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To the Graduate Council:

I am submitting herewith a thesis written by Charles Craddock Carrington entitled "Role of the States in Flood Plain Management." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science in Planning.

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ROLE OF THE STATES IN FLOOD PLAIN MANAGEMENT

A Thesis

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the Graduate Council of

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Planning

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Charles Craddock Carrington

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CHAPTER I

INTRODUCTION

Now is the time to re-evaluate the kind of world in which we live. We should stop and observe how we live, our vehicles for living, and what the directions for the future should be. After consideration, one might suddenly discover that the vehicles by which we live, or our methods and modes of living, have ceased to perform the functions as originally designed because now the functions are complex rather than simple.

For example, the basic governmental structure existing in our metropolitan regions is not adequate to meet the needs of today's complex society, not only in the fields of transportation and air pollution, but also in flood protection. For almost thirty years, little legislation was passed concerning flood plains and primary reliance was placed on flood control structures. As our population grew, houses and industrial plants were built in flood plains compounding the ever increasing problems of urbanization and population expansion. Hills were stripped of trees and slopes terraced to open the way for residential zones. As a result, serious erosion problems led to streams becoming clogged and channels filled to the extent that they were no longer able to contain the flood waters. In turn, this caused flooding more frequently and more severely. This type of uncontrolled development, as shown in Figure 1, is a major source of flood damage irritation.

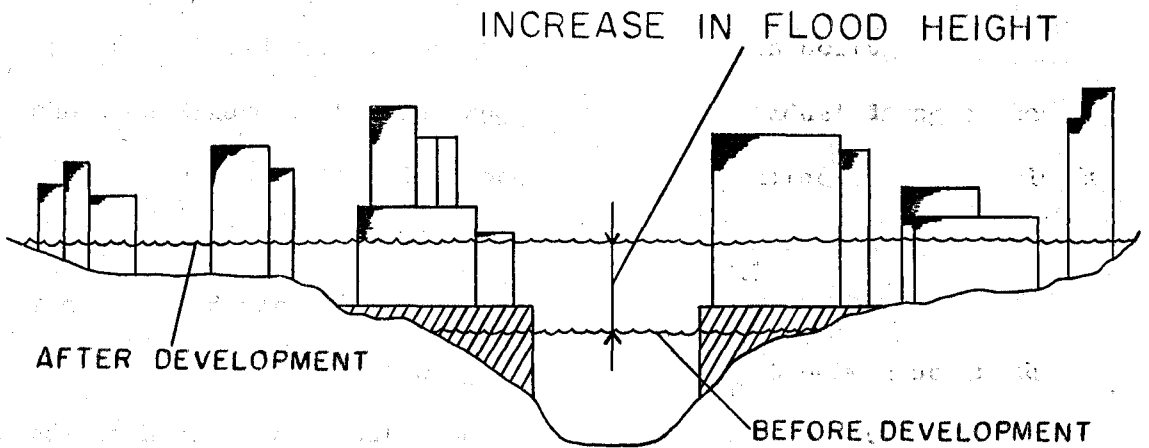


FIGURE 1

EFFECTS OF IMPROPER DEVELOPMENT
OF A FLOOD PLAIN

Source: Anderson-Nichols and Co., Inc., Boston, Massachusetts.

Despite tremendous Federal investments in flood protection and prevention, estimated annual losses from floods have climbed steadily since 1936. Through the Corps of Engineers and Soil Conservation Service, the Federal government has invested \$7 billion for flood control structures since a national flood control policy was adopted in 1936. In 1966, Federal expenditures were \$500 million and residual flood damages had reached one billion dollars annually, as shown in Figure 2. These expenditures and residual damages occurred on only 6 per cent of the land occupied by the United States, excluding Alaska and Hawaii, and within this small portion of the nation are located most of our largest cities.

Floods have far-reaching effects. They not only concern the immediate hazard area, but impose a serious economic burden on the residents of the community, the region, and the state through a loss of taxes, revenue, and services. Future flood damages could be significantly lessened by means of proper development or management of the flood plain. Proper development can occur only after the public is made aware of the flood damage problem and its solution.

Although flood control works have been constructed to protect many areas, local development within the flood plains is being constructed faster than protective works can be built. Alone, this tool is no longer able to serve the needs of our society. The sound development of land use regulations or flood plain zoning, for which we have waited far too long, is now an essential part of the proper management and development of flood plain lands.

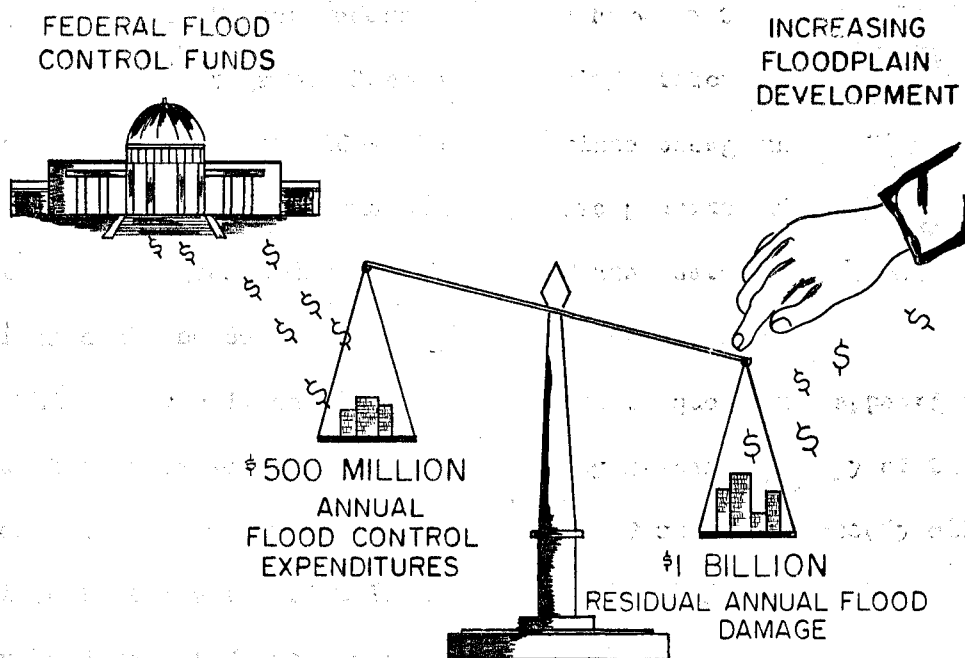


FIGURE 2

ANNUAL EXPENDITURES VERSUS RESIDUAL
ANNUAL DAMAGES

Source: Anderson-Nichols and Co., Inc., Boston, Massachusetts.

