SECTION 406 HAZARD MITIGATION PLANNING: CHANGES IN THE FEDERAL APPROACH

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Section 406 of Public Law 93-288 (The Disaster Relief Act Amendments of 1974) requires that Federal disaster assistance be conditioned upon appropriate actions taken by recipients of the assistance (for the most part State and local governments), to "mitigate" hazards and reduce the potential for future occurrences of disasters. These mitigation actions can include such things as building standards and land use and construction practices. During the past ten years, this section of the law has been applied with varying degrees of success. This paper will attempt to identify some initiatives the Federal Emergency Management Agency (FEMA) will be proposing to improve the consistency with which this section is applied, and will describe some recent experiences in field testing some new concepts for administration of Section 406. The authors specifically chose these ASFPM annual meetings for presentation of this material. Many of the problems that are identified, and FEMA's new approaches designed to mitigate them, are the result of direct input from ASFPM members. Thus, this forum is an appropriate means of communicating FEMA's responsiveness to the ASFPM's concerns.

Following enactment of PL 93-288, the Federal Disaster Assistance Administration (FDAA), then part of the Department of Housing and Urban Development, assumed responsibility for developing regulations implementing the new provisions of the Federal Disaster Act (The Act) including Section 406. Section 406 was assigned a relatively low priority in this process, however, and it was not until November 8, 1979, that regulations were published (at 44 CFR Part 205, Subpart M) to implement Section 406 of the Act. These regulations focused primarily on defining responsibilities and concepts and establishing procedures for FEMA and intergovernmental coordination. While this definitional and procedural approach was probably necessary in introducing the concept of post disaster hazard evaluation and mitigation, experience in working with the present format, and structural changes such as the development of the Intergrated Emergency Management System, have revealed shortcomings in the present program approach and regulations.

Three problems in the current approach which FEMA recently has begun to address include lack of guidance on 406 plan scope and content, not viewing State hazard mitigation planning as an evolving and cumulative process, and not integrating 406 mitigation requirements into the comprehensive emergency management program of the State. By not providing guidance on Section 406 plan scope and content, FEMA has made it difficult, if not impossible, to condition disaster assistance on the implementation of appropriate mitigation measures by grantees. New Subpart M regulations, scheduled to be proposed some time during Fiscal Year 1985, will rectify this. By not viewing Section 406 planning as an evolutionary or cumulative process, FEMA has probably caused many States a great deal of frustration by not giving any credit for past accomplishments. Under the scant

Section 406 plan guidance currently in effect, all that States are technically required to do is a hazard mitigation plan for each disaster, regardless of their history of previous Section 406 or non-disaster related mitigation planning. The new regulations mentioned above will encourage States to establish ongoing state-wide hazard mitigation strategies and programs requiring, where these exist, only an updating and review of mitigation policies following a disaster, rather than drafting of a "plan." Finally, although mitigation has been included as one of the four phases of comprehensive emergency management (along with preparedness, response and recovery), it has not been integrated well by FEMA into the programs which support State emergency management planning. The creation of the IEMS, however, which starts with hazard identification and capability assessment, provides an ideal format for the Section 406 "hazard evaluation" and assessment of current State mitigation programs and capabilities. This will allow emergency planning assistance provided to States to be used, in many instances, to accomplish mitigation objectives.

Even though these concepts have not been formally established through the promulgation of regulations as yet, recent examples demonstrate how FEMA has begun to move in this direction. While these examples are from FEMA Region VIII, it should be noted that these efforts have their roots in the strategies of Alan William's work in the State of Connecticut, and the fundamental framework of IEMS. Mr. Williams has successfully demonstrated the importance and effectiveness of the involvement of all State agencies and particularly the Office of the Governor, in orchestrating a comprehensive State-wide hazard mitigation program. The IEMS format of hazard identification, capability assessment, multi-year development planning (HICA/MYDP) and implementation readily lends itself to the 406 process, while additionally providing FEMA the opportunity to practice what we preach; integrated emergency management.

