficiaries bear such a small portion of the costs of the structural program. . .?[1]

The effect of this consideration was linked with deficiencies in benefit-cost calculations and reimbursement policies, and then related directly to failures in realizing flood management objectives.

Of particular concern here is the fact that the justification of the structural program is often to enhance the value of the flood plain; even though enhancement value is a function of human perception which poses inherent deficiencies in itself. Thus, while these enhancement values are part of the benefits to be measured in providing flood control protection structures; they are difficult to arrive at and subject to differentes in judgment.[2] This in part contribute to a problem of defining beneficiaries and cost sharing burden. As a result, the flood plain owner is not required to participate in any of the cost of protection. This is true despite the fact the justification of the project is dependent upon

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[1]Fox, "National Water Resource Policy Issues," March, 1958, p. 481.

[2]U.S., S. Doc. No. 97, 1962, p. 10.

enhancing the attractiveness of private land for subsequent development.

Considerable concern about this fact was registered in the Task Force on Federal Flood Control Policy in their report. In the report they indicated,

> The major purpose of engineering projects is changing from protection of established property to the underwriting of new development. Increasingly, Federal funds are used to support projects justified on the basis of protection of land for future use.[1]

This raises serious questions as to the effectiveness and appropriateness of existing Federal programs in obtaining policy objectives. It has been noted that while flood loss prevention benefits have been significant; the projected costs of pursuing the flood control construction program are increasing while the rate of flood losses continues to mount also. Moreover, the increasing role enhancement values play in project formulation can be seriously questioned in light of the mounting losses in the developing and developed flood plains.[2]

As a result, the selection of engineering works is natural when viewing the individual occupant's and the community's basis of selecting a means of securing their existing or proposed flood plain developments. The relatively low cost to the individual beneficiary under the Federally funded flood control program compares most favorably with other means of flood protection and reduction of loss potential. Notwithstanding this, the costs which must be borne by the community (the so called a,b,c, requirements) are frequently significant enough that they prevent final funding of favorable projects. This has been evident in Michigan. A number of projects were cited in a 1967 Corps report for Michigan as pending local commit

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[1] U.S., Task Force Report on Federal Flood Control Policy, House, Doc. No. 465, 1966, p. 9.

[2] *Ibid.*, pp. 1, 3, 4, 9, 12 and 14-15.

to or fulfillment of local project requirements.[1] The most notable example has been the Shiawassee Flats project which has been held in abeyance for nearly two decades because of the inability to secure local requirements and commitments.[2,3]

In the final analysis, the Task Force Report stated "Public Policy should distinguish between the problem of minimizing damage to existing flood plain developments and the problem of achieving optimum future use of flood plains."[4] The first problem is a matter of present protection; the second is one of selecting the best investment alternative. Flood plain regulations, when properly drafted, create a decision making environment that forces the flood plain owner to consider and absorb more fully the costs of pursuing his proposed investment. Engineering works of flood protection attempt to ease some of these costs through the economies of collective action. Reconciliation of these two decision making processes is particularly difficult when dealing with projected new investments and enhancement values. Cost bearing and reimbursement responsibilities incurred under various program alternatives have a marked effect on investment decisions in the flood plain.[5] Historically, the tendency has been towards relieving and easing individual cost bearing burdens without at the same time guiding subsequent investments.

Flood Proofing

Flood proofing is similar to engineering works of flood protection

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[1] Water Resources Development in Michigan, 1967, p. 56-57 and 59.

[2] Ibid., p. 57.

[3] Lawrence Witte, Personal Communication, September, 1971.

[4] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 15.

[5] Ibid., pp. 1 and 41-43.

and regulation in that it involves engineering design and construction principles. However, it differs significantly in that flood proofing as a technique is implemented through individual actions. In contrast, flood protective works are characteristically implemented through collective, public actions. Both techniques offer considerable potential for reducing flood losses. In Michigan flood proofing appears to hold significant potential in obtaining a reduction in flood losses and a prevention of further new losses from occuring. This latter must still be regarded as a hypothesis, because little empirical evidence has been acquired and reported in this state which would deny or support this hypothesis.

The potential for flood proofing as a technique is outlined most convincingly by John Shaeffer.[1,2] Further recognition of the value of the technique is given in the National Flood Insurance Program. Provisions are included in the enabling act for adjusting chargeable flood insurance premium rates to reflect the reduction in flood damage risk resulting from adopted flood proofing measures.[3] In addition, it has significant relevance for developing building code and flood plain zoning regulations which will allow reasonable use of flood plains.

In conclusion, it is felt that this particular technique may deserve the highest priority in pursuing additional study into applications of new techniques for reducing flood losses in Michigan.

Flood Warning System

Little comment can be made in this paper on the application and effectiveness of a flood warning system in Michigan. One does exist in

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[1] Shaeffer, Flood Proofing, 1960.

[2] Shaeffer, Introduction to Flood Proofing, 1967.

[3] Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, 82 Stat. 577.

this state, but its structure and organization appears to be decentralized.[1] Study of this system in Michigan is felt to be justified. In the absence of such work, comment here can only be based upon literature reviews of the national system.

The Task Force Report on Federal Flood Control Policy concluded that significant increases in data collection, river monitoring and technical assistance were needed in providing flood warning services to more communities and in developing emergency preparedness plans.[2] At the same time, emphasis was placed upon encouraging improvements in the utilization of communications systems and the provision of education services so that emergency preparedness plans would be effectively used when warnings are issued and temporary evacuation of flood prone areas is required.