The purpose of this study is to determine the role of the states in flood plain management. In the first place, an analysis of current Federal programs, legislation, or special studies is important because of the significant impact Federal agencies have on the state flood damage prevention program. Secondly, a brief history of the role of the states until 1962 provides the appropriate background. Finally, a review of the current status of the states provides the framework for establishing trends from which certain conclusions and/or recommendations could be derived.

This study will be limited to the twenty questions appearing on a questionnaire sent to each of the fifty states. A copy of this questionnaire may be found in the Appendix. Further, the study will be limited to the years from 1962 to 1967 since prior years have already been reported upon in a previous study.

CHAPTER II

FLOOD PLAIN MANAGEMENT MEASURES IN

THE FEDERAL GOVERNMENT

The overall approach to the management of the flood plains is broadening to more effectively serve today's needs. Officials, planners, and engineers are searching for alternate approaches and supplements to outdated programs. Many alternate approaches have already been found. The past two years have brought forth some of the most provocative legislation and/or recommendations in the history of flood plain management. The greater the need, the quicker the cure. We have at last reached the point where urbanization has so increased demands on natural resources that these resources absolutely must be protected and preserved. Our water supply is essential. Our water supply includes our flood waters.

Because floods are a national as well as local problem, Federal leadership in this field is essential. Some of the recent studies and new Federal legislation suggest directions for future programs by the nation, the state, and localities. These show some definite trends toward the formulation of a nation-wide long range flood plain management program which will have significant effects on the role of the state in the national program.

I. A TEN YEAR PROGRAM OF FEDERAL WATER

RESOURCES RESEARCH

A basic need is to more completely understand the flood problems and the limits to which alternative solutions may be reasonably applied. A major effort in this direction was made in 1966 by the Federal Council for Science and Technology Committee on Water Resources Research. Its report was a systematic appraisal of long range water research needs. Of particular significance is this report's evaluation of research related to water resources planning as well as recommendations regarding the kinds of research and the funds which it will require.

In dealing with water, we cannot ignore the problems caused by too much. Solutions to these problems may require flood mitigation, flood plain zoning, flood proofing, flood forecasting, land drainage, erosion control, or urban and highway storm drain damage. Flood waters, undesirable as they may be, are part of our water supply and must be considered in any program of water resources research.¹

It was pointed out that the specific area of water resources planning received as little as 1 per cent of the current total research effort and yet this is the area described as the most promising in terms of immediate and long range payoff.

Again it was pointed out that although multi-purpose water resource planning made major advances with the Tennessee Valley Authority's

¹Federal Council for Science and Technology Committee on Water Resources Research. A Ten Year Program of Federal Water Resources Research (Washington: U. S. Government Printing Office, 1966), p. 1.

program in the 1930's, the procedures for planning and evaluating projects have far from kept pace with the increasing problem. Improved methods of planning coupled with evaluation procedures for projects can lead to reduced national expenditures on water as well as more efficient management of a very needy resource.

Included in the Water Resources Research Committee recommendation are a series of intensive economic studies of flood damages in rural areas. Research in the areas of agricultural and capital improvements can provide the basis for estimating costs and benefits of watershed development. Currently, the Corps of Engineers research program includes evaluation of flood plain development, with specific reference to land valuations. The Tennessee Valley Authority has, since 1953, provided information to encourage and assist cities and counties to take responsible action to solve flood problems. Upon request, TVA will furnish to communities within its region historical data on past floods and projections for future floods as well as graphic flood hazard information. Presently, the Economic Research Service is analyzing the applications of zoning to water management with specific emphasis on land use zoning, stream zoning, taxing policy, public purchase, and other measures.

The last section of this report authorizes a study to be conducted which would permit extension of the insurance program to cover earthquakes and other natural disasters.

Within the past five years efforts of all agencies have changed from almost exclusive concern with flood control structures to programs

which embrace non-structural effects as well as increased meaningful research.

II. NATIONAL PROGRAM FOR MANAGING FLOOD LOSSES

The Bureau of the Budget appointed a Task Force on Federal Flood Control Policy. They were assigned the job of recommending a national program for managing flood losses. Briefly, a change is called for in the approach toward floods and the use of flood plains by all agencies involved: Federal, state, local, and private.

Basic recommendations of the program included:

1. A program should be adopted to outline major flood hazards. This could be accomplished more completely by listing towns and streams with flood problems, outlining the flood plain on maps or aerial photography, and hastening the program of flood hazard information reports.
2. A uniform technique for determining flood frequency should be developed.
3. A new national policy for collecting or surveying flood damage should be made at ten year intervals.
4. The study of flood plain occupancy and urban hydrology should be stepped up.
5. States should build up a staff capable of dealing with the broad responsibility of flood plain management.
6. Federal agencies should take measures to assure that state and local planning agencies include a proper account of the flood hazard.

7. Federal agencies when considering the location of Federal installations or the disposal of Federal land should consider the flood hazard.

8. Collection and dissemination of flood data should be included in the Corps of Engineers program and coordinated with the Department of Housing and Urban Development and the Department of Agriculture.

9. Flood forecasting services should be broadened.

10. Agencies conducting surveys pertaining to flood problems should expand the objectives of flood control studies.

11. Modification of Federal policy in the area of flood project cost sharing is urged.

12. Financial assistance to the state and local public bodies should be increased for the acquisition of land in flood plains.

13. Proper legislation which calls for extension of the Federal loan authority for contributions to flood control projects should be adopted. Such loans would be made to local beneficiaries who cannot raise funds for projects on the local market.

III. WATER RESOURCES PIANNING ACT OF 1967

Of recent Federal legislation, perhaps the most important is the Water Resources Planning Act of 1967. This act is designed to provide for the optimum development of the nation's natural resources by the establishment of a Water Resources Council and river basin

commissions. In order to increase state participation in water and related land resource planning, the act encourages coordinated planning of all affected Federal agencies, states, local governments, individuals, corporations, business enterprises, and others concerned. This act also provides financial assistance to the states. A major responsibility of the Council would be to establish a proper relationship between river basin plans and the requirements of the larger regions of the nation. Of further significance is the Council's continuing review of the adequacy of administrative and statutory measures to assure coordination of policies and programs of participating Federal agencies.

