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Hydrologic Engineering Center

Flood Plain Management Services Program

General Guidelines for Comprehensive Flood Warning/Preparedness Studies

October 1988

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FOREWORD

The Corps of Engineers has long been involved in the development of flood warning/preparedness programs. Under the Flood Plain Management Services Program, the Corps has been providing technical analyses for flood-inundated area mapping and assistance to communities in the development of emergency evacuation plans for many years. Recently, there has been a marked increase in requests from State and local governments for assistance in preparing comprehensive flood warning/preparedness plans. Their interest includes not only flooded area mapping and evacuation planning, but the entire range of activities from flood threat recognition to post-flood recovery. Due to this increase in requests and the anticipation of continued interest in this type of assistance, there is need for a standardized set of guidelines for comprehensive flood warning/preparedness studies.

This document, prepared by the Hydrologic Engineering Center at the request of HQUSACE, provides technical and administrative guidance for Corps of Engineers Districts undertaking comprehensive riverine Flood Warning/Preparedness studies. The administrative guidance is applicable for Flood Warning/Preparedness studies performed under the Flood Plain Management Services Program. The technical guidance, with few exceptions, can be applied to any Corps Flood Warning/Preparedness planning effort.

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GENERAL GUIDELINES FOR COMPREHENSIVE FLOOD WARNING/PREPAREDNESS STUDIES

1. INTRODUCTION

1.1. Overview

This document provides guidance for Corps of Engineers Flood Plain Management Services (FPMS) staff who are assisting federal, state, and local government agencies and others in implementing flood warning/preparedness programs (FW/P). The guidelines are intended as a framework for conducting the investigations. They focus on defining the existing conditions and arrangements, postulating potential enhancements, and evaluating and recommending specific actions.

The role of the FPMS staff is to provide planning services in support of local agency requests for assistance in implementation of FW/P. The level of involvement and participation will vary depending on the nature of the flood problem and the local institutional capabilities. The involvement may range from site-specific recommendations for businesses and individuals to detailed technical assistance and planning services for entire communities. The FPMS staff should be cognizant of opportunities for assistance under the other Corps authorities such as the continuing authorities program (Section 205), the feasibility study program, the Corps Emergency Operations program, as well as opportunities for assistance from other federal and state agencies.

1.2. General Authorities

The investigation of FW/P is covered under existing authorities and Corps regulations related to the FPMS program. The Flood Plain Management Services Program of the Corps is authorized by Section 206 of the Flood control Act of 1960, as amended. Under this Program the Corps is authorized, upon request by other Federal or non-Federal entities, to provide a full range of technical services and planning guidance on floods and flood plain issues under the general umbrella of Flood Plain Management. Flood Warning/Preparedness planning is an important activity under this broad authority. Specific guidance on the Corps FPMS Program may be found in ER 1105-2-10.

1.3. Overview of Flood Warning/Preparedness Programs

Flood warning/preparedness programs can be separated into five elements: flood-threat recognition, warning dissemination, emergency response, post-flood recovery and re-occupation, and continuous plan management. Appendix A defines specific actions associated with each of these elements. These actions are accomplished through use of specific equipment for collection of data, technical analyses to determine the extent and severity of flooding and the need for a warning, and formal and informal organizational arrangements in response to that flood warning. Successful performance of a FW/P system during a flood event requires a detailed response plan that includes provisions for proper coordination between Federal, state, and local governmental agencies and private sector organizations. Appendix B provides a summary of agency responsibilities and authorities related to FW/P.

2. MANAGEMENT PROCESS FOR FPMS ASSISTANCE

2.1. General

The FPMS staff should use the entire Corps technical expertise in water resources to provide information on FW/P. Within personnel and funding capabilities, requests for technical services shall be honored from states, communities, other federal agencies, private organizations, and individuals.

Requests for comprehensive community assistance should be treated as an FPMS Special Study and will be funded as such. Normally, all study and planning costs are provided under the FPMS Program while the purchase and installation costs for the necessary hardware and equipment are a local or State cost. This type of special investigation should involve the preparation of a detailed study and should require Division review. This study process normally consists of two distinct phases, the study phase and the implementation phase.