The hearings on Federal appropriations to the Environmental Science Services Administration were consulted for fiscal year 1966-1967. Significant budget increases were requested to implement the recommendations of the President's Task Force on Federal Flood Control Policy. An increase in permanent positions was requested involving 2.9 million dollars in order that river and flood prediction and warning services of the Weather Bureau could be improved as recommended by the Task Force Report.[3] An additional 100,000 dollars was requested to improve the technical assistance and educational services of the Weather Bureau.[4]

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[1] Lawrence Witte, Personal Interview, January 29, 1969.

[2] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, pp. 36-37.

[3] U.S., Congress House, Committee on Appropriations, Subcommittee on Departments of State, Justice, Commerce, The Judiciary, and Related Agencies Hearings, 1967, p. 563.

[4] *Ibid.*, p. 552.

Evacuation and Relocation

The importance of an adequate flood warning system to temporary evacuation and emergency flood proofing measures was noted in previous chapters.[1] The presence of emergency preparedness plans or temporary flood evacuation plans at the municipal level was not documented in this study. An evaluation of such plans is therefore precluded under this study. However, such an evaluation would be merited under a separate study.

Three Federal authorities and one Michigan authority were cited in the previous chapter as providing a basis for pursuing permanent public evacuation of private flood plain developments.[2] General usage of these authorities for pursuing flood plain evacuation has not been documented in Michigan. Consequently, evaluation of actual technique application is restricted.

One example of a potential application of the evacuation technique was noted in a Lansing Urban Renewal Project under the Model Cities Program.[3] In a broader perspective, the proposed evacuation of portions of the downtown Grand River flood plain is actually related to redevelopment objectives and open space objectives. The neighboring redeveloped residential, commercial, and community college properties will be served by the evacuated flood plain open spaces. Accordingly, its significance as a technique may be better evaluated in the following section.

Redevelopment

As suggested in the preceeding section, evacuation measures used

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[1] *Supra*, pp. 112-113, 116-117, 119-120, 234 and 245.

[2] *Supra*, pp. 228, 230, 231, and 232.

[3] *Supra*, p. 230.

under an urban renewal program authority may be more appropriately viewed in a redevelopment context. Little experience in redeveloping flood plain areas has been reported in Michigan. The principle and outstanding example of employment of redevelopment measures was found in the Golden Triangle Area in the City of Pittsburgh.[1] A distinction in program philosophy is again tentatively suggested here. The redevelopment program in Pittsburgh stressed sound redevelopment of the Triangle Area. This involved significant use of flood proofing measures. In Lansing a contrast is suggested by the permanent evacuation of flood plain areas in redevelopment areas. Open space is secured on the flood plain to serve the aesthetic and recreational needs of the adjacent structurally redeveloped tracts.

At best, the technique can be termed premising in Michigan flood plain management and flood loss management. However, specific and separate study of this technique is needed before further comment is made on its exact role in Michigan flood loss management strategies.

Rebuilding Finance

Evaluation of rebuilding finance policies must focus on private and public credit institutions. This was seen in considerations of credit and financial policies in a postdevelopment context.[2] Limited experiences with this technique were obtained in Michigan. Information on private credit policies was not obtained at all. Some information was obtained from public credit agencies with respect to their role in influencing rebuilding of flood damaged properties.

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[1] Murphy, Regulating Flood Plain Development, 1958, p. 3-5.

[2] Supra, pp. 135-138 and 237-241.

The principle public agency identified in the flood loss management literature which was contacted in this study was the Small Business Administration.[1] In the future, it may develop that the Department of Housing and Urban Development will have significant impact upon rebuilding in flood plain areas through administration of the National Flood Insurance Program. However, to date, the Small Business Authority appears to be the principle public agency having a specific charge in aiding rebuilding of disaster stricken areas. In this respect, the program as administered tends to approach an emergency relief operation as opposed to a guidance program. The emphasis of the disaster loan program appears to be one of the replacement and/or renovation without significant allowance for improving the integrity of the rebuilt structure or its contents to withstand flood losses.

Criticisms and deficiencies of the Small Business Administration Disaster Loan Program seem to generate from the lack or absence of relating the program to long term economic use of the flood plain.[2] This seems understandable when it is understood that one of the objectives of the S.B.A. Disaster Loan Program is swiftness in returning the flood damaged community back to its original economic activity. This objective seemingly runs counter to a program of considering or studying evacuation as an advisable program. In contrast, long term planning with respect to community development and relocation should be incorporated into any rebuilding finance programs.[3] Consequently program considerations are

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[1] Supra, p. 238.

[2] U.S., Task Force Report on Federal Flood Control Policy, House, Doc. No. 465, 1966, pp. 11, and 30-31.

[3] Ibid., p. 31.

moved beyond this federal agency's scope. Examples of the type of thinking and extent of coordination necessarily required might be found in the evolving Model Cities Program of the Housing and Urban Development Department.

Another deficiency appears from the absence of clear and definitive policy statements or directives with respect to having Small Business Loan Officials advise loan applicants of the possibilities of building structural modification and flood proofing measures. The capabilities of such a service function appear to depend largely on the background of the field appraiser or reviewing loan advisor. While it was indicated that flood proofing measures would certainly receive positive consideration in disaster loan applications, no assurance can be apparently given that such considerations will be entertained by indivudual loan applicants and loan advisors.[1] It is interesting to note that the official with which the author discussed Small Business Administration Disaster Loan policies had an engineering background and had availed himself of opportunities to become acquainted with the U.S. Army Corps of Engineers programs through annual work sessions. Consequently, this particular official is likely to have a greater awareness of alternative flood loss reduction alternatives and philosophy than might be found of other loan officials.