The act has three major titles. The first creates a Water Resources Council composed of the Secretary of Interior, Secretary of Agriculture, the Secretary of the Army, the Secretary of Health, Education and Welfare, and the Chairman of the Federal Power Commission. In essence, the Council functions as the mechanism to assure coordination among the varied Federal agency programs.

Under another title of the act the President may, upon request from a state water resource council, create river basin water and related land resources commissions. Commission membership will be composed of representatives from both the Federal and state agencies. The primary function of the River Basin Commission is to prepare a comprehensive coordinated joint plan with responsibility restricted to the areas of investigation and planning.

Finally, the act provides financial assistance to the states to assist in developing a comprehensive water and related land resources planning program. Interestingly, each state allotment also includes funds for training personnel, which is an important factor in view of the fact that there is a shortage of skilled planners.

IV. CLEAN WATER RESTORATION ACT OF 1966

Another important piece of Federal legislation is the Clean Water Restoration Act of 1966. This act is designed to amend and to make more effective certain programs under the Federal Water Pollution Control Act. The responsibility of water quality and pollution control, recognized as more than a health problem, has been transferred from the Health, Education and Welfare Department to the Department of Interior. Recognizing that the primary strength of this act is directed toward water quality and pollution control, the programs must also consider the problems of flood and erosion control. Additional funds in the form of grants are made available to the states to pay 50 per cent of the administrative expenses of a planning agency capable of developing an effective comprehensive water quality control and abatement plan.

The Secretary of Interior is authorized to make grants for research and development to any qualified agency for the purpose of improving water treatment and water purification methods. In cooperation with the Secretary of the Army, the Secretary of Agriculture,

the Water Resources Council, and with other appropriate Federal, state and local agencies, the Secretary of Interior must promote and encourage contributions to, among other problems, flood and erosion control. Methods such as tax incentives to industries are suggested as a means of reducing or abating water pollution.

V. LAND AND WATER CONSERVATION FUND ACT OF 1965

Of further significance is the Land and Water Conservation Fund Act which is prepared to assist the states and Federal agencies to develop and preserve future outdoor recreation areas. Funds are made available as well as Federal assistance to the states to plan, to acquire, and to develop certain land and water areas. Funds would be apportioned to the states on the basis of need, considering such factors as state population as related to total population in the United States. Grants to the states are made on a 50 per cent Federal and 50 per cent matching requirement basis.

Of particular importance is the requirement that states must have developed a comprehensive state-wide outdoor recreational plan in order to qualify for financial assistance. Not only must this plan outline the program for implementation, but it must be correlated with other Federal, state, regional, and local planning programs. If a comprehensive state-wide plan is not available, the act authorizes the Secretary of Interior to make funds available to the state for preparation of such a plan. Although the act provides the needed financial assistance to purchase and develop land and certain water areas for

recreational purposes, it specifically states that the property acquired cannot be converted for purposes other than public outdoor recreational uses.

VI. NATIONAL FLOOD INSURANCE ACT OF 1967

A flood insurance proposal, the National Flood Insurance Act, is expected to have far-reaching effects on the national scene if it passes Congress and becomes law. Unlike the Federal Flood Insurance Act of 1956 which has not had appropriate funds to carry out its provisions, this act will not tend to increase development in the flood plain. The 1956 Insurance Act cited the same rates for all, regardless of occupancy. This insurance act cites a lower rate for those who do not live in a flood plain than for those who do. In other words, the rate is related to the risk.

The National Flood Insurance Act of 1967 is divided into four sections: the flood insurance program, land management programs in the flood prone areas, insurance industry participation in the program, and various miscellaneous provisions. The act suggests that flood insurance be handled by private insurance firms. In order to assist private firms, the program recommends the following forms of Federal aid:

1. The Federal government agrees to absorb all claims for flood losses beyond an agreed catastrophic breakpoint in return for modest annual payment from insuring companies.

2. If heavy losses from floods should occur before insurance reserves are built up, the Federal government will offset deficits in the form of loans.

3. The insurance companies will be provided with Federal mapping which defines special flood hazard areas and flood risk zones so that the insurance industry will have valid information on which to base flood insurance premiums.

Under the bill, the flood insurance program will be limited to one-to-four family dwellings and a possibility of extended coverage to other property at some future date. States demonstrating a positive interest in the program as well as giving assurance of adoption of appropriate land use measures for land management by June 30, 1970 will be extended a priority. A limit of \$15,000 aggregate liability per unit with \$30,000 for any single structure is implied. Personal property would have a total liability limited to \$5,000 per dwelling unit.

Insurance premium rates are to be based on studies and investigations to assure their reasonableness and to encourage purchase of flood plain insurance. No flood insurance could be made available unless appropriate land use measures have been adopted by the appropriate public body of an area by June 30, 1970.

The bill also authorizes the secretary to identify all flood plain areas including coastal areas with special flood problems. The objective would be to establish flood risk zones in these areas within two years by working with Federal departments or state and local agencies. For each of these areas within the next ten years,

the secretary would make estimates with respect to rate and of the probable flood caused loss. This section would further authorize the secretary to investigate or make studies to determine the effectiveness of state and local measures in flood plain management. If needed, the secretary could then encourage the adoption of improved state and local measures for the long range management and use of flood plains. Technical assistance could also be provided to the state, interstate, and local governmental agencies as needed. States and localities would be encouraged to carry out land acquisition or land conversion programs to improve the long range use of properties in the flood-prone areas. Finally, when property located in flood areas has been damaged beyond repair, the secretary has the authority to negotiate a purchase agreement for transfer to state or local agency ownership.

VII. SUMMARY

The Federal government in providing funds and assistance through recent legislation is offering to the state a stronger role in flood plain management. Only thirty years ago floods were considered a local problem. Today the problem is recognized as being regional in scope. This phenomenon is reflected in the aspects of legislative efforts which are giving attention and support to the regional program. It is essential that a more active role by individual states be assumed in order to allow Federal agencies freedom to attend to problems on a nation-wide scale.

CHAPTER III

STATE DEVELOPMENTS TO 1962

Before describing the state's role in flood plain management as it exists today, a review of the situation as it existed five years ago is fundamental. A Master's thesis, written by Henry Morse, entitled "Role of the States in Guiding Land Use in Flood Plains," provides the background for current research. This detailed report presents a unique opportunity to analyze changes, before 1962, in the flood control program of the states. The purpose of this chapter is to summarize the Morse findings as related to the states' positions in flood plain management at that time.