2.2. General Criteria

(1) The FPMS office must receive a written request for services from a state or local agency outside the Corps. The letter must document an existing flood problem and an interest in developing a FW/P system. In order to design and implement a successful FW/P system, the local sponsor must dedicate adequate time and effort to the study throughout the planning process. The sponsor must also have the general interest and financial capability to purchase and install the hardware and equipment needed to implement the FW/P system. The letter request should indicate the local sponsor's willingness to do so.

(2) The FPMS staff must explore the possibility and applicability of other authorities under which the investigation may be conducted and state that these authorities are not applicable.

(3) The FW/P planning study will be performed in a cooperative manner with the community. Normally, all study funds will be provided under the FPMS Special Studies program. However, it may be necessary or helpful for the local sponsor to share in the costs where extensive analysis and mapping is required in order to expedite the study. Also, the FPMS staff will normally act in a supporting role in the development of the emergency response plans.

(4) The FPMS office will coordinate with state and federal agencies throughout the conduct of the study. Under some circumstances a general Memorandum of Understanding (MOU) with these agencies, such as the appropriate regional River Forecast Center of the National Weather Service, may be desirable.

(5) Prior to the implementation phase of the selected FW/P plan, a MOU should be developed and signed. This MOU will contain details of each agency's and the local sponsor's responsibilities during the implementation of the plan, including cost arrangements and responsibilities for purchase of necessary equipment, installation of equipment and costs for continued operation, maintenance, and management of the FW/P system. The agreement should clearly state additional technical services assistance to be provided by the Corps during and beyond the implementation phase of the study.

2.3. Specific Actions Required

(1) After a request for FW/P planning services is received from a community and a determination made to proceed under the FPMS Program, the District FPMS office should prepare a written request for study approval and funding. The request should include evidence of anticipated cooperation from the local sponsor and other study participants, a description of the study area, and an estimate of resource requirements to conduct the study. The request should be forwarded to the Division office for review and transmittal to HQUSACE.

(2) After the request is reviewed and approved by HQUSACE, and funding is provided, a detailed plan of study should be prepared which will serve as a framework for the ensuing study. The plan of study should specify what actions or tasks are to be accomplished by each of the participating agencies and local entities. The plan of study can serve as an informal MOU between the various study participants.

(3) A draft report will be prepared in accordance with the investigation strategy described in these guidelines. The draft report should be submitted to the Division office for review and approval, with a copy to HQUSACE. Appendix C contains a summary of the technical information to be included in the report.

(4) After Division approval, the report should then be presented to the local sponsor for acceptance and the signing of the implementation phase MOU (if they elect to proceed).

2.4. Study Schedule

The FW/P investigation and preparation of the study report normally should be completed within 8 to 10 months, starting from the date study funds are made available and ending with completion of the draft report. Allowing time for resolution of any outstanding issues and report review, the total study time frame should be 12 months. A typical study schedule is shown in Figure 1 below.