A consequent impression was that the success of a Small Business Disaster Loan in reducing future flood losses depended a great deal on the personal awareness of the involved Small Business Administration loan official, his personal philosophy, and his disposition with respect to the alternative of prescribed role functions. And yet, it should be noted here, that an overly defined or prescribed duty function is found less

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[1]George Strong, Personal Communication, February 17, 1969.

desirable to one allowing significant discretion. It appears that where the latter is exercised, a more innovative and individual treatment is given to each disaster loan application. What appears to be desirable is a uniform distribution of information concerning flood loss management techniques to loan officers for their minimal or initial consideration. An educational and training function is needed to increase and reinforce their potential function as effective flood loss management advisors. This may require a directive similar to the one given by the Secretary of Housing and Urban Development in his Secretarial Order No. 25 of May 25, 1967. The Secretarial Order appears to have been successfully passed down to appropriate Housing and Urban Development agencies, as evidenced by the Federal Housing Administration.[1]

Flood Insurance

Flood loss insurance was covered earlier in the predevelopment section. However, an additional comment is needed in terms of the acquisition provisions included in the enabling act.[2] At present, it is not known how extensively these provisions will be applied within the flood insurance program. More experiences with the program as it is developed further, will clarify this question. Even without such experiences, it can still be pointed out that such a provisions integrates the insurance technique with several other techniques including redevelopment, rebuilding finance, and permanent evacuation. It remains to be seen how such a feature will be integrated with other programs and how it will be used to lower flood losses in developed flood plain areas.

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[1] Supra, p. 185.

[2] Housing and Urban Development Act of 1968, Title XIII, National Flood Insurance, 82 Stat. 588.

Study is needed in determining how criteria should be developed for implementing acquisition provisions. Contact with the Department of Housing and Urban Development should be undertaken to determine what studies are being pursued or need to be pursued in applying acquisition features of the flood insurance program. At the same time, a need exists for determining what role flood insurance will or can play in rebuilding flood damaged buildings. It is apparent from the act that the program is directed at small flood plain operations and is restricted to those operators and residents who elect to buy flood insurance. However, what guidance, counseling, and financial assistance will be made available to the flood plain operator in relocating or rebuilding a flood damage property is not clear. Study is needed here also. Finally, what further actions are required to make Michigan and its local units of government eligible for natural flood insurance needs to be studied and evaluated. This was noted earlier in the predevelopment section discussion of flood insurance.

Other Techniques

Several flood loss management techniques do not fit into the dichotomy of a predevelopment and postdevelopment classification scheme in terms of flood loss reduction measures. Flood insurance would be an example of such a technique if it were not for the land use control constraints attached to the program. Moreover, the constraints are a means of obtaining implementation of other techniques for reducing or preventing flood losses. Without such constraints, flood insurance, would be an example of a technique utilized for mitigating flood losses through redistribution of flood loss bearing and not one of truly reducing flood losses.

Flood Relief

A second example of such a technique is flood relief. A similar function is served by flood relief as that found in flood insurance, except that redistributional effects are even broader. The recipients of flood relief have only very indirect financial relationship with the program as administered. The relationship is dependent upon governmental programs of relief, wherein tax revenues are utilized from the general fund to financially assist flood stricken property owners or occupants. Little relationship exists between flood risk, taxation burden, and flood relief payments. Because the program is not veiwed as a significant program in reducing flood losses, it is briefly reviewed.

Evaluation of the flood relief program in a national context was noted in several references. The Task Force on Federal Flood Control Policy concluded that:

> The minimum objective of public policy should be to assure consideration of the advantages and disadvantages of flood proofing and of relocation before action is taken to restore damaged property.[1]

Their conclusion was prompted by the observation that the current focus of flood relief is on quick restoration of conditions to a pre-flood status. This in turn reflects a public and private norm which needs to be broadened and redirected where possible so relocation or flood proofing will be considered along with considerations of immediate restoration.

In terms, of Michigan, little can be concluded from this study. General comments made by state and local officials suggest that a good study hypotheses in this area would be that existing flood relief policies

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[1] U.S., Task Force Report on Flood Control Policy, House, Doc. No. 465, 1966, p. 31.

and measures in Michigan do not or are unable to give serious consideration to the possibilities of assisting relocation or flood proofing in redevelopment relief requests.

Education and Technical Assistance

From what information that was obtained for this study, it appears that Federal and Michigan technical assistance measures are meeting with significant results. The principle deficiency might be that not enough of such assistance is being utilized or requested. From information provided by the Corps of Engineers and the Michigan Water Resources Commission, it can be concluded that a considerable need continues to exist in many communities for some flood loss management. As cited, earlier, at least 105 Michigan communities were found to have stream flooding problems.[1] At the same time it was pointed out that the initiative for requesting technical assistance under the Section 206 flood plain information studies resides with the local community. Consequently, increases in local requests for technical assistance might be prompted through (1) State agency contact and encouragement, (2) compulsory state flood plain regulations like those found in Wisconsin, or (3) subsequent flood events.

One other possible improvement is needed. Some reconciliation is needed between national policy objectives and restrictive regulations concerning structural developments in both the floodway and flood plain storage area. At present, flood plain zoning ordinances tend to be quite restrictive. The 1963 Farmington, Michigan Flood Plain Information Report on the Upper River Rouge was found to suggest that restrictive regulations in terms of filling would be appropriate for both areas.[2] On the other

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[1] Supra, p. 158.

[2] Farmington, Michigan Flood Plain Information Report, 1963, p. 20.

hand, the State demonstrates a primary concern for floodway encroachments; wherein, small fills in flood plain storage areas are permitted when they do not affect the regulated floodway.[1] Consequently, it appears that some need exists in reconciling methods of reviewing developments in flood plain storage areas as to their potential detrimental effects. Such a reconciliation is needed in order that a more optimum use of the flood plain can be achieved within flood plain management regulations.