By 1962, only Hawaii had prepared a comprehensive state plan relating the policies and programs of all state agencies to the overall objectives and development of the state, and had adopted the idea of "state zoning." The states hold the key to responsible action for regulating flood plain management and development and few states had exercised their authority in this area. They have, instead, authorized the local agencies to effectuate land use regulations. In order for flood plain zoning to be most effective, all of the communities affected by a watershed need to regulate the flood plain. If only one or two communities prohibit structures in the flood plain, this action may not be sufficient to allow free passage of flood waters through whole stream valleys. Control of land use throughout a

watershed will minimize the flood potential for each community and also protect the water supply.

Eight states have enacted floodway or encroachment statutes. The basic purpose of these laws is to prevent obstructions to the stream channels that would restrict width or increase flood heights and velocities.

At this time, all but one of the states were engaged in one or more programs to collect hydrologic information. While virtually all of the agencies collected flood data, only eighteen presented the information in useable form. No policy or procedure was established to publish the information for use by other states, localities, or even individuals, and only nine states were able to provide technical assistance on flood problems to localities. As a result, even by 1962, most flood data collected by states was not really useable.

To compound the problem, not enough information concerning the general flood problem was circulated to the public. Some states, recognizing the need for information of this kind, took the initiative and did publish literature of value for public use. The Ohio Water Commission published a pamphlet designed to negate some of the popular misconceptions about floods. New Jersey and Tennessee also published educational leaflets on the subject, and in 1960 the Nebraska Advisory Flood Control Committee recommended that a program of education in flood control be developed.

The construction or operation of flood control works has been done primarily by the Federal government. The states have taken a backseat and only six states paid funds to localities for local contributions to projects and some states constructed facilities. The State of Washington contributed directly to the Federal government for Federal flood control projects.

Of the twenty-seven states having a single agency responsible for the overall water resources planning, only a few show any identification with a comprehensive plan considering state-wide water resources and flood damages. For example, California developed overall plans for highways, recreation, and water resources. New Jersey had developed state-wide plans for highways, transportation, recreation, water resources, and other activities.

Twenty-six state agencies that prepared water resource plans did not report state-wide plans for other activities and only twenty states coordinated the activities of their water resource agencies with other state agencies. A lack of coordination of various state agencies often leads to conflicting interests whereas coordination of interests would often resolve conflicting land uses.

In 1962, fifteen of the states had state planning agencies able to coordinate flood management activities but it was reported that only nine of these agencies were actually concerned with flood damage prevention. Most state planning agencies are operated by commissions or boards with primary responsibility for economics or

industrial development. When this situation exists, attention is given to local planning assistance and the overall state planning function is virtually eliminated.

This chapter illustrates state programs existing five years ago and establishes a basis for comparison of the programs existing today.

CHAPTER IV

CURRENT STATUS OF STATE PROGRAMS

Since 1962, states have taken a far more active role in flood plain management than heretofore seen. Many states are in the process of organizing a completely new program or are re-organizing the existing program. For example, as an effort to re-organize their program, the current session of legislature in Florida is considering the possibility of providing land use controls to regulate the size and use of structures in areas subject to flooding. In an effort to discuss state activity further, this chapter will illustrate the current status of the states in the role of flood plain management.

In order to be able to competently answer the questions concerning the flood situation of each state, it was necessary to obtain valid information from the source. A questionnaire was prepared containing twenty questions and posted to each state planning agency and each water resource agency or representative thereof in the fifty states. A copy of the questionnaire may be found in the Appendix and a summary of the most pertinent information may be found in Table I. One state, however, failed to answer either of the questionnaires and had to be deleted.

Primarily, this chapter will determine the organization of the water resource agency and its planning process, if any. It will also illustrate the agency's relationship to the state planning program.

Finally, it will describe the methods by which each state handles varying aspects of the water resource program such as the collection of flood data or by providing technical assistance. Significant changes will be illustrated as well as possible reasons for these changes.

I. WATER RESOURCE AGENCY

The organization for water resources development and management varies significantly from state to state. A few states do not have an agency involved in water resources. Many states have two or more agencies responsible for this overall development while some states have a single such agency. The most effective organization appears to be a single agency responsible for the overall water development. (See Table I.) Those states having a single agency responsible for overall water resources demonstrate more activity in all related fields, such as encroachment lines and land use controls, than do those states with two or more agencies. Seventeen of the nineteen states having a single water resource agency are active in five or more of these areas. Only nineteen of the twenty-five states having two or more agencies responsible are active in five or more areas. Further, in 1962, only fifteen states had a single agency responsible for overall water resource development. Today, nineteen states have a single agency illustrating change to this precept.

In order to coordinate a water resource program, planning is necessary for proper development. Here again, states vary in approaches.

Some states have a single agency responsible for overall resource planning such as a water resource commission or board. In other states, two or more agencies may plan for water resources development. Presently, more than half of the states have a single agency responsible for planning. This illustrates a gain of only two over the twenty-seven single agencies planning for water resources in 1962. In evaluating the chart to determine whether a single state agency could better handle a planning program, it was discovered that many states plan for water resources development through the combined efforts of the state planning agency and the water resources commission or department. It stands to reason that any water resource agency planning in coordination with a state planning agency could better handle the affairs of the water resource agency and the state. For example, Washington has recently made an overall organizational change. Until now, several agencies have been responsible for water resources development. These responsibilities are being consolidated into a new Department of Water Resources. Comprehensive planning for the state will be transferred from the Department of Commerce and Economic Development to the Planning and Community Affairs Agency established as a part of the governor's office. These changes are designed to put the state in a better position to carry out and coordinate planning responsibilities in general and water resources in particular.

II. STATE PLANNING AGENCY

Certainly a state with an "official" state planning agency and comprehensive state plan could better coordinate the activities of the other state agencies. In 1962, only fifteen states had state planning agencies. Currently forty-six states report having a state agency concerned with the overall plans of the state. However, many of these agencies are located in various departments of the state such as the Development Commission, and their activities consist primarily of public relations or some particular function of the department in which the "planning" agency is located. There is some coordination of activities of the state, but no comprehensive plan for the overall development. Such a situation exists in Florida. The planning agency is located in the Development Commission and, except for local planning assistance, state planning activity is nonexistent. The Florida agency program is oriented to public relations and industrial promotion. Presently, however, it is hoped this can be remedied. The current session of Florida legislature is expected to create a State Department of Planning.