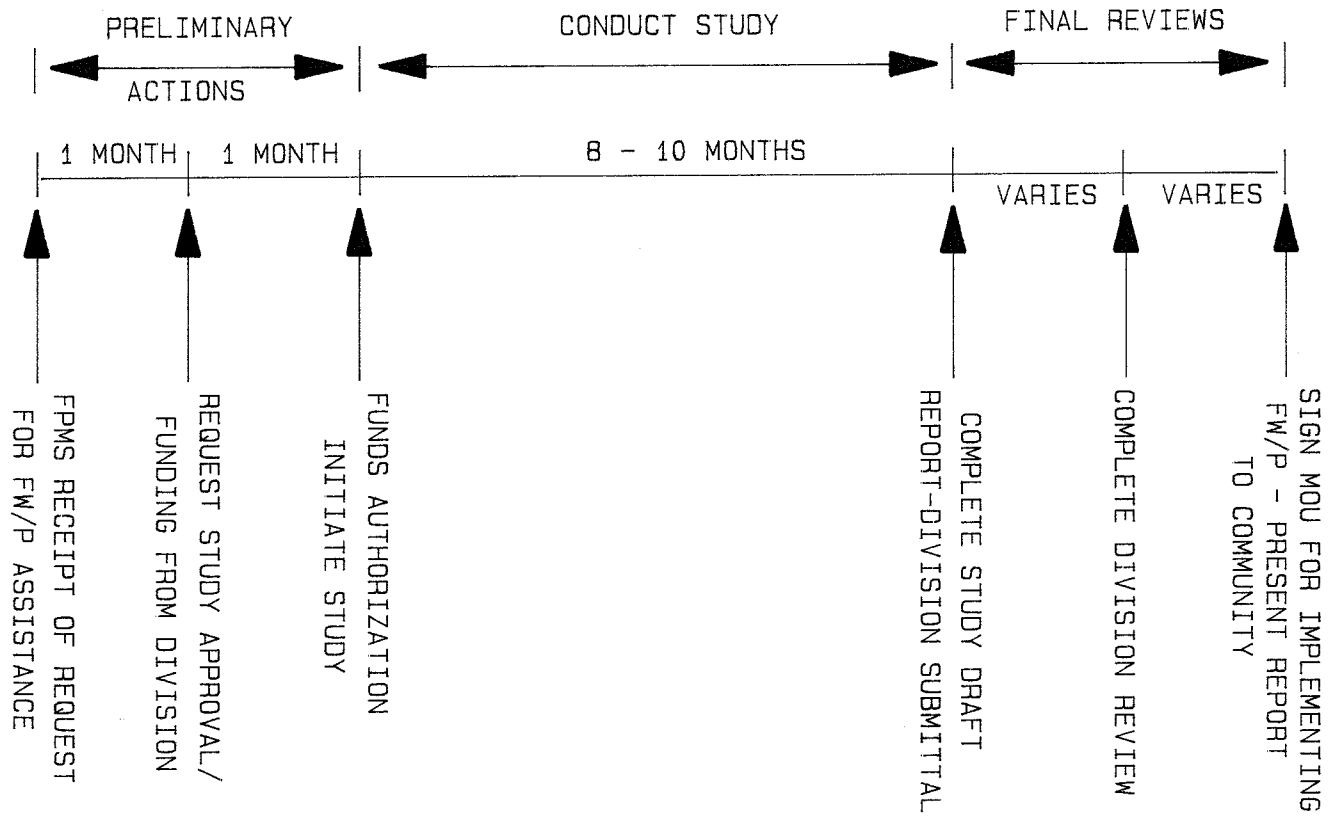

Figure 1 - Typical Study Schedule

The interest and momentum that is generated during the study phase of the FW/P plan must be maintained throughout the implementation phase in order to ensure that the plan is installed and operational as soon as possible after the report is approved. Therefore, the implementation phase of the FW/P plan should begin immediately after completion of the final report. In cases where the sponsor's budget cycle or funding mechanism would delay implementation of the FW/P plan by more than 1 to 2 months, this should be identified early in the study and the study schedule should be adjusted accordingly.

2.5. Progress Reporting

The study schedule specified in the plan of study should be followed as closely as possible. Study progress will be measured in terms of accomplishment of major actions throughout the study performance. Major actions include the Problem Definition, Flood Hazard Analysis, Threatened Property Analysis, Institutional Analysis, development and evaluation of the FW/P system and cost estimate, development of the response plan, completion of the Technical Data Report, and completion of the FW/P System Implementation Plan. These major actions are described in Paragraphs 3, 4, and 5 of these Guidelines.

A fact sheet detailing the accomplishment of major study actions should be prepared for the Division office and HQUSACE. This fact sheet should include a brief study description, a list of the major actions accomplished to date, and major actions still to be accomplished. The fact sheet should also include other pertinent data, anticipated problems, and/or comments. The fact sheet should be updated every two months during the planning phase of the study.

3. INVESTIGATION STRATEGY

3.1. General Overview

A sequence of tasks is undertaken during the performance of a typical study to plan a community's FW/P. The tasks normally include problem identification, definition of existing and anticipated adverse future conditions, development of enhancements to existing FW/P, and evaluation and selection of the recommended plan.