Since last August, when many of us participated in the Emergency Management Institute's prototype course for State 406 hazard mitigation planning, Region VIII has developed State-wide multi-hazard 406 plans in South Dakota, Colorado, and Utah. Each planning effort was similar in that their framework, objectives, and methods were based on the IEMS and Connecticut examples. Each plan follows the HICA/MYDP format, and each plan thoroughly examined the existing authorities of appropriate State agencies as a means of accomplishing the capability assessment.

However, each planning effort differed due to initial information available, and differing levels of political acceptance and support. In South Dakota, this was the State's initial 406 plan, and it was partially based on recommendations of the Interagency Hazard Mitigation Team (IHMT). In Colorado, there was an existing 406 plan, but no IHMT was activated for this particular disaster. In Utah, there was not only an existing plan, but also an IHMT that offered suggestions for the new plan.

Most importantly, each planning process specifically addressed the three previously identified problems. Increased, organized, and goal-oriented guidance was provided. Previous mitigation efforts were recognized and expanded upon, rather then being ignored or duplicated. Initiatives were taken in order to create an avenue by which 406 implementation would be integrated into the States' emergency management programs.

In each of the three planning efforts mentioned, the Federal and State Hazard Mitigation Coordinators approached appropriate personnel within State agencies and local governments to explain the purpose and implications of the 406 requirement as well as each entity's responsibilities. FEMA hazard mitigation staff remained on-site in each instance in order to initiate State hazard mitigation task forces, identify potential areas of opportunity, develop a 406 outline, suggest recommendations, and to provide through coordination, the technical assistance and available resources of the other Federal agencies. In South Dakota, FEMA coordinated and paid travel expenses for representatives from six Federal agencies to travel to the State capitol and provide the State Mitigation Task Force with the requested technical assistance. These representatives also had served on the IHMT, and were therefore familiar with the situation. This group became the Federal-State planning team that developed and reviewed the State plan. In Colorado, a similar Federal-State planning team was developed. Since there was no IHMT for this disaster, the Federal representatives were from the local offices, in order to limit expenses. Many, however, had served on the IHMT and Federal-State Planning Team following the 1982 Lawn Lake/Estes Park disaster. In Utah, the same assistance was offered but declined by the State. 406 guidance now included procedures for format, content, implementation, monitoring, and enforcement.

The Colorado and Utah 406 efforts clearly demonstrate how past mitigation efforts are no longer ignored or duplicated. From the day of the Presidential declarations, this was explicit as the "standard" paragraph in the FEMA-State agreement which requires the 406 Plan was modified from,

> The State agrees...to prepare and submit...a hazard mitigation plan or plans for the FEMA designated areas...
> (FEMA-State Agreement, FEMA-665-DR-CO, 07/26/82)
> (FEMA-State Agreement, FEMA-680-DR-UT, 05/04/83)

to,

> The State shall review the status of implementation measures from the current State 406 hazard mitigation plan in the light of the recent flooding, and modify or update such plan as appropriate to address new or additional hazard mitigation needs or issues.
> (FEMA-State Agreement, FEMA-719-DR-CO, 07/27/84)
> (FEMA-State Agreement, FEMA-720-DR-UT, 08/23/84)

This created the precedent of mitigation program reviews (MPR). The States' original 406 planning efforts strived to develop State hazard mitigation programs through establishing an increased priority for hazard vulnerability and loss reduction within existing authorities. Subsequent disasters then allow for an MPR rather than plan duplication. The intent of MPR's is to recognize and build upon past efforts; to analyze what initiatives did and did not work; to develop new or improved ideas; and to identify those recommendations that may well have reduced the current impact had they been implemented. (This is not entirely new. Illinois should be noted for their annual review of their 406 plan.) This type of program review then allows a plan to be updated not only in future disaster situations, but also on an annual basis as States fulfill their HICA/MYDP requirements for IEMS. Conversely, a disaster declaration could provide the opportunity to update a State's HICA at the county level where that

work had not yet been completed.