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[1]Lawrence Witte, Personal Interview, January 29, 1969.

CHAPTER VI

RECOMMENDATIONS

What needs to be done in Michigan in terms of flood loss management?

The principle initial charge for this study was a review of flood loss management policy and practices with reference to Michigan needs. The formulation of recommendations that could be made in terms of program development, adoption, and/or revision were an integral part of that initial charge. It was also anticipated by the exploratory nature of the study that much of the work would produce further questions and outline additional research needs. Both of these expectations were premised on the hypothesis that flood loss management in Michigan could be improved. Accordingly, the ensuing recommendations will reflect contributions and findings of the previous chapters in terms of (1) proposed flood loss management techniques, (2) present practices and applications of these in the State of Michigan, and (3) an evaluation of these practices as applied to the state.

A significant weakness in this thesis has been the absence of direct field observations and primary data collection. Such observations and data provide the strongest basis of critically evaluating management program adoptions and achievements. Five areas for which a significant amount of information was acquired are focused upon for making actual program recommendations. The five areas which will receive particular attention are floodway encroachment regulations, flood plain zoning, subdivision regulations, flood proofing, and engineering works of flood protection and prevention. Other areas for which some, little, or no

field information was acquired will be commented on in terms of recommendations for further information collection and/or study analysis.

Recommendations will be approached in two divisions. Initially, recommendations will be proposed and reviewed on an institutional basis. Following this, there will be a series of proposed recommendations made on a technique by technique basis. In this manner, program needs and potentials can be more thoroughly covered.

Recommendations by Institutional Level

Recommendations have been made in the literature which are keyed to institutional levels of implementation.[1,2,3] Such approaches give recognition to the difficulties in developing various alternative proposals without giving recognition to institutional structures and jurisdictions. At the same time, such approaches offer the opportunity to reinforce the concept of a range of alternatives which can be integrated into a program of multiple thrusts. While doing this, recognition is given to the constraints attributable to institutional organization which impede attainment of various actions in a multi-level, multiple technique, program.

Federal

Improvements in Federal policies and programs in flood loss management have been recommended frequently in the literature. In terms of Michigan

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[1] Wallace E. Akin and Merwin D. Dougal, "Flood-Plain Regulation in Iowa," in Papers on Flood Problems, ed. White, Departments of Geography Research Paper No. 70, University of Chicago (Chicago: University of Chicago, 1961), p. 180.

[2] Summary of Proceedings, Third Annual Meeting on Interstate Conference on Water Problems (Chicago: Council of State Governments, December 5-6, 1960), p. 15.

[3] Murphy, Regulating Flood Plain Developments, 1958, p. 160-161.

needs, two measures deserve significant attention. First, increased levels of technical assistance in providing hydrologic data for flood plain management is needed. Second, provision of the Federal Flood Insurance Program should be requested for implementation in this state. Both needs are dependent upon local and state initiative in making the requests; but ultimate control of the program is provided by the Federal Government.

A third area also needs attention. Federal programs for engineering works of flood protection and regulation need to be thoroughly reviewed. Matters of enhancement benefits and cost reimbursement need further study and adjustment. The Task Force on Federal Flood Control Policy outlined five points which need addressing in policy reviews and adjustments.

> (1). The more widely the beneficiaries share in costs, regardless of the type of project, the more likely the programs will promote efficient and socially desirable use of flood plains.
>
> (2). The larger the proportion of costs that are repaid the greater the check on uneconomic investments.
>
> (3). There is special advantage to any policy which identifies beneficiaries and charges them some portion of the cost of achieving economic future development in the flood plain.
>
> (4). There is no reasonable basis for differing cost-sharing requirements. . .for varying requirements between regions.
>
> (5). Fifth, and absolutely essential, cost-sharing policy should be consistent for all Federal construction agencies.[1]

While such adjustments in policy must be directed at the Federal level, the impact of the needed adjustments will be one of increasing the attention given to state and local land use planning and control techniques. As a result, these latter techniques will need to bear more of the burden in achieving an optimum economic development of the flood plains in the state

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[1] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 42.

and the nation.

State

The State of Michigan should reevaluate its movement into direct regulation of flood plain development and occupancy. Comments from officials in other states and information on the State of Wisconsin's comprehensive flood plain management program strongly suggest that the State of Michigan redirect flood plain regulation to the municipal level. A strong state involvement in flood plain management can be secured by enacting provisions which require local adoption of flood plain regulations which must meet minimum standards established by the Michigan Water Resources Commission. Commission review and approval of ordinance enactments and program enforcement should also be provided. In the event local regulations are not adopted or do not meet state standards, then authority should be available for Commission establishment of flood plain regulations which provide minimum standards for local regulation of flood plains.

The Michigan Water Resources Commission should make inquiry as to the availability of the National Flood Insurance Program. If compliance with Federal program requirements is not currently present, measures for meeting such compliance should be evaluated and adopted.

A special educational program should be established at the state level. Information should be designed to demonstrate the need for private and public regulation of flood plain development. In part, this function can be achieved through increased state activity in encouraging local requests for U.S. Corps of Engineers, Section 206 Flood Plain Information Studies.