III. FLOOD PLAIN MANAGEMENT PROGRAM

Presently, the program for water resource management is concerned with many and varied activities. Each constitutes an important part of the total program. Therefore, it will be necessary to review the content of the state's program to evaluate any given trends.

Collection and Analysis of Flood Data

In order to be able to understand the nature of the flood problem and to provide a basis for a flood plain management program, the collection and analysis of flood data is essential. Although previously pointed out in 1962, all but one of the states collect flood data. The survey made as a part of this study shows that only thirty-three states profess to collecting hydrologic information. Obviously, the accuracy of either the 1962 survey or the present survey should be doubted. Confusion seemed to exist concerning the question itself. Several state agencies felt if they had coordinated with the Corps of Engineers in a hydrologic study they were consequently collecting hydrologic information. The question was intended to mean for the express purposes of the state and by the state with distribution available to any interested and qualified authority. It can be safely assumed that the majority of flood data collection and distribution is being done by the services of Federal agencies in conjunction with the states.

The majority of technical assistance in flood plain management is provided by the states in cooperation with Federal agencies. Thirty states reported providing technical assistance to localities.

Land Use Controls

Land use controls are essential to the development of a state-wide comprehensive water resource program for without these controls flood plain losses will continue to rise.

Of the states concerned with overall water resource planning, thirty-one are more actively involved in land use controls than flood control works. Only nine agencies were using land use controls in preference to flood control works in 1962. This is evidence to an awakening of the advantages of land use planning as well as the relative simplicity and ease by which it can operate effectively. Eight states have gone as far in land use controls as to establish encroachment lines or floodways, and six more states are in the process of developing these lines. In 1962, eight states had established encroachment lines. Progress here is evidenced by the six states in the progress of developing these lines.

Land use controls are probably more important at the local level since most states have given local authorities the primary power to regulate the use of land. However, there is evidence that states have started to exercise use controls where localities refuse to act. This is described in detail in section IV of this chapter.

One of the ways localities can regulate the use of land is by zoning power. All states have local zoning enabling legislation for cities and for counties. Another way a local agency is able to regulate land use is by subdivision standards and regulations. These regulations can control the general location of the subdivision as well as interior design to insure flood free homesites. Forty states have enabling legislation controlling local subdivisions.

Review of Construction Plans

Land use controls alone are not enough to control or manage the flood plains. The construction of protective works is also important. The Corps of Engineers and Soil Conservation Service are Federal agencies that construct flood control projects on a national scale; the Tennessee Valley Authority and the Bureau of Reclamation construct projects in more limited areas. All of the states are required by Federal procedures to review the projects of each agency. The replies to the current questionnaire stated that forty-one states reviewed Corps of Engineers work. This is a bit surprising since forty-three states admitted reviewing Corps of Engineers works in 1962. Only forty-two states reviewed Soil Conservation Service projects in 1967 with forty-six reviewing such projects in 1962. Here, again, the process varies widely among the states. In two states the governors send proposals to the state attorney's office where they are reviewed only for legal purposes. In three states the projects are reviewed by the state highway departments. In most states, however, the water resource agency is responsible for this review, but a few states have a special committee appointed for this purpose.

Construction and Operation of Protective Works

The states have assumed a minor role in the construction and operation of protective works. Seventeen states have constructed protective works whereas only twelve states had constructed such works

in 1962. Twelve states are presently operating flood control works, and more states are making financial aid available to local governments for flood protection works. Presently nineteen states are offering such aid as compared to six in 1962.

Inter-Agency Coordination

Actions of many agencies affect the use and development of flood plain lands. Conflicts between these agencies' programs as well as conflicts of individual agency programs with sound principles of water management add to the complexity of the problem. For example, efforts to drain wetlands versus imbalance of water versus preservation of wildlife habitats could be more readily resolved if flood prevention decisions were made in relation to a comprehensive plan for the coordinated development of the state. The majority of the states, however, do not have a comprehensive plan to which they could refer and must depend on inter-agency coordination. Thirty-eight states are now trying to coordinate their water resource agency programs.

In conclusion, by following Table II, most significant trends can be determined. The majority of the states still have more than one agency responsible for the overall water resource development of the state. However, five states have organized their water resources under one department and at least one other state, Florida, has such action before the legislature. Certainly a more effective and comprehensive program of water management could be initiated under one agency

TABLE II
COMPARISON CHART

Number of States		State Program Content
1962	1967	
15	19	Has a single water resource agency.
27	29	Has a single agency responsible for overall water resource plan.
9	31	Has land use controls.
12	17	Has constructed flood control works.
20	38	Coordinates activity.
49	33	Collects flood data.
18	25	Distributes flood data.
9	30	Provides technical assistance.
8	8	Establishes encroachment lines.
40	46	Has state planning legislation.
15	46	Has an agency concerned with overall state planning.

as will be shown in Chapter V.

Most states now seem to be convinced that land use controls are an important part of the overall program as evidenced by the large number of states putting such controls to use since 1962.

Finally, the majority of the states now have state planning legislation and are demonstrating a concern for overall state planning.

IV. CASE STUDIES

In order to gain a clearer insight as to the kind of activity occurring in particular states, several case studies are presented. The first two concern research in the field of water management and explain the proposed plans of Texas and Nebraska. The third is a report describing the delineation of a flood hazard area and research involved establishing this area in New Jersey.

The last two studies describe legislation recently enacted in Wisconsin and California.

Research

In Texas, the Water Development Board's planning staff has devised an original method of dealing with two problems: flood water and sewage.

The comprehensive water development plan calls for the construction of sixty reservoirs, a 930 mile long system of pipelines and canals, and treatment facilities for Texas' twenty-one large cities to permit re-use of water. The system is to be used to take water from flood areas and supply it to dry areas. The distribution system, operated by computer programming, is estimated to cost \$2,734,000 and

will be operated as a single unit.² The plan also calls for cities to construct sewage treatment facilities at an estimated cost of \$971 million and the state to provide construction grants totaling \$350 million. San Francisco water expert and former Director of the Water Resources Agency of California, Harvey O. Banks, described the plan as the most comprehensive one yet developed in the field.

Nebraska's approach to water problems was drafted January 3, 1967, in the form of a state water plan presented as a recommendation to the legislature and governor by the Soil and Water Conservation Commission.