Finally, as a means of addressing the continual and critical problem of little or no funding for mitigation activities, several examples exist of efforts to integrate 406 planning efforts into States' emergency management programs. Following the Connecticut example of funding specific 406 recommendations through FEMA's CCA mechanism using SAP supplemental funds, FEMA Region VIII has requested State Hazard Mitigation Coordinators, through State Emergency Services Directors, to identify and include in their annual CCA negotiations, 406 tasks that can be funded and implemented through use of existing programs. FEMA provides States with funds through a variety of disaster preparedness and emergency management grants that can be applied to mitigation initiatives. As we work with States to establish mitigation as a priority, we are doing the same within FEMA. Further, as an evaluative criteria established for Hazard Mitigation Assistance Grants, (a new source of Regional funds to support mitigation activities) CCA proposals that indicate a State's willingness to apply these other program dollars to 406 items will be favored.

In conclusion, FEMA, both Nationally and Regionally, feels responsive towards the identified weaknesses and needs of State 406 planning efforts. We are attempting new, aggressive strategies to address problems as they arise. While it should not be expected that each new methodology prove successful, it can be anticipated that each will further our knowledge of this evolving process, and serve to improve our capability to decrease our nations vulnerability to our increasing hazards.

THE ROLE OF INSURANCE ASSOCIATIONS IN DEVELOPING COMMUNITY FLOODPLAIN MANAGEMENT PROGRAMS

Robert Ross, Jr.
Florida Association of Insurance Agents

Insurance Associations for years have played an important role in providing training and education on insurance programs to the general public/consumer. The National Flood Insurance Program is no exception. Mr. Robert Ross, Jr., Director of Education for the Florida Association of Insurance Agents has been actively involved with the NFIP in Florida since its inception in 1968. In the following question and answer format, Mr. Ross will provide an insight into the role of Insurance Associations and the agent/producer in community flood plain management programs.

Q In general terms, what is the function of Insurance Associations in the insurance industry?

A The function of the Florida Association of Insurance Agents as a trade association involves a myriad of activities: legislative relations, marketing, agency management, insurance company/insurance agency relations for the consumer, and education.

Q Specifically, what role does the Florida Association of Insurance Agents (FAIA) play in the implementation of the NFIP in Florida? (i.e., training, education....)

A In the implementation of the NFIP in Florida, FAIA develops educational programs for its agent members, puts on schools in many cities throughout the state, provides technical expertise in policy interpretation and rating, and directly involves itself in efforts to make the processing of flood insurance more efficient, and the agent's role more productive.

Q What areas of the NFIP do agents get involved in other than policy writing and processing?

a) Do Agents get involved with the floodplain management regulations?

b) Do Agents have the capability to get involved in these areas?

c) Are Agents interested in these areas?

d) Is their involvement with the insured or the local official or both?

e) If the involvement is with local officials, how is this relationship initiated?

A In other than policy writing and processing, insurance agents are involved in the following other NFIP areas:

a) The clients of insurance agents call on them for interpretation of flood plain management regulations. When a building is built in violation of these regulations and no variances issued, the agent is often thrust into a battle between the community and the client because of the difficulty in obtaining a flood policy, and then the subsequent high premium involved.

b) It is difficult to say whether the agent has the capability to get involved in these areas. Some do. Some don't. Most, because they feel they have a responsibility to the client, become involved and try to learn as much about the flood plain management regulations as they possibly can. They often are the only ones who are willing to go that extra step.

c) As a result of their client involvement, agents <u>are</u> interested in these areas.

d) Their involvement is with the insured and the local official in most cases. Actually, the agent becomes a traffic cop between the insured (client), community officials, lenders, engineers, and any others involved. The agent ends up having to try to inform each of the parties where their responsibility lies and what might be expected of them.

e) The involvement with local officials is initiated by the agent at the request of the client, in most cases. We find that community officials don't seem to understand the tie-in between flood plain management and insurance. The fact that a community official is responsible for the estimated BFE (in unnumbered A Zones) tends to marry the agent to that community official. In many other ways, the community official can be helpful, but very often he has not been sufficiently informed of the role he might play by his superiors and by such agencies as FEMA and ASFPM.