3.2 Problem Definition

The nature of the flood related problems that led to the initiation of the investigation of a FW/P system should be defined. The description should include historic event information regarding FW/P actions undertaken, loss of life, flood hazard, flood related damage, and the number of people effected. If historic data are not available then the perceived flood problems should be clearly stated. Appendix D contains a FW/P Information Form which may be used as a checklist of the information normally gathered during the problem definition and existing conditions identification stage of the study.

3.3. Existing Conditions

3.3.1. Overview. In most instances, some form of emergency action presently takes place during a flood event. It is important to document the existing arrangements, procedures, and capabilities for flood threat recognition; flood warning dissemination; emergency response actions; post flood recovery and re-occupation; and continued plan management. Comprehensive assessments and documentation of the present and adverse future conditions provides the basis for development of enhancements to the existing FW/P.

3.3.2. Flood Hazard Analysis. Flood hazard analyses are performed to provide information on the flood characteristics of an area. The flood hazard data provides information on the potential for the loss of life, the possible scope of flood damages, and other impacts. The analyses include hydrologic and hydraulic studies to define the flood hazard. Information to be developed includes:

(1) Discharge-frequency relationships;

(2) Discharge-elevation relationships;

(3) Flood inundation boundary maps;

(4) Warning times for various levels of flooding;

(5) Estimations of depth and velocity relationships for various levels of flooding; and

(6) Evaluations of the effectiveness and reliability of flood threat recognition systems.

The hydrologic and hydraulic studies are normally not required for future conditions unless evidence exists that future conditions may significantly alter the hydrology, hydraulics, damage potential and FW/P operations within the study area.

3.3.3. Threatened Properties Analysis. Flood inundation boundary maps, aerial photographs, field reconnaissance, and other data are used to identify locations where existing properties are threatened by various levels of flooding. The information is used to assist in development of warning and temporary evacuation plans, location of mass care centers, management of vital services, and to estimate the number of structures and people impacted by an event. The information is also used in defining areas for potential implementation of temporary flood loss reduction actions such as flood fighting, installation of temporary barriers, and removal or raising of contents of structures.

3.3.4. Institutional Analysis. Institutional analysis is the study of formal and informal organizational arrangements for communication, coordination, and conduct of operations required to implement a local flood warning-emergency preparedness plan. It is a principal aspect of the interaction process of an often large number of organizations needed to successfully implement a successful FW/P.

Specifically, the institutional analysis should define the existing processes for information collection, analysis, and dissemination for each plan component. The organizational authorities, responsibilities, and general capabilities to implement potential plan enhancements must also be determined. The local community will normally have the principal responsibility for performing the existing institutional analysis, with the Corps in a supporting role.

3.4. Development and Evaluation of Plan Enhancements

3.4.1. Overview. A FW/P plan should be developed that addresses the problems identified considering the present and adverse future conditions without the plan. Each element of the FW/P should be addressed to ensure that it is responsive, complete, and comprehensive.

If more than one alternative plan is developed, the plans should be evaluated considering costs and expected accomplishments; likely ability of the sponsor to afford the system; capability of the sponsor to operate and maintain the system; and the general practicality of the system. A narrative description of each alternative plan, listing the pros and cons of each plan, will normally suffice for this evaluation.

3.4.2 Flood-Threat Recognition System. One important enhancement to the overall FW/P system will usually involve improvements to increase the warning time and its reliability before a flood occurs. Careful consideration must be given to flood-threat recognition system affordability and also the local sponsor's ability to operate and maintain the proposed system.

3.4.3 Response Plan. The response plan is of equal and in some cases of even greater importance than the flood-threat recognition system, and therefore should be carefully developed to ensure that comprehensive procedures are available for implementation during a flood event. The existing institutional arrangements should be revised where necessary to better respond to the improved flood threat recognition system. This requires the design of formal arrangements for proper communication and conduct of operations for the various organizations responsible for each element of the FW/P plan. The design should be flexible enough to ensure high adaptability to unforeseen situations that often occur during flood events. The emphasis should be on enhanced emergency response actions that reduce the risk to life, reduce flood damage, and minimize social disruption during flood events.

3.4.4. Plan Accomplishments. The general accomplishments from enhancements to a FW/P plan are shown in Table 1. Potential enhancements anticipated from the developed plan (or plans) should be well documented. This documentation will assist local officials in making necessary decisions regarding plan selection, acceptance, and implementation.