The objectives of the program are:

1. Limiting construction in flood plains which would limit channel capacity and increase flood heights.
2. Protect home and land buyers from victimization brought about by purchase of property in a high flood hazard area.
3. Reduce public expenditure for emergency operation, evacuation, and restoration.
4. Prevent loss of life, protect property and public health.
5. Minimize unwise development.
6. Recommend techniques of flood proofing of existing improvements in flood plains.

²Metropolitan Area Digest. "States Increase Water Resource Planning and Pollution Abatement Activities." (Albany: State University of New York, July-August, 1966), p. 7. (It is strongly suspected that an error regarding cost exists in this publication. The author.)

7. Remove impediment to community growth which a history a flooding creates.

8. Encourage development of flood plains for parks, green-belts, etc.

The Nebraska plan submitted that a total program of flood prevention can only be achieved that includes:

1. Soil and water conservation treatment on the uplands.
2. Detention structures on tributaries.
3. Main stream structures storing large amounts of flood water.
4. Channel improvement.
5. Proper land use in flood hazard areas to reduce damages where other means of control are not utilized or not sufficient.
6. Effective emergency action.

Under the section entitled, "Flood Prevention by Land Use Regulation," it was pointed out that land use regulation is a necessary supplement to the control of flood waters by impoundments. Land use regulation can be put into effect quickly, inexpensively, and yield great benefits. By its very nature, it is a forward looking program which will not solve past mistakes but can help prevent future ones. The primary responsibility of adopting flood plain regulations and ordinances rests with such local units of government as municipalities and county governing boards.

Finally, the policy of the Nebraska Soil and Water Conservation Commission is to assist local governments with information and encourage them to apply and enforce desirable regulations in the flood plains.

They will draft minimum acceptable regulations for areas of flood hazard based on the best information available and enforce minimum standards by the state when local units fail to act. They will request assistance of Federal agencies. They will adopt flood plain regulations that are not arbitrary and will let public interest govern in conflicts between public and private interests. They will recognize the need for supplementing flood control projects with flood plain regulations and consider the need for such regulations in granting full approval of any project deriving benefits from flood control in Nebraska.

As a result of this recommendation, the Nebraska Soil and Water Conservation Commission hopes that the legislature will formally act to spell out their functions, retain authority at the state level to invoke proper land use regulations in absence of local action, and provide for the enforcement of adopted land use regulations. It is hoped that funds for necessary studies will be made available as well as a provision for the posting of flood hazard areas.

Today a real problem of flood damage exists in New Jersey from the continuing intense development of the flood hazard areas. This problem is going to be further aggravated unless intelligent land use is made of flood hazard areas throughout the state. Two factors are pointed out as being responsible for the flood damage potential:

- (1) many people chose to develop land near the river and (2) planners and local officials who recognized the danger of the river lacked specific information concerning the extent of flood hazards and were

unable to plan or regulate the proper use of the land. To remedy these ills, the Division of Water Policy and Supply of the New Jersey Department of Conservation and Economic Development initiated a state-wide program to develop flood hazard areas. A report prepared by a consulting firm for this agency describes the procedures and mapping of the delineation of the flood hazard areas along Stony Brook. The wise utilization of the flood-prone areas along this brook and the reduction of future flood damages by preventive methods were discussed.

The objectives of the state-wide flood hazard delineation observe that the state is the logical level of government to initiate the program. The state is able to protect one community from the detrimental actions of another and prevents the program from being organized on a piecemeal basis. The first step is delineation of the flood hazard area. It was recommended that the state regulate development in the floodways throughout the state and local governments regulate development in the flood hazard areas. Any necessary flood data and assistance would be furnished to the communities in order to provide the technical basis for local regulations.

The delineation of the flood plain is necessary to sound planning. Of the available information, both the U. S. Geological Survey and the Corps of Engineers are participating in flood hazard information relative to New Jersey. A flood hazard map is an essential element of the state-wide program as it provides the necessary actual information as to the extent of the flood hazard area along a reach of river and presents detailed information in a manner easily understood by non-

technically oriented persons who are to use the information. As a result of the various factors involved in determining the study, an established flood hazard area along the Stony Brook has been delineated by the state. It now remains for local authorities to regulate immediate land use.

Legislation

In 1965, the California state legislature passed the Cobey-Alquist Flood Plain Management Act. The primary importance of this act is that the state will withhold funds if localities fail to establish prescribed land use regulations by a pre-arranged date. The act states that sound development of land use regulation is essential and the primary responsibility for planning, adoption, and enforcement of land use regulations to accomplish flood plain management rests with local levels of government. It is the policy of the state to encourage local levels of government to plan land use regulations in order to accomplish flood plain management and provide state assistance and guidance as appropriate.

Before a city or county establishes flood plain management regulations, they may request and receive a review by the Department of Water Resources. The formal request should be accompanied by appropriate hydrologic studies. If personnel are not available to prepare the technical data, then the resource department might provide the information with the city or county bearing the cost of the project. If a city or county fails to establish the necessary flood plain regulations within a reasonable time, as defined by the state water resources

department, then the state shall not appropriate money to pay the costs of lands, easements, and rights-of-way associated with the flood control project as set forth in the project report of the Federal agency.

The act further provides that a floodway can be divided into two zones: the immediate floodway and a restrictive zone. Uses of the floodway must be limited to open space uses and must not affect the carrying capacity of the floodway. Lands in the restrictive zone are subject to occasional flooding and require special regulation. Flood plain development should be a part of comprehensive planning, and regulations should spell out the permissible uses as well as prohibited uses of these lands.

A current act for Wisconsin demonstrates how a state can move forward and assure up-to-date legislation providing the tools with which to solve a problem as well as the power to enforce solution of the problem.

The 1965 Water Resources Act granted the necessary power to organize a comprehensive program under a single state agency for the management and protection of all waters of the state. The Water Resource Development Commission was created to serve as the central unit of government to protect, maintain, and improve the quality and management of the waters of the state. It is designed to start operations no later than July 1, 1968, and should have completed a long range comprehensive state water resources plan for each region of the state by that date. The act further provides for a joint accelerated water

resources research and data collection program administered and coordinated by the Director of the Water Resources Program Center of the University of Wisconsin.

Also, the act provides for zoning of the shorelands on navigable waters. Counties may zone all lands (shorelands) in their unincorporated areas within the prescribed distances from the normal high-water elevation of navigable waters. For example, 1,000 feet forms the boundary from a lake, pond, or flowage, and 300 feet is the boundary from river or stream or the landward side of the flood plain, whichever is greater.