In the final analysis the state should be directly involved in stimulating and encouraging local program development. Subsequently, it should act as a coordinating unit when local programs need or draw upon

Federal program assistance. In this latter function, Michigan has performed well in coordinating Federal local involvements.[1,2]

Local

Problems have been confronted in the past in obtaining satisfactory local flood loss management programs. This results from the large number of local units of government, their political autonomy, and their decentralized nature. The Interstate Conference on Water Problems reflected this situation when they could not achieve a consensus on how to get local governments functioning successfully in flood loss management.[3] Wisconsin has moved to answer this problem by adopting a program of compulsory local enactment of flood plain regulations. It was recommended above that Michigan reevaluate its current trend and review the possibilities of following an approach similar to that found in Wisconsin. In any event, the ultimate focus for flood plain management should center on local units of government regardless of the incentives, sanctions, or pressures elected by the state to bring about such local flood plain planning and management.

The first step in local flood plain management should be the development of a comprehensive plan which reflects flood risk to the special development control needs in flood plain areas. This should be followed with special flood plain development restrictions within subdivision regulations, floodway encroachment regulations, zoning ordinances, building codes, and sanitary or health regulations. Other techniques as warning signs land acquisition, building finance, flood proofing, and relocation should be

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[1]Carl Argiroff, Personal Interview, February 18, 1969.

[2]Lawrence Witte, Personal Interview, January 29, 1969.

[3]Summary of Proceedings, Interstate Conference on Water Problems, December 5-6, 1960, pp. 15-16.

encouraged where appropriate. Urban renewal and capital improvement plans should reflect flood plain risks and associated needs for development protection. Property tax relief should be granted where restrictive floodway and flood plain prevent or depress development of income producing land uses. Flood insurance, when available should be required of proposed flood plain developments. Finally, a strong educational program should be maintained which provides information on why such flood plain planning and guidance programs are needed.

Recommendations for Improvement of Techniques

Predevelopment Flood Loss Management Techniques

Floodway Encroachment Regulations

The State of Michigan should reevaluate the floodway encroachment program established under Act 167 of Public Acts of 1968. Program developments in other states as well as here suggest that more of the floodway regulatory burden should be retained by municipalities. A compulsory program could be adopted whereby the relevant local units of government would be required to adopt floodway encroachment regulations. Care in moving to such a program is needed. It may be found that only municipalities of a certain population size or jurisdictional level can afford the resources to support a staff qualified to undertake technical review and enforcement functions, as are required here. At the minimum, local governments should be encouraged to adopt floodway regulations which would allow primary review and enforcement functions to pass to the local unit of government. Provisions for establishing minimum standards could be granted to the Michigan Water Resources Commission. In addition, local ordinance review and approval powers should be retained by the Commission as is presently provided for in Act 167 of 1968.

A series of specific recommendations follows:

1. If the current state level program continues, then serious consideration should be given to the establishment of floodway encroachment lines. This would be in addition to the present individual permit review functions. Personnel should be obtained and dedicated principally to delineating encroachment lines along reaches of Michigan watercourses.

2. The Commission should encourage municipalities in adopting local floodway regulations. Such regulations and enforcement could be more restrictive than state requirements, or they could reflect the state established minimum criteria.

3. In order to further the above, a model local floodway encroachment ordinance should be developed. State and Federal technical assistance should also be provided to further aid local (a) adoption of such an ordinance and (b) establishment of a permit review program.

4. A distinction needs to be drawn between floodway and flood plain pondage areas. In existing flood plain regulations such a distinction needs to be carried through in regulated uses prohibited and/or permitted in the respective areas.

5. As a general policy, the transfer of primary field review and enforcement responsibilities should be encouraged as much as possible to local units of government. Review and supervisory functions should be maintained by the state.

6. The Commission should undertake a legal analysis of what powers are available for abating nonconforming floodway uses. Where such powers or provisions are not present, guidelines for obtaining and establishing such powers should be developed.

7. The Commission should also undertake or sponsor economic studies to evaluate the differences in economic impacts of varying the floodway encroachment zone. Moreover, means of establishing and evaluating the hazardous externalities posed by floodway obstructions should be studied and illustrated.

Flood Plain Zoning

Experiences with local enactments of flood plain zoning in Michigan suggest a possible need for a more comprehensive approach. Information regarding Wisconsin's broad flood plain management program lends evidence for a compulsory program requiring local enactment of flood plain zoning in Michigan. However, information concerning existing flood plain zoning ordinances in Michigan and the Wisconsin program was generally devoid of observations or data on actual field applications. Accordingly, further study, particularly of Wisconsin's experiences with their program, is needed before actually embarking upon a similar program in this state. As suggested in floodway regulations, some consideration must be given to what political units are capable of supporting the technical staff required in administering flood plain regulations. At the minimum, the Michigan Water Resources Commission should proceed in drafting a model flood plain zoning ordinance for consideration by municipalities. In addition, the Commission and technical-administrative staff should encourage a program of state review and technical assistance in drafting local flood plain zoning ordinances. An excellent example of such a cooperative effort was evident in the drafting of the Lansing flood plain zoning ordinances.

Specific recommendations are listed as follows:

1. A compulsory local flood plain zoning statute should be studied and evaluated. Under such a proposal, a thorough

review of Wisconsin's experiences with their flood plain management program should be of significant benefit. Additional states should also be contacted to evaluate their experiences with flood plain zoning. Within such a program, state review and approval of required local ordinances should be considered. In return, state technical assistance and data should be available for support in developing local ordinances and interpreting their administration and enforcement requirements.

2. A model local flood plain zoning ordinance should be drafted by the state in order to assist local governments in adopting such ordinances. This would be of considerable benefit regardless of the existence of a state compulsory local enactment program.

3. The availability of state technical assistance in developing data, interpreting data, and applying data should be assured local units of government regardless of the existence of a compulsory local enactment program. This assistance should include procurring Federal technical assistance when possible and interpreting the results when requested.