Q Specifically speaking for the FAIA, what problems (if any) do you see that hinder the effectiveness of the NFIP in reducing future flood damages in Florida?

A The primary problem that hinders the effectiveness of the NFIP in reducing future flood damages in Florida is lack of communication. Areas of responsibility, as mentioned above, should be more specifically defined.

Q What suggestions can the FAIA make which will improve the effectiveness and the efficiency of the NFIP, not only in Florida but across the nation as well?

A To improve the effectiveness and efficiency of the NFIP, we would suggest:

a) Better communication.

b) Simplification in all respects; i.e., flood plain management insurance writing, manual preparation, written communications, verbal communications training, et al.

GALVESTON BEFORE AND AFTER ALICIA: HOW CAN THE INSURANCE AGENT ASSIST IN THE DEVELOPMENT OF HIGH-RISK AREAS

Fred E. Madsen
United Services Automobile Association (USAA)

USAA is the leading producer of flood insurance policies, under the NFIP, writing in all 50 states. Mr. Madsen, Director of Property Insurance Plans has been a key figure in the development and growth of the NFIP since its beginning in 1968. Hurricane Alicia, in August 1983, wreaked havoc with the Texas coast, especially the Galveston area. USAA, a prime insurer in that area, was actively involved in the redevelopment of the devastated coastline. Mr. Madsen, in the following question and answer format, will provide some insight into the role of the Agent/Producer in the development and redevelopment of high risk areas such as the Galveston coast.

Q As a large insurance producer, what role did your company play in preparing your insureds for Hurricane Alicia?

A We did not participate as an individual company. As a member of the Texas Insurance Information Institute and the Texas Catastrophe Property Insurance Association, we supported and encouraged a Hurricane Awareness program. Almost one million brochures entitled, "Texas Coastal Hurricane Preparedness Information" were distributed from key points along the Texas coast (copy attached). Much of this same information was printed on the grocery bags used by supermarkets in coastal areas. In this way, the information was carried home by the customer. Public Service Announcements were prepared for the various media and distributed.

The Institute for Storm Research held a three-day Hurricane Awareness Seminar, primarily for the benefit of community officials. This seminar provided a wealth of information on concepts of hurricane awareness.

Q The processing of claims of Hurricane Alicia uncovered a significantly large number of policies that were misrated largely due to enclosures below the elevated first floor. In your opinion, when did these violations of the NFIP Minimum Flood Plain Regulations occur; at the time of construction or during the term of the policy?

A In our considered opinion, most of these violations occurred after completion of the initial construction and after the initial elevation certification was

obtained. Some enclosures were anticipated as a part of the original plan and some were built as an afterthought on the part of the insured. We are led to believe that one contractor was actually coaching property owners as to how to answer inquiries after the enclosure had been put into place. In other instances, the enclosure was constructed due to ignorance on the part of the property owner.

Q If the violations occurred during the term of the policy, why were they not corrected at renewal time?

A The Agent or Producer is not required to inspect the property either at the time of taking the application or at the time of renewal. Accordingly, the Agent/Producer was probably unaware of the problem. Many Agents/Producers lived in Houston and wrote insurance on property in Galveston or Galveston County. Even after the loss, they did not see the property.

Also, the computer direct-bill process makes it unnecessary for the producer to contact the insured at renewal time unless the premium is not paid. The lack of contact amplifies the problem.

Q When alterations to a structure, covered by a flood policy, are made, who has the responsibility to provide this information in order to update the conditions of the policy?

a) The Homeowner--According to policy condition, the homeowner must notify the agent if changes are made. This is rarely done.

b) Agent--The Agent/Producer might be apprised of the alterations in the unlikely event of an inspection. Otherwise, the only clue an Agent/Producer would have is if the insured increases coverage on the structure.

c) Local Official--We feel that the ultimate responsibility lies with the local official. If building permits and building codes are enforced, the local official should always know of the alterations and the nature of the alterations.

Q At what time during the policy term should this information be made available?

A The information should be made available no later than the time the changes are made. Ideally, prior knowledge of the anticipated changes would allow local officials and/or the Agent/Producer to advise the property owner of potential problems or actual violations.