TABLE 1

EXAMPLE PLAN ACCOMPLISHMENT CATEGORIES

Category	Contributing Action
Reduced threat to life	Barricades, evacuations, rescues, public awareness
Reduced social disruption	Traffic management, emergency services, public awareness
Reduced health hazards	Evacuations, public information, emergency services
Reduced disruption of services	Utility shut-offs, emergency services supplies, inspection, public information
Reduced cleanup costs	Flood fighting, self-help loss reduction, efficient resource use
Reduction in inundation	Flood fighting, temporary damage measures, technical assistance

3.4.5. Costs. The cost of a FW/P plan will weigh heavily in the community's decision to accept, implement, and maintain the plan. A properly designed plan will be fiscally as well as technically and institutionally feasible. The costs involved in the implementation of the FW/P plan can be developed to assist community officials in their decision.

Costs items that should be considered consist of first costs of investigating and implementing the FW/P plan, annual costs of maintaining plan components in a state-of-readiness, and the periodic costs associated with implementing specific actions during flood events. Table 2 summarizes general costs items associated with implementing a FW/P.

TABLE 2

EXAMPLE COST ITEMS

First Costs

Development of plans
Outfitting/equipping of administrative facilities
Purchase and installation of equipment and hardware
Development/printing brochures, instructions
Stockpiling equipment and materials

Annual Periodic Costs

Updating flood recognition methods, and formal warning, response, recovery, and continuous management plans
Updating/printing brochures, instructions, etc.
Operation drills
Supplement/replace stockpiled materials
Equipment/hardware operations, maintenance and replacement

Event Costs

Personnel overtime and emergency hiring
Equipment purchase and rental
Transportation/storage of personnel property
Materials/supplies consumed
Mass care operations

The actual cost to implement an the FW/P plan is the incremental cost above that to operate the existing FW/P. The most credible approach is to separate out those items specifically attributed to the proposed enhancements to the existing plans. However, some enhancement activities, such as additional daily monitoring of the stream system, may be assumed as part of the daily staff duties. The cost items listed in Table 2 should be adjusted and tailored to the specific situations and conditions being studied.

Costs to conduct the FW/P study can be borne by the Corps. This includes development and evaluation of the warning system and flood maps. Corps personnel can also provide technical assistance and advice to local officials during the development of the community response plan. Purchase and installation of equipment, maintenance, and operating costs are the responsibility of the local sponsor.

3.5. Plan Evaluation and Selection

The contribution to increased effectiveness and efficiency of emergency response actions of each plan will present the pros and cons of potential plan enhancement measures. Studies performed under the FPMS Program do not require detailed economic benefit-cost analyses for plan evaluation and selection. The selection should be based on the plan that best meets the study objectives and is implementable from the local sponsor's perspective. A benefit-cost analysis could be made if requested by the sponsor to demonstrate the value of a FW/P system. The selected plan for enhancements to the existing FW/P may be a mix of components from several plans evaluated.

4. PLAN IMPLEMENTATION

An implementation plan should be designed that specifies the actions by the responsible authorities to bring the plan to fruition. Cost responsibilities, institutional cooperation requirements, legal considerations, and similar items should be developed to ensure that the decision makers have a complete plan that is ready for implementation.

The Corps should be involved throughout the plan implementation phase of the study. Technical assistance and advice should be provided as necessary to ensure proper equipment installation and testing of the system.

The implementation plan should include a suggested maintenance schedule, including provisions for the local sponsor to periodically review and update the plan to reflect changed conditions. These conditions include administrative changes as well as changes to the impact area and flood events.

Implementation of a successful FW/P plan requires design of formal arrangements for proper communication and conduct of operations. The design should be flexible enough to ensure high adaptability to unforeseen situations that often occur during flood events. An understanding of interfaces between various organizations responsible for each element of the FW/P plan is paramount to implementing viable actions during a flood action.