4. There should be considerable distinguishment between floodway encroachment areas and flood plain pondage areas when new local flood plain zoning ordinances are adopted or existing ones are revised. Most of the existing ordinances fail to distinguish between these two areas adequately and/or regulate allowed land uses accordingly. Currently, open space needs appear to be secured at the expense of reasonable (flood proofed) structural land use in flood plain storage areas.

5. In addition, studies should be conducted into means of relating flood proofing, building codes, flood insurance, and other techniques to zoning criteria which can be used in permitting flood plain land use. Specifically, what criteria are appropriate for use in a flood plain zoning ordinance? What criteria give adequate recognition to means of preventing or managing flood loss in structural developments on flood plains?

Subdivision Regulations

Consideration should be given to redirecting more of the administrative burden under subdivision controls to local units of government. The state should establish definitive criteria and procedures for municipal consideration in regulating the subdivision of land into plats which will be partially or wholly within a flood plain. Some attempt has been made at pursuing this goal in the existing rules and regulations of the Water Resources Commission.[1] Thereafter, local units of government should be encouraged or required to adopt subdivision controls which at least meet state minimum requirements. State review and approval responsibilities should be maintained over these units. It may also be found that only municipalities of a certain population size or jurisdictional level can provide resources for supporting the professional staff needed for the technical reviews required in flood plain development permits. Thus, where local resources are inadequate or satisfactory regulations are not enacted, the State may find it necessary to continue with direct permit review and enforcement programs.

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[1] Michigan, Rules and Regulations of the Water Resources Commission, 1967, R. 560.303(2) and (3).

Currently, the backlog of subdivision permit applications continues to tax Bureau of Water Management review capacities. In 1969, inadequate staffing prevented adequate review of subdivision permit applications in the alloted review period.[1] Staffing has been increased since that time, but so has permit applications and other flood plain management program requirements.[2] Consequently, increased staffing is required and/or a redirection of primary review and enforcement responsibilities.

Finally, some experience with this approach is available under the existing program. Mr. Witte observed that under the general subdivision control procedures, some subdivider's were conferring with various review bodies in an attempt to find one or more that would favorably approve a plat proposal.[3] Thereafter, such approval was used as a lever in trying to get other review bodies to approve a land subdivision proposal. In contrast, a countervailing strategy was noted whereby local units were sometimes found to refer applicants to other municipal or state review bodies for indications of assurances of approval before they would approve a subdivision application. This phenomenon suggests that local units are interested in enforcing subdivision controls, but they need support in their actions from higher units of government. Further study of this phenomenon would be extremely valuable. At the minimum, it should provide further insight into the dynamics of sharing flood plain regulatory responsibilities between state and municipal governments.

Building Codes and Flood Proofing

The use of building codes for preventing flood losses in this state

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[1] Lawrence Witte, Personal Interview, January 29, 1969.

[2] Lawrence Witte, Personal Communication, September 1971.

[3] Lawrence Witte, Personal Interview, January 29, 1969.

is thought to be nominal. Use of flood proofing is also thought to be little practiced in reducing flood loss potential in flood plain developments. A few illustrations of proposed buildings incorporated flood proofing principles were noted in discussions with flood plain management personnel. Nevertheless, this premise still needs substantiation.

Literature discussions of building code practices and applications of flood proofing in other areas can be used in guiding the needed research to be undertaken in this state. Studies should be initiated which identify proposed and existing examples of flood proofed buildings in Michigan. Research is needed as to how flood proofing concepts might be adopted in building code regulations. An evaluation is also needed as to the implications of administrative problems in flood plain areas in enforcing present building codes if amended. Information needs to be developed and provided such that local units of government and the private sector are better informed as to the potential benefits of flood proofing. Evaluations of technical assistance services should be undertaken to identify the role such services might provide the private sector and local units of government. Specific research needs include:

1. Determination of means for translating flood proofing concepts into building code provisions. Particular attention should be directed at performance type criteria. Research work at the U.S. Forest Service Products Laboratory in Madison, Wisconsin has been conducted on wood structures and their ability to withstand hurricane winds.[1,2,3] Similar work was

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[1] L.O. Anderson and Walton R. Smith, "Houses Can Resist Hurricanes," U.S. Forest Service Research Paper FPL 33 (Madison, Wisconsin: Forest Products Laboratory, August, 1965.)

[2] R.F. Luxford and Walton R. Smith, "Observations of Damages to Houses by High Winds, Waves, and Floods, and Some Construction Precautions," Forest

not being done in terms of flood damage, but is definitely needed for structures of all types of construction.

2. Evaluation of the need for a state building code or a special flood plain building code; and/or

3. Development of model flood plain building code provisions.

4. Evalustion of the administrative problems in building code regulations which might have bearing on implementation of flood plain building code restrictions.

Other Predevelopment Flood Loss Management Techniques

Warning Signs

Warning signs have received insufficient exploration and treatment. Murphy's findings suggest major weaknesses which have prevented their successful employment as a flood loss management device.[1] On the other hand, the identified weakness also suggest negative implications for successful applications of other flood plain regulatory measures. Accordingly, further study of flood plain warning signs is needed. Attention should be given to potential interrelationships between warning signs and floodway encroachment regulations, flood plain zoning, and/or building codes. If flood plain warning signs are not acceptable to the local area, what are the prospects for implementing flood plain regulations?

Building Finance

Studies are needed to evaluate private and public credit program procedures in terms of recognizing, evaluating, and reflecting flood risk

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Products Laboratory Report No. 2095 (Madison, Wisconsin: U.S. Forest Service, Forest Products Laboratory, October 1957).