The legislation provides that if any city, county, or village does not adopt an effective flood plain zoning ordinance by January 1, 1968, the department, after petition by interested parties and after public hearing, will determine and fix by order the limits of any or all flood plains within such county, city, or village where serious damage could occur.

In summary, each of these case studies illustrates the kind of action required by states if they are to participate effectively in the national flood damage prevention program. Texas considers an entirely new approach to solving water problems by preparing a state comprehensive water plan. California's approach is unique because state funds are withheld if localities fail to regulate land use. On the other hand, Wisconsin will regulate land use if the localities fail to do so after a pre-determined period of time. Wisconsin is also establishing a comprehensive research and data collection program.

New Jersey demonstrates that regional land use should be regulated by the state, and localities should regulate the immediate flood plain as demonstrated by state delineation of the Stony Brook Flood Hazard Area. Finally, the Nebraska approach illustrates a comprehensive flood plain management program. Additional information from the survey may be found in Table I, page 22.

CHAPTER V

CONCLUSION

The purpose of this chapter will be to recommend how a state can organize an effective program of water resource management. This will include the agencies, both planning and resource, as well as program content. Some basic reasons why these programs are sound will be given and discussed further by the relationship of the state, locality, and Federal government to the overall water resource program.

I. STATE WATER RESOURCE AGENCY PROGRAM

Responsible water resource development, properly planned and coordinated with all interests, must be forthcoming if we are to progress economically and wisely use all of our vast natural resources.

Agencies

The organization for flood plain management should include or provide for a single agency to control the overall water resource administration. States now having several agencies concerned with flood problems should act to place such agencies in one department with enabling legislation controlling water resource needs, as demonstrated by the state of Washington. When responsibility for water resources is spread out in two or more departments, coordination with other departments of the state is difficult if not impossible.

Further, the single water resource agency must be responsible for the preparation of a state-wide water resource plan and statement of policy, taking into account overall water needs and including activities relating to water resources such as flood control, land use regulations, and other phases of flood damage prevention. Comprehensive water planning can help obtain greater returns for dollars spent by coordinating efforts and outlining broader objectives. Comprehensive water resource planning enables the state to give private enterprise a clearer idea of government programs and consequently allow them to plan more effectively.

This agency should also establish regional water resource programs and flood damage prevention activities by establishing regional offices to plan and administer the water programs.

Public relations of the state water resource agency should also be improved by providing the public with a better understanding of flood problems and by actively coordinating with other state agencies or Federal agencies. Interstate compacts should be considered to promote development of a river basin. Finally, each state should establish a state planning agency responsible for the preparation of comprehensive plans and policies for the overall development of the state. This agency should help the water resource agency prepare and keep up-to-date a state-wide water resource program that relates to state overall development policies.

Program

In order to draw up a comprehensive state damage prevention program, the state water resource agency should collect, interpret, and distribute flood data to other state agencies and local units of government.

The lack of good flood plain management is often attributed to the lack of detailed hydrologic information on which a sound program could be based. In order to construct an equitable, workable, and legal regulation, more information concerning stream conditions, stream history, and up-stream situation is needed than is available in most cases. On the other hand, more hydrologic information is available than most localities are aware of.

Flood plain regulations should be included as a part of the comprehensive plan. Very often flood plain regulation is viewed only as prohibitive. Such regulations would probably be more effective and receive greater public acceptance by stating the permissible uses as well as undesirable uses. In many locales, state expenditures for Federal flood control projects have been increased because local agencies fail to adopt the necessary flood plain regulations. Increase in costs is largely due to continued development in the area and rising costs between project formulation and active construction.

Blight is also a side effect of flood activity and the lack of land use control. Urban areas encroach upon the flood plain. Structures built here are of cheap materials and are not well maintained.

Property owners will not undertake improvements because of the fear of floods.

Who is best able to regulate the use of land--the state or the locality? California's Cobey-Alquist Act forces localities to act to regulate use of the flood plain by refusing to give water management funds to those localities that have not provided the area with land use regulations. Other states have placed a deadline on zoning. The locality must zone the area by a certain date or the state will "assist." Zoning of the entire state is being done on the state agency level in one state.

Presently, though, land use regulation power for flood plain management is often placed at too low a level of government to be effective. For example, an entire river basin can be regulated more easily at the state level. However, local controls would be adopted with more ease and speed if said locality were provided with the appropriate "push" in this direction.

Strictly speaking, flood plain zoning restricts the use of land subject to flooding. An accurate basis for zoning is the kind of reliable data that will properly describe the nature and extent of the flood problem.

Any technical assistance needed by localities as well as assistance in preparing and enforcing zoning, subdivision regulations, or other regulations regarding land use in the flood plains should be provided by the water resource agency in cooperation with the state planning agency.

These organizations and programs would enable the states to find solutions to flood problems in relation to overall water needs, and the states should use these organizations to relate Federal, state, and local flood control programs to state and local land use measures in order to devise a comprehensive flood damage prevention program which could result in a decline in the annual flood damage potential of the nation.

II. RELATION TO THE OVERALL STATE PROGRAM

If a successful water resource program for the state is to be introduced, all the resources of the state must be brought to bear in an integrated program of planning and action. A water resources plan unaccompanied by a state comprehensive plan may fulfill planning needs of certain closely related fields but will not be of aid to other state departments such as highway, finance, and economics.

One of the most perplexing characteristics of state government is the increase in the number of activities and functions it must assume. Coordination at all levels is lacking, and as a result, duplication, wasted time, and complexity prevail. The key to the problem is the preparation of state comprehensive plans with all aspects of development taken into account.

The preparation of a comprehensive plan and policy for overall development of the state should be prepared and coordinated by a state planning agency. Although few states have created a "true" state-wide overall planning program, it is a prerequisite to the effective

development of a state. Recent trends show that many state agencies have been located in departments of economics or industrial development which has limited their planning efforts to the interests of the respective departments. Clearly, the state planning agency located in the office of the chief executive is the most effective program.

The state planning agency can assist the water resource agency in the preparation of an overall water resource plan that relates water policies and programs to overall state development policy. The state planning agency's comprehensive plan should be programmed to serve the needs of the state and could serve as a frame of reference for the more detailed plans of the water resource agency.

III. RELATION TO LOCALITIES

Probably the greatest influence on any state program is the strength or weakness of its local units of government. Today the basic governmental structures are not keeping pace with urban expansion. Counties, particularly, have not kept pace. Their legal powers are inadequate, and structural organizations and staffing patterns obsolete. Cities, on the other hand, have more or less kept up. Increasing urbanization and growth to the periphery, however, have caused overlapping of governments and a new approach is demanded.