Q During the rebuilding period after Alicia, did property owners continue to build in the same area, ignoring the potential risk to life and property? Did owners build in compliance with NFIP minimums, and if not, why not?

A Following Alicia, property owners did rebuild in the same areas. Some properties were built in compliance with NFIP minimums, especially where building permits were required and secured. Some community officials allowed the property to be built in such a manner as to exactly reproduce or replace the damaged structure. Easily secured grants, low interest loans and insurance payments were so readily available that there was no deterent to rebuilding.

The National Flood Insurance Program has instituted a reinspection program whereby a substantial number of the properties damaged in Hurricane Alicia were scheduled for reinspection and inspected after the reconstruction was completed. Unfortunately, this applied only to those structures which had been insured under the NFIP.

Q What role did your company play in the rebuilding period after Alicia?

a) Did you provide information to insureds, who suffered substantial damages, on how to rebuild safely? ANSWER: Only if they requested information.

b) Did you encourage insureds to relocate outside the high risk areas? ANSWER: Only if they requested comments.

c) What role, if any, did you play in assisting local officials in the rebuilding of the severely damaged areas? ANSWER: No assistance was provided on a direct basis. However, we cooperated with the NFIP and the Texas Insurance Information Institute.

Q Isolation is a major problem along the Texas coast. Because of isolation and budget constraints, structures are completed without being inspected by qualified authorities. Alterations and additions are being completed without benefit of a building permit. This only adds to the problem. The obvious solution is, of course, to require and enforce the obtaining of building permits and to have the construction inspected for compliance with building codes as well as flood plain management compliance.

a) What are the problems? ANSWER: So long as the public is convinced that losses will be covered by insurance, government grants or low-interest loans, building will continue. The property owner is able to transfer his risk to someone else.

b) What are the causes? ANSWER: There is a shortage of risk-free land to be developed. The coastal lifestyle is very desirable. Insurance is the cornerstone of credit. With insurance for the peril of wind readily available from Wind Pools or Beach Plans and the Flood Program insuring the risk of Flood, there is no deterant to building in these areas.

c) How can they be resolved? ANSWER: The Coast Barrier Resources Act is a step in the right direction. We have a myriad of separate problems and an array of actions for resolving these problems; community compliance should be rigidly required and rigidly enforced; all program deficiencies should be corrected and all violations abrogated; compliance efforts in other communities should not be undermined.

The Federal Emergency Management Agency is the authority to enforce community compliance by probation, suspension, conditional reinstatement, and subrogation action. Further, they should also consider community-wide verification of insurance rates and recertification of flood insurance policies at renewal.

With regard to individual structures, NFIP can deny insurance on the basis of Section 13.16 and should actively engage in the rerating of individual noncompliance structures. They can also deny claims or collect back premiums on misrated policies. Subrogation action should be taken where appropriate.

THE ROLE OF THE SMALL COMMUNITY AGENT IN THE FIELD OF FLOOD HAZARD MANAGEMENT

John Z. Norris
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Sound flood hazard management programs are the result of a successful marriage of federal, state, and local resources. The key remains the involvement of local community officials. Floods, more often than not, occur in smaller communities with little or no professional planning/engineering staff. Therefore, it is so essential that in these communities, everyone in both the public and private sector works together to build a successful program of flood hazard management. In this scenario, what is the role of the local agent/producer, if any, and how can his resources be used. Mr. Norris of Norris Insurance Agency, located in Baton Rouge, Louisiana, provides some insight into the role of the small agent/producer in the following question and answer format.

Q As an active member of the Producers Services Review Committee, what do you see is the role of the small community agent/producer?

a. In the field of education
b. In the field of local flood plain management
c. In the field of flood disaster response

A a. The role of the small community agent in <u>education</u> primarily relates to helping educate the buyer and prospective buyer of the need for flood insurance.
b. In <u>local flood plain management</u> issues, his role is probably limited to working through his agent's association.
c. In <u>flood disaster response</u>, he can be of real assistance to flood victims not only with individual counseling but also through mass media news releases.