[3]H.F. Zornig and G.E. Sherwood, "Wood Structures Survive Hurricane Camille's Winds," U.S. Forest Service Research Paper FPL 123 (Madison, Wisconsin: Forest Products Laboratory, October 1969).

[1]Murphy, Regulating Flood-Plain Developments, 1958, pp. 123 and 163.

in granting credit or insuring the extension of credit. A field review of private and public sources of credit should be undertaken to determine the impact that the recommendations of the Task Force on Federal Flood Control Policy had on the credit institutions in Michigan.[1] In particular, the impact of Executive Order 11296 and the Secretary of Housing and Urban Development Order No. 25 should be evaluated in terms of Federal credit programs in Michigan.[2,3]

A number of specific study needs can also be pointed to:

1. What information and technical assistance needs are required in reviewing credit applications for proposed flood plain developments?

2. Where are the various points in credit deliberations that leverage can be applied to obtain adequate recognition of flood risk?

3. How can flood risk be accounted for in the terms of a loan contract?

4. What should the interrelationships be between credit policies and flood plain insurance if and when it becomes available to Michigan flood plain occupants?

Taxation

A special study of tax policy is needed as a means of furthering flood loss management objectives. Within Michigan more attention should be directed at property tax policies. How can the property tax reflect

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[1] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 27.

[2] U.S., President, Executive Order No. 11296, August 11, 1966.

[3] U.S., Department of Housing and Urban Development, Secretary's Order No. 25, February 17, 1967.

flood loss management needs without further eroding the existing tax base? What adjustments if any are needed in appraisal policies, where flood plain parcels are restrictively regulated?

Acquisition

Acquisition of flood plain lands appears to be compatible with other program objectives as open space and recreation. Considerable attention was given in Chapter III to outlining the various measures available under this technique. Case studies are needed in Michigan and elsewhere for illustrating the costs and problems of such measures in addition to their benefits. Such items as enhancement benefits, recreational benefits, reduction of possible flood losses, reservation of flood plain storage areas, as well as costs of property interests conveyed, property tax considerations, and limited proprietary interests in conveyed property of less than the fee simple need more detailed specification and evaluation.

It was noted earlier that acquisition of developed flood plain properties is available within urban renewal programs. In addition, it may become available under the National Flood Insurance Program. However, consideration of both of these latter possibilities is more appropriate under evacuation and redevelopment measures.

Flood Insurance

Inquiry needs to be made into the availability of the National Flood Insurance Program for Michigan flood plain residents and occupants. What additional prerequisites might be needed to qualify for the program? What constitutes adequate land use control measures? And to what extent will chargeable premium rates reflect flood proofed buildings and contents?

Postdevelopment Flood Loss Management Techniques

Compulsory Techniques

Considerable study of nonconforming use restrictions in floodway encorachment regulations, flood plain zoning, and building codes is required. When and to what extent can abatement measures be utilized? What use can be made of controls over alteration, expansion, remodeling, or reconstruction of nonconforming uses? Studies of the interrelationships between flood proofing and nonconforming uses should be undertaken.

Subscriptive Postdevelopment Flood Loss Management Techniques

Engineering Works For Flood Protection and Prevention

Information on Federally assisted programs of engineering works for flood protection indicates that these programs are receiving continued attention nationally and locally. Problems were noted in obtaining local "a,b,c, requirements" in some Michigan projects. Indications were that sufficient resources were lacking or were difficult to commit in advancing these projects towards construction phases. Case studies should be considered which might identify financial and other resource allocation problems in securing local fulfillment of the "a,b,c, requirements." Strategies should also be studied which might assist local units in meeting cost sharing responsibilities. Loan programs are available to local participants in Public Law 566 Watershed Protection and Flood Prevention projects. However, such loan assistance programs are not generally available to local communities in engineering works for flood protection constructed by the Corps of Engineers. This is quite important in light of increasing arguments and proposals calling for a readjustment in Federal-local cost sharing policies.[1] The impact of such proposals is generally to increase

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[1] U.S., Task Force Report on Federal Flood Control Policy, House Doc. No. 465, 1966, p. 43 and 45.

the cost bearing burden of private and community beneficiaries in Federally assisted projects. More importantly, such proposals will likely increase the shift of attention in flood loss management to land use guidance and control measures.

Evacuation and Relocation

Further study is needed of these techniques. Significant application of both can be obtained in blighted urban areas where flood hazards may be a factor in causing blight. Authorities exist for evacuating urban flood plains under urban renewal programs, engineering works for flood protection (principally as an alternative to levees), and the National Flood Insurance Program. Examples of evacuation as an alternative to an engineering work for flood protection project are not known in Michigan. However, case studies of evacuation authorized under urban renewal projects should be investigated in Michigan. In practice it can be expected that evacuation under this last program authority will actually be associated with redevelopment measures.

Redevelopment

Redevelopment offers somewhat of a contrast to the focus of acquisition, evacuation, and relocation. Redevelopment focuses on sound land use which includes structural developments in flood plains. At present it can be termed a promising technique for blighted flood plain urban areas. Potential and existing applications of urban renewal in blighted flood plain developments need to be identified and studied in Michigan. Urban Renewal Project Area No. 2 in the City of Lansing offers an example of evacuation and redevelopment in a flood plain setting.[1] Further study of this example

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[1]Redevelopment appears to be confined to areas adjoining the flood plain; while permanent evacuation of existing structures are projected for flood plain areas. Supra, p. 130.

is warranted. In addition, other similar case studies should be attempted in other Michigan communities.