Where possible, city and county governments should combine to form a metropolitan system of government. A metropolitan system would allow the area to obtain personnel on a more professional basis. The

county's organizational structure could be up-dated. The local process of government would be more able to effectuate a proper and stronger program of development within the overall state structure.

Of significance also is the localities' power to regulate land use. If the local unit of government is inadequate, local land use regulation and enforcement will be inadequate. There seems to be some question as to who should have this power--the state or the locality. As stated previously, some states lead local municipalities to zone by withholding funds. Other states issue ultimatums: "either do it or we will do it for you." However, the trend in other states is now to diversify zoning or land use regulation. The state would assume the broad responsibility of regulating a river basin, and the locality would regulate the restricted and permitted uses of the flood plain located within its domain.

Despite continuing encouragement from planners, communities have been slow to enact flood plain regulation. As recently as 1959, a study found that only forty-nine flood plain zoning ordinances were in effect throughout the country. The most of them had been adopted since 1950.

Local land use control has proved ineffective because flood plain areas frequently extend into two or more governmental jurisdictions where officials are unwilling, or perhaps unable, to cooperate in adopting uniform enforcement regulations. Very little flood plain information has been made available although it could be provided through

Federal agencies when requested. Many localities fear flood control areas because of a "supposed loss of taxes." No real truth seems to exist that there is a real loss of taxes, but some states are paying in-lieu-of taxes to local governments for state facilities which are not subject to local real property tax.

In order to protect one community from the detrimental actions of another, sound and orderly development must begin with the state. The state should regulate the development of the floodways throughout the state and local governments should regulate the development for the immediate flood hazard area. Any necessary flood data and technical assistance would be furnished by the state to the locality.

IV. RELATION TO THE FEDERAL PROGRAM

The very fact that estimated annual flood losses continue to mount despite increased annual expenditures in flood prevention is indicative of the need for change. As discussed earlier, many Federal measures suggesting program change and adjustment have been introduced during the past five years. As a result, these are the major development decisions that will shape the broad area of flood plain management for the next ten years. The major goals and policies, either prescribed by law or recommended in research, are pre-requisite to evaluating Federal interest in water as it affects future state development.

The Presidential Task Force on flood problems outlines new measures involving closer cooperation between Federal, state, and local

governments. This emphasis is placed on measures of flood plain regulation where structures or other flood plain measures are not feasible or effective. This calls for increased state responsibility in formulating legislation as well as proper coordination with Federal and local means. The state, acting as an axis of coordination and information, would assume the key role and would be forced to take a more active role in planning and coordination as well as seek qualified people to fill the many important tasks.

The Water Resources Planning Act of 1965 that re-introduces the coordinated river basin plan composed of joint Federal state commissions places increased demands on state planning agencies to coordinate Federal aids and place them into a meaningful, comprehensive state program. The Delaware River Basin Commission, as an example of a joint Federal-state approach toward the development of water resources, combines energies in a compact which includes Delaware, New Jersey, New York, Pennsylvania, and the United States. Since 1961, the commission has created and has implemented a comprehensive plan for the water resource development of the river basin. The plan is directed toward increasing the water supply, reduction of flood damage, expansion of recreational facilities, and harnessing water power. State and Federal grants as well as loans provide some financial aid. Revenue bonds and the sale of water power provides additional revenue. The first phase of their comprehensive plan calls for the consideration of twelve large dams and reservoirs as well as other watershed projects.

Presently, in the Federal agencies lies the key to the preparation of flood plain information reports. Rather than a state attempting to formulate historical and other flood and water related data, Federal agencies are geared to serve as the research and information center for the nation. If the states assumed a more comprehensive and inquiring viewpoint, the Federal agencies would be free to devote energies to the function of national assimilation of water related resource information.

For example, the Florida Board of Conservation requested that the Corps of Engineers discontinue its county-by-county approach to obtain water research data and undertake a flood plain identification study of a complete river basin. It is hoped that the adoption of sound zoning ordinances or regulations will be developed for these river basin studies. President Lyndon B. Johnson pointed out the responsibility for success of the water resource development program and the solution of the problem thus:

The Federal interest in this matter is beyond doubt. The Federal effort to cope with the problem will be unsparing. But I cannot over-emphasize that very great responsibility for success of the program rests upon state and local governments, and individual property owners in the hazard areas. The key to resolving the problem lies, above all else, in the intelligent planning for and state and local regulation of use of lands exposed to the flood hazard.³

³A Unified National Program for Managing Flood Losses, (Washington: A Task Force on Federal Flood Control Policy, 1966), p. iii.

1. The first part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

$$f(x) = \frac{1}{2} \left(f\left(\frac{x}{2}\right) + f\left(\frac{x+1}{2}\right) \right)$$

It is shown that the function $f(x)$ is continuous and that it satisfies the functional equation

$$f(x) = \frac{1}{2} \left(f\left(\frac{x}{2}\right) + f\left(\frac{x+1}{2}\right) \right)$$

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APPENDIX

THESIS QUESTIONNAIRE

Role of the States in Flood Plain Management

Answer yes or no

1. State has state planning legislation. _____
2. Location of the Planning Organization within the state governmental framework. Check one.
____ (1) Resource development department
____ (2) Administration and financial department
____ (3) Office of the governor
____ (4) Development commission
____ (5) State regional planning program
____ (6) Other. Please specify _____
3. State has local zoning enabling legislation for cities _____
for counties _____
4. State has local subdivision control enabling legislation. _____
5. State has agency actively concerned with flood damage prevention.

6. State program includes collection of flood data. _____
7. State program includes distribution of flood data. _____
8. State provides technical assistance on local flood problems. _____
9. State has established encroachment lines or floodways. _____
10. State has constructed flood control works. _____
11. State has operated flood control works. _____
12. State makes grants and loans available for local flood works. _____
13. State has established a review of Corps of Engineers works. _____
14. State has established a review of U. S. Soil Conservation Service programs. _____
15. State has established a review of Bureau of Reclamation projects.

16. State program includes the review of water control structural design. _____
17. State is equipped to coordinate state water resource agency programs. _____
18. Please list the state agencies directly involved in activities related to flood damage prevention. _____
19. In regard to state plans and policies, one single agency has authority for overall water resource planning. _____
20. The statewide water resource planning activity is concerned with
_____ flood control works
_____ land use controls

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