Q Having heard the presentations of Bob Ross (FAIA) and Fred Madsen (USAA), what comments can you offer from the perspective of the smaller producer to what they have said?

A The small agent introduces both advantages and disadvantages into sale of flood insurance. Small agents who write few flood insurance policies are sometimes unfamiliar with procedures, rules, rating and can cause delays in issuance of policies. However, many small-town agents <u>are</u> familiar with flood insurance.

Such agents are good vendors because they are usually much more familiar with risk location, flood geography and community status than their big city cousins. For the large city agent, a major problem is locating the risk on a flood map.

Q What problems in the implementation of the NFIP at the local level have you noticed and what suggestions could you offer for resolution to these problems? (Perspective should be from a producer's standpoint.)

A A major problem of implementing NFIP is conducting a continuous program of education for agents who sell flood insurance. NFIP flood insurance is a complicated, intricate and detailed program to work with. This is necessarily so because flooding in and of itself is a complicated physical event. NFIP was constructed by congress on principles which differ greatly from those of commercial insurance programs. Finally, NFIP has a history of changing its program regularly and frequently. It is a difficult insurance product for a salesman to keep current on.

Q Do you have any suggestions for improving the overall success of the NFIP at the local level?

A The success of the NFIP can be improved by improving communications between the parties. NFIP needs better communications with both agents and flood plain managers. Flood plain managers need to communicate more with agent groups and associations. Agents need better communication with the buyer of flood insurance.

LIMITED-DETAIL FLOOD INSURANCE STUDIES CONDUCTED BY THE U.S. GEOLOGICAL SURVEY

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Introduction

The Federal Emergency Management Agency (FEMA) required a less costly and quicker means of conducting flood studies for insurance purposes than those methods used in the detailed flood studies. In February 1984, the U.S. Geological Survey (USGS) entered into an agreement with FEMA to evaluate 2,349 communities for the application of limited-detail study (LDS) methods. This paper discusses the LDS methods that were considered, the results of the evaluation, and present USGS-LDS activities.

Limited-Detail Study Methods

Eight LDS methods were considered during the community evaluations. They are: 1) simplified step backwater; 2) historical floods; 3) slope conveyance; 4) depth frequency; 5) reservoirs; 6) information from previous studies; 7) tidal flooding; and 8) profile interpolation.

Common to all of the limited-detail studies are the following:

- The profile and inundation boundaries are determined only for the 100-year flood.
- No floodway is computed.
- The summary report is greatly reduced relative to that required for the detailed studies.
- Profiles must be tied to a datum, usually the National Geodetic Vertical Datum of 1929.

When more than one LDS method would provide a suitable profile, the choice of method is based on an assessment of the level of development in the flood plain, a comparison of the cost of applying the LDS methods, and the expected accuracy of the methods. For highly developed areas, it was a goal of the evaluations to select the most accurate LDS method available. The historical data

method generally provides the most accurate results and is a relatively low-cost method to apply where available high-water mark information is sufficient to define a flood profile at, or near, the 100-year level. The simplified step-backwater method is a high-accuracy method but it is usually the most expensive to apply of the several methods. Combinations of the methods may be applied in many studies. A description of the various LDS methods follows.

Simplified Step-Backwater Method

This method is most similar to the method commonly used in the detailed flood-insurance studies. In addition to those differences that are common to all LDS methods, cross sections are spaced as far apart as possible, few or no sections are obtained for profile convergence purposes, cross sections are interpolated where the channel is fairly uniform or gradually converging or diverging, and bridge and culvert configurations are superimposed on valley cross sections where the valley section is fairly uniform through the bridge or culvert area. Slope-conveyance methods are often used to estimate starting elevations for the simplified step-backwater method.

Historical Floods Method

This method utilizes historical flood information. This information may be available in reports or on maps that have been prepared for major floods, from high-water marks, from gaging station data, or from indirect flood-discharge measurements made in the study area. Historical flood information may often be found in USGS flood or data reports, or in USGS files. The information may also be available in reports or files of other agencies. In all cases the information must be evaluated for accuracy and applicability to the present conditions.