Rebuilding Finance

The study recommendations made in the Building Finance Section above apply here also. This technique currently overlaps with redevelopment measures and flood relief. Information was not obtained in this study on policies of private credit and lending institutions. Some information on the Small Business Administration suggests that further study is needed of public credit policies. In particular, to what extent do existing policies as applied in Michigan reflect pressures to rebuild and restore damaged structures as quickly as possible? Are considerations of flood proofing or relocation allowed and promoted in rebuilding finance applications ? In terms of both private and public credit institutions, what information and technical assistance is required for introducing flood proofing or relocation considerations in applications for rebuilding finance?

Other Techniques

Flood Disaster Relief

Little attention was given to this technique in this study. Selected sources of flood relief were noted. Applications and extent of use in Michigan were not studied. Recommendations have been made at the national level which suggest that adjustments be made in flood relief programs as currently administered. Program adjustments should reflect a recognition of the contributions and importance of flood proofing and relocation measures. The tendency to quickly restore communities to reexisting conditions should be tempered by long range considerations of reducing flood loss potential. Most of the attention is then focused at the Federal

level to bring about such adjustments. However, a significant need exists for studying the contingency planning of local units of government. Are local units of government prepared to bring about corrections in flood plain land use after a flood event passes? How can nonconforming land use provisions, rebuilding finance, acquisition, urban renewal, flood proofing, building codes be integrated to prevent simply reestablishing a community to its preflood state?

Education and Technical Assistance

It is difficult to make specific recommendations concerning an educational program. This results from inadequate and frequently divergent discussion of education in the flood loss management literature. In short, disseminating more and clearer information may not elecit the anticipated program responses. At present, there are conflicting accounts concerning the incorporation of flood plain information in the decision making processes of the flood plain occupant or developer. Accordingly, basic research is needed on the educational process, information flows, and decision making as they relate to flood plain development and occupation. Such research is essential for developing the ability to predict responses to educational programs and to other regulatory programs which require a strong educational program.

Specific research needs include the identification of the various individuals and groups which need to be served by information and educational programs. Differentiating the recipient public into various audiences is essential in developing objectives and methods of implementing educational programs. This is especially apparent where public educational programs may be initiated at the state or local level. More research is needed on the different flood plain information requirements of various private and public decision makers and associated problems of perception, attitude, and

sensitivity to flood risk.

The needs for and problems of an educational program directed at local governmental officials are evident in the existing Federal and State flood plain information and technical assistance programs. The need and justification for allocating more resources to these programs are evident as noted in the preceeding chapter. At the same time, deficiencies in the educational function are also evident. Specifically, it was found that flood plain management efforts are significantly enhanced when the technical information and advisory assistance are furnished to local governments. Nevertheless, problems are still present in effectively translating the hydrologic information into sound land use controls. This is most evident in flood plain zoning ordinances.

An initial state educational program effort should include the goal of bringing about a clearer understanding of floodway and flood plain storage area dynamics. A goal or benefit sought under such an educational effort would be a clearer discrimination in floodway and flood plain management programs at the local level. A complicating issue arises from local and state efforts in securing open space and park lands in flood plain areas through the use of police powers as contrasted to the use of eminent domain. Accordingly, the Water Resources Commission should publish materials and guidelines which would assist in clarifying the regulatory needs of floodway and flood plain storage areas and the issue of police power versus eminent domain. These two efforts should assist local communities in designing sound flood plain management programs which alleviate the potential of problems with litigation.

Additional specific study needs relate to establishing public programs to provide educational information and technical assistance to architects, contractors and builders, private and public credit institutions, building

code inspectors, planning officials, property tax assessors, administrators of emergency or disaster relief officials and the news media. As noted in several of the preceeding sections, there is a particular need for the Michigan Water Resources Commission to develop and publish model flood plain control ordinances or provisisions. For example, there is need for model floodway encroachment regulations, flood plain zoning ordinance, local flood plain subdivision regulatory provisions, and local flood plain building code provisions.

Comprehensive Land Use Planning

Greater attention needs to be given to comprehensive land use planning as a basis for integrating many of the flood loss management techniques. To date insufficient discussion has been given to the concept in the flood loss management literature. Reviews of a limited number of municipal land use or master plans during this study suggest a similar conclusion, i.e., to little attention is given to flood hazards and associated land use problems by communities during the development of their master plans.

A more exhaustive review is needed in Michigan of comprehensive land use or master planning at the municipal level; specifically in those communities where flooding has been identified as a hazard. Case studies of communities with flood plain land use regulations or management programs are needed to study the degree of correlation and integration achieved between land use plans and implementation of flood plain management programs. Where such integration is absent, then evaluations and recommendations are needed as to what might be done to correct such disparities in comprehensive planning and flood plain land use management.

Research is needed in evaluating various mechanisms needed to assure that flood plain land use planning is incorporated into land use planning by communities faced with flood risk. In what manner and to what extent

can education and technical assistance be used in assisting the incorporation of flood plain land use planning in comprehensive planning? Would special flood plain land use management information guides and state technical assistance programs be of value in promoting community consideration of flood plain land use? How might subdivision regulations, land use zoning, property taxation procedures, open space land acquisition, public capital improvements construction, and urban renewal in flood plain areas be made dependent upon prior treatment and adequate recognition of flood hazard in a community land use plan?

In summary, local land use planning offers considerable potential for tailoring and integrating implementation techniques such as subdivision regulations, zoning ordinances, building codes, special ordinances, taxation policies, acquisition plans, and redevelopment plans in such a manner as to reflect flood plain land use considerations and needs. A thorough review of the current state of the art is needed to point out the disparities between recommended policy and actual practice. Specific recommendations should follow which are directed at improving current comprehensive planning practices as they relate to flood hazards and flood plain land use.

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