5. STUDY PRODUCTS

Two documents will normally result from a FW/P study, the Technical Data Report, and the FW/P System Implementation Plan. The Technical Data Report should document the study process, and include the type of information listed in Appendix C. The System Implementation Plan is the document that the local sponsor will use for implementation, operation and maintenance of the FW/P system, and should include the following:

(1) Plan for initial purchase and installation of the system, including number, type, and location of data collection and transmission devices, data processing hardware and software, warning devices, and other related equipment and supplies;

(2) Operation Manual for system hardware and software;

(3) Flood inundated-area maps of sufficient quality and scale to easily identify affected areas, evacuation routes, shelters, and other pertinent features.

(4) Response plan for use during flood events; and

(5) Suggested maintenance schedule for equipment and response plan.

In many cases, these two reports can be combined, i.e., the Technical Data Report could be included as an appendix to the System Implementation Plan.

APPENDIX A

OVERVIEW OF FLOOD WARNING/PREPAREDNESS PROGRAMS

The type and sophistication of the appropriate FW/P measures can vary significantly due to physical characteristics of the stream system, the nature of the threatened area, local resource availability, and institutional factors. Flood warning/preparedness programs differ from other flood loss reduction measures in that they provide for coordinated response and management during a flood disaster, instead of permanent, long-term control of flooding by modification to the flood plain or damageable property.

The primary components of a flood warning/preparedness program are listed in Table A-1. More detailed descriptions of flood warning/preparedness programs may be found in Guidelines on Local Flood Warning and Response Systems (Hydrology Subcommittee of the Federal Interagency Advisory Committee on Water Data 1985), and Proceedings of a Seminar on Local Flood Warning-Response Systems (Hydrologic Engineering Center 1986).

TABLE A-1

COMPONENTS OF A FLOOD WARNING/PREPAREDNESS PROGRAM

Flood-Threat Recognition System

- Collection of data and information
- Transmission of data and information
- Receipt of data and information
- Organization and display of data and information
- Prediction of timing and magnitude of flood events

Warning Dissemination

- Determination of affected areas
- Identification of affected parties
- Preparation of warning messages
- Distribution of warning messages

Emergency Response

- Temporary evacuation
- Search and rescue
- Mass care center operations
- Public property protection
- Flood fight
- Maintenance of vital services

Post-Flood Recovery

- Evacuee return
- Debris clearance
- Return of services
- Damage assessment
- Provisions for assistance

Continued Plan Management

- Public awareness programs
- Operation, maintenance, and replacement of equipment
- Periodic drills
- Update and arrangements

APPENDIX B

AGENCY RESPONSIBILITIES AND AUTHORITIES

B.1 Overview

Numerous agencies have authorities and responsibilities in planning, designing, and implementing FW/P. Within the Corps several authorities exist. It is the responsibility of the FPMS staff to be knowledgeable of the authorities and capabilities of not only the Corps but other organizations. The Guidelines on Community Local Flood Warning and Response Systems published by the Hydrology Subcommittee of the Federal Interagency Advisory Committee on Water Data overviews the responsibilities and authorities of several agencies. Information concerning selected organizations from that document are summarized in the following paragraphs.

B.2. Corps of Engineers

The Corps has several authorities that encourage participation in preparation of FW/P. Section 206 of the Flood Control Act of 1960 authorizes the Corps to provide information, technical planning assistance, and guidance upon request to both Federal and non-Federal entities in planning the wise use of flood plains. These type studies normally would be conducted under the Flood Plain Management Services Program.

Section 73 of Public Law 93-251 expresses Congressional policy and, in effect endorses Corps practice that consideration shall be given to nonstructural measures (which includes flood warning/preparedness programs) in the formulation and planning of flood loss reduction studies. These studies normally fall under small continuing authorities or feasibility studies.

Emergency Operations pursuant to Public Law 99, 84th Congress, as amended by Section 206, of the Flood Control Act of 1962 includes: flood emergency preparation; flood fighting and rescue operations; and emergency repair and restoration of damaged or destroy flood control works. These activities can, in specific instances, assist local agencies in preparing and implementing plans.

B.3. National Weather Service

The National Weather Service (NWS) Hydrologic Service program performs two primary functions: 1) to warn the public about adverse weather and stream conditions in order to reduce the threat to lives and property damage; and 2) to report on the nation's rivers in order to support water resources management activities. The NWS has 13 River Forecasting Centers which provides direct flood forecasts on larger rivers and generalized watches and warnings for smaller streams.