Historical information may be used directly if it approximates a 100-year flood. Otherwise, the 100-year flood profile will have to be determined by interpolation or extrapolation. Sometimes historical information is not adequate in itself to define a 100-year flood profile. In this situation, the historical information may be used to define water-surface slope and roughness coefficients or to confirm a profile developed by another method.

Slope-Conveyance Method

This method is similar to the simplified step-backwater method. A primary difference is that the energy equations are not balanced. This method is used on long, fairly uniform reaches, at the start of a simplified step-backwater study reach, or with historical information.

One of the problems with this method lies in the estimation of the energy slope. This can be estimated with information from high-water marks, historical flood profiles, discharge measurements, bed slope, or, generally as a last resort, from topographic maps.

Depth Frequency Method

This method was recommended for use in the community evaluations for only those areas for which a depth-frequency relationship had already been determined. Many depth-frequency studies determine the height of the 100-year flood profile above the elevation of the 50% flow duration or the height above the average streambed profile. These heights are then physiographically regionalized and related to drainage area or other profile characteristics.

The depth-frequency method is not applicable at bridges, culverts, contractions, in areas of backwater from downstream obstructions, or in channels modified by man's activities. Backwater elevations for manmade constrictions or obstructions must be computed through the use of appropriate hydraulic equations. The method should be used only for channels for which the depth-frequency relationship was developed. For example, if the relationship was developed from information obtained from alluvial channels, this relationship should not be applied to channels in other morphological settings.

The base profile used for application of the depth-frequency method can usually be established by surveying a low-water profile through the study reach. This profile will often approximate the water-level elevation of the 50% duration flow. A rough approximation of the base profile can be obtained from a topographic map if the contours are fairly close together. The contours at stream crossings generally represent low-flow elevations. However, owing to inaccuracies in most topographic maps, field surveys are usually needed to make the necessary elevation adjustments.

Reservoirs Method

There are two approaches using this LDS method. The first is used where 100-year flood elevations are needed in the reservoir area. In this approach, a rating is determined for the outlet from the reservoir. The stage for the 100-year flood peak is then determined and that stage is used to define the 100-year flood elevation around the reservoir. It is assumed in this case that reservoir

storage is small and has little affect on the 100-year flood peak. The method is not applicable where this assumption is significantly violated.

The second approach is used where 100-year flood stages are needed downstream from a reservoir. Flows must be routed through the reservoir and the 100-year flow downstream from the reservoir determined. This method is not used as an LDS method downstream from large, complex reservoirs.

Information From Previous Studies

Information is obtained from other studies. This may be information resulting from model or other types of studies. The information must be evaluated for its adequacy and applicability to current conditions. If the profile from this other information cannot be tied to a datum, it may still be of value for estimating water-surface slopes and roughness coefficients.

Tidal-Flooding Method

This method is used only in coastal areas that are protected from significant wave action. The method uses 100-year tide elevations provided by other agencies such as the National Oceanic and Atmospheric Administration. These elevations are then applied to maps. This method was recommended in the community evaluations for only two States.

Profile-Interpolation Method

This method is used to interpolate the 100-year profile between stream segments where the 100-year profile is already defined. This method is applicable generally only for short stream segments, the length depending on the uniformity of the channel and channel slopes.

Evaluation Results

Evaluations were made of 2,349 communities for the application of LDS methods. The evaluated communities are located in 38 States (see figure 1). Pennsylvania had by far the largest number of communities with 817 communities evaluated. The State with the next largest number of communities evaluated was Mississippi with 151.

Of the 2,349 communities evaluated, it was determined that LDS methods could be used in 1,710 of the communities. Detailed studies were considered appropriate for 62 communities and no studies were considered appropriate for 577 communities.

In the 1,710 communities for which LDS methods could be applied, 9,390 miles of streams were estimated to be appropriate for the application of LDS methods. The estimated cost of conducting studies in these communities was about $23 million or about $2,500 per mile of stream studied. Many of the stream segments that were evaluated were less than one mile long. These short stream segments tend to elevate the cost per mile of these studies.

The following lists the length of stream for which various LDS methods could be applied.

LDS method	Percent of total stream length
Simplified step backwater	40
Historical method	12
Slope conveyance	1
Depth frequency	11
Reservoirs	1
Previous studies	3
Tidal flooding	1
Profile interpolation	1
Combinations of methods and other methods	30

Present USGS LDS Activities

The USGS has entered into an agreement with FEMA to begin work on about 515 communities in 1985 using LDS methods (see figure 1). Most of these studies are to be completed by September 1986. The remainder will be completed in 1987.

Summary

Limited-detail studies include eight methods. They are: 1) simplified step backwater; 2) historical floods; 3) slope conveyance; 4) depth frequency; 5) reservoirs; 6) information from previous studies; 7) tidal flooding; and 8) profile interpolation. The simplified step-backwater method was found to be the most appropriate for use on about 40% of the total stream lengths for which

LDS methods could be applied. The average cost of application of LDS methods is about $2,500 per mile of studied stream length. The USGS is beginning studies in 515 communities in 1985. All of these studies will be completed by 1987.

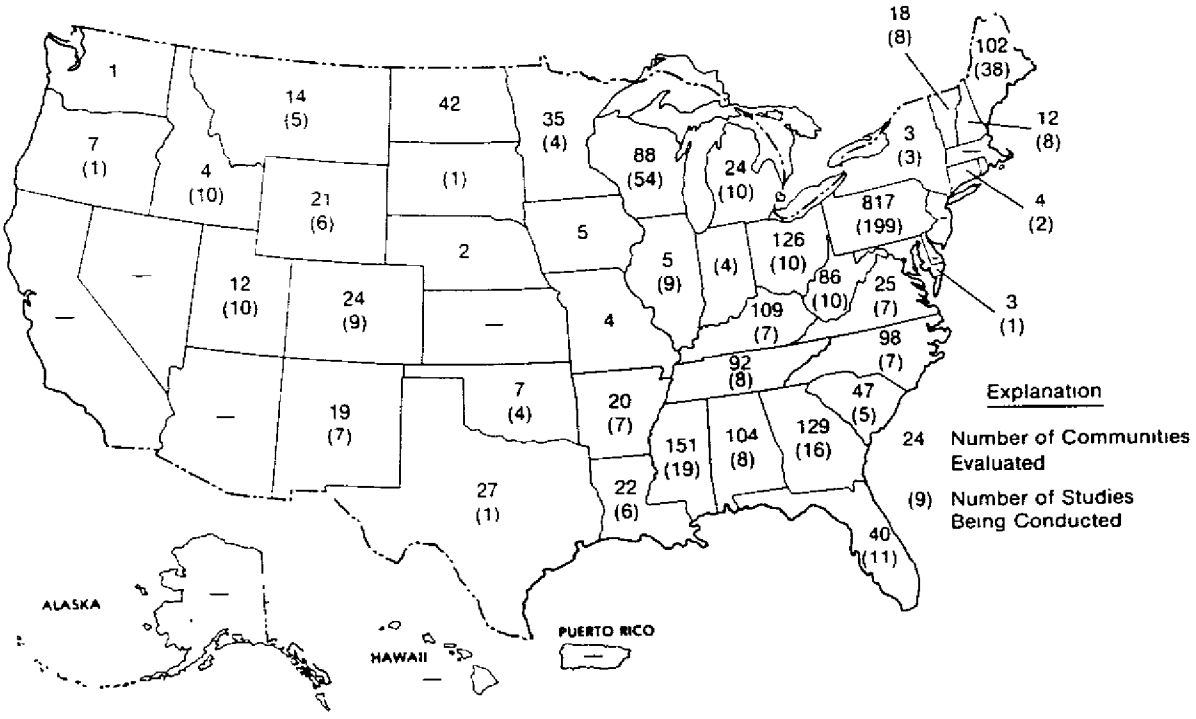

Figure 1 — Number of communities evaluated for the application of limited-detail study methods and the number of communities where limited-detail studies are being conducted.