The NWS provides technical assistance in flood-threat recognition to communities with flood problems. Technical support includes: recommendations of alternative flood warning systems; assisting communities in the design, installation, and implementation of FW/P, and providing operational support and training to responsible officials.

B.4. Soil Conservation Service

The Soil Conservation Service (SCS) can provide financial and technical assistance to develop and install FW/P. The SCS responsibilities are generally limited to watersheds less than 6 square miles. The SCS can finance up to 80 percent of the installation costs.

B.5. Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) encourages the development of pre-disaster and post-disaster emergency preparedness and response plans. The agency may provide funding, technical assistance, services, supplies, equipment, and direct support for fulfilling state and local government emergency management responsibilities.

The FEMA may fund: an inventory of properties and structures in flood prone areas; public awareness media presentations on flood hazards; and handbooks or other technical assistance on a variety of flood hazard topics.

B.6 State Assistance

State assistance for planning, designing, and implementing flood warning/preparedness programs varies significantly by individual states. Generally, the assistance is limited to technical and financial. State financial assistance may come from several agencies. Technical assistance varies with the capabilities and resources of each state.

APPENDIX C

REPORTING DOCUMENT REQUIREMENTS

1. Introduction

    1.1. Study Name
    1.2. Location
    1.3. Identification of the Local Sponsor

2. Background Information

    2.1. Study Area
    2.2. Stream System
    2.3. Problem Description
    2.4. Previous Studies
    2.5. Existing Flood Loss Reduction Measures in Place
    2.6. Data Available from Previous Studies

3. Existing Conditions

    3.1. Description of Historical Events
    3.2. Existing Flood Hazard
    3.3. Threatened Property Analysis
    3.4. Institutional Analysis
    3.5. Description of Existing Plan and Arrangements

4. Plan Enhancements

    4.1. Potential Enhancements for Each FW/P Element
    4.2. Development of FW/P Plans
    4.3. Plan Accomplishments and Costs
    4.4. Organizational Responsibilities
    4.5. Cost Responsibilities

5. Plan Selection

6. Plan Implementation

    6.1. Agency Responsibilities
    6.2. Resource Requirements and Schedules

Appendices

    A. Correspondence of Initial Request

    B. Implementation MOU

APPENDIX D

FLOOD WARNING/PREPAREDNESS PROGRAM INFORMATION FORM

FOR FLOOD PLAIN MANAGEMENT SERVICES STUDIES

STUDY NAME: _____

LOCATION:

COMMUNITY: _____ COUNTY: _____

STATE: _____ STREAM: _____

LOCAL SPONSOR: _____

I. Background Information

1. Description of Study Area.

_____

_____

_____

2. Description of Stream(s) - (Include Sketch on Next Page).

A. Drainage Area (sq. mi.) Above Upper Study Limits: _____

B. Stream Slope (ft./mi.): _____

C. Is Stream Alluvial? _____

D. General Description: _____

_____

_____

_____

3. Previous Studies (Type and Dates)

A. Corps: _____

B. Other Agencies: _____

4. Existing Flood Loss Reduction Measures in Place:

_____

_____

SKETCH OF STUDY AREA

C. Describe Data Available From Previous Studies

1) Storm Studies: _____

2) Hydrographs: _____

3) River Hydraulics (Water Surface Profiles): _____

4) Discharge-Frequency Relationships: _____

5) Flood Velocities: _____

6) Flood Inundation Maps: _____

7) Elevation-Number of Structures (By Type) Data/Tabulation: _____

8) Elevation-Damage (By Type of Structure) Data/ Tabulation: _____

9) Flood Warning/Preparedness Plans. What is done now and what are ongoing plans: _____

II. Problem Description

Describe the nature of the existing flood problem which lead to the initiation of this investigation. Include information on the flood hazard, risk to life, damage potential, social disruption, institutional factors, and previous efforts to manage flood problem. Complete as many descriptions of historical events using the forms on the next page as appropriate.

HISTORICAL EVENT: _____ DATE: _____

1. Risk to Life

   A. Deaths: _____ B. Injuries: _____

2. Precipitation

   A. Average Amount (Inches) Above Study Area: _____

   B. Duration of Event in Hours: _____

3. Describe characteristics of the storm and corresponding flood event including the type of storm, and peak flood stages, frequency, and areas inundated: _____

4. Flood Related Damage

   A. Residential: _____ B.Commercial: _____

   C. Industrial: _____ E. Other: _____

   F. Description: _____

5. Description of the Flood Warning/Preparedness Program Actions Implemented. Specifically Describe Warning Times: _____

6. List Data Sources: _____

III. Description of Existing Conditions

A. Flood Hazard

The flood hazard data provides information on the flood characteristics of an area. Specifically, the risk to life, discharge-depth-frequency-velocity relationships, and warning times for a range of conditions should be described. Table 1 should be completed for each reach.

B. Estimated Flood Damage Potential

Estimates of the flood damage potential may be used to identify potential threatened areas for evacuation, define the type of damage, and identify areas where temporary flood loss reduction actions might be implemented. These aspects of the existing condition should be specially addressed. Table 1 also addresses these items.

C. Existing Institutional Arrangements

Institutional analysis is the study of formal and informal organizational arrangements for communication, coordination, and conduct of operations required to implement a flood warning/ preparedness plan. The pages following Table 1 define institutional arrangements for flood threat recognition, warning dissemination, emergency response functions, post flood recovery, and continued plan management.

TABLE 1

EXISTING FLOOD HAZARD AND DAMAGE DATA

Location: _____ Flood Stage: _____

Stream: _____ Maximum Velocities: _____

Frequency: % Chance:	Peak Q: cfs	W.S.EL.: ft.	No. of Structures: Res:	Ind:	Com:	Damage ($1,000's) Res:	Ind:	Com

Location: _____ Flood Stage: _____

Stream: _____ Maximum Velocities: _____

Frequency: % Chance:	Peak Q: cfs	W.S.EL.: ft.	No. of Structures: Res:	Ind:	Com:	Damage ($1,000's) Res:	Ind:	Com

DESCRIPTION OF EXISTING METHODS AND ARRANGEMENTS
FOR
FLOOD THREAT RECOGNITION

A. Observers

B. Simplified Charts and Tables

C. Precipitation and/or Water Level Monitoring Systems

D. Automated Flood Forecasting System

In addition to the general description below, complete the form on the following page if the system is operated and maintained by a local agency.

EXISTING FLOOD FORECASTING SYSTEM

A. Local agency responsible for operation of the forecasting system.

B. Is the system directly tied into the National Weather Service?

C. System Configuration:

1) Number of Precipitation Gages:

Daily Reporting: _____

Continuous Automatic Reporting: _____

2) Number of Stream Gages:

Staff Gages: _____

Automatic Reporting: _____

3) Number of Repeater Stations: _____

4) Define Base Station Components:

_____

_____

_____

_____

D. Describe operation and maintenance of flood forecasting system. Include description of software and hardware, transmission and data processing, reliability of forecasts, time to make forecasts, redundancy of system, etc.

EXISTING FLOOD WARNING DISSEMINATION PROCESS

A. Agency with primary responsibility for decision to issue warning:

B. Other agencies/organizations that participate in the warning dissemination process:

C. Is the process flexible for various times during the day and week?

D. Are warning messages delivered door-to-door, do the messages contain specific flood related information and recommended actions? Are people with handicaps specifically addressed?

E. In the space below draw a schematic of the existing flood warning dissemination process including both formal and informal lines of communications.

EXISTING EMERGENCY RESPONSE PLANS AND ARRANGEMENTS

A. Agency responsible for overseeing the emergency operations.

B. Responsible Agency for Emergency Response Actions

Emergency Response Action	Incorporated Areas	Unincorporated Areas
1. Search & Rescue		
2. Law Enforcement (Surveillance)		
3. Traffic Control		
4. Fire Protection		
5. Emergency Medical		
6. Electricity		
7. Gas		
8. Water		
9. Sewage		
10. Evacuation of Residents		
11. Mass Care Centers		
12. Flood Fight		
13. Other (Specify)		

APPENDIX E

REFERENCES CITED

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