GUIDE FOR COMMUNITIES PARTICIPATING IN THE NATIONAL FLOOD INSURANCE PROGRAM IN ARKANSAS

VOLUME 2

NFIP FLOOD STUDIES AND MAPS

(Chapters 3 and 4)

Published by

Arkansas Natural Resources Commission
101 East Capitol, Suite 350
Little Rock, AR 72201

STATE OF ARKANSAS

ARKANSAS NATURAL RESOURCES COMMISSION
101 EAST CAPITOL, SUITE 350
LITTLE ROCK, AR 72201
(501) 682-3960

MIKE BEEBE, GOVERNOR

COMMISSIONERS

David Feilke, Chairman
Stuttgart

Robert White, Vice-Chair
Fayetteville

Jerry Mitchell
Harrison

Ann Cash
McGehee

James Neal Anderson
Lonoke

Alec Farmer
Jonesboro

Sloan Hampton
Stuttgart

Daniel Bryant
North Little Rock

Corbet Lamkin
Chidester

COMMISSION ADMINISTRATION

J. Randy Young, P.E., Executive Director
Jon R. Sweeney, P.E., Deputy Director/Chief Engineer
Earl Smith, P.E., Chief, Water Management Division

DAM SAFETY AND FLOODPLAIN MANAGEMENT

Alvin Simmons, P.E., CFM..... Supervisor, Dam Safety/Floodplain Management
Michael J. Borengasser, CFM… State NFIP Coordinator
Shawn L. Jackson, CFM……..... Floodplain Management Specialist
Jeffery S. King……..... Flood Map Specialist

March 2008

Arkansas Natural Resources Commission

J. Randy Young, PE
Executive Director

101 East Capitol, Suite 350
Little Rock, Arkansas 72201
http://www.anrc.arkansas.gov/

Phone: (501) 682-1611
Fax: (501) 682-3991
E-mail: anrc@arkansas.gov

Mike Beebe
Governor

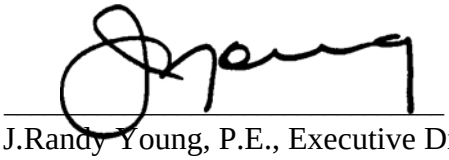
March 2008

TO: LOCAL FLOODPLAIN ADMINISTRATOR
of Communities Participating in the National Flood Insurance Program

Flooding continues to be a major problem for communities in Arkansas. Through the National Flood Insurance Program (NFIP), many citizens can now insure their property against flood losses. At the same time, future losses can be reduced by proper management of flood-prone areas.

This guide is intended to assist local officials of communities, which are participating in the NFIP, in managing their floodplains. Further assistance may be obtained by contacting the Arkansas Natural Resources Commission.

We acknowledge the assistance of the Federal Emergency Management Agency (FEMA), through the Community Assistance Program - State Support Services Element, in the preparation of this guide. Through such programs the efforts of Federal, State and Local governments can be effective in reducing future flood losses.



J.Randy Young, P.E., Executive Director

ORIENTATION

A. INTRODUCTION

This guide is contained in four (4) volumes. Chapters are numbered consecutively throughout the document. The Orientation and Table of Contents are repeated at the beginning of each volume.

This guidebook is intended to provide Floodplain Administrators and other local officials with tools in managing development in the floodplain as a participating community in the National Flood Insurance Program (NFIP). Any questions should be directed to the Floodplain Management Program of the Arkansas Natural Resources Commission (ANRC). Floodplain Administrators should read through this guide to familiarize themselves with its contents.

Each floodplain administrator should become familiar with the community's floodplain management regulations, usually contained in the form of an ordinance, code or some combination.

The evaluation of development permits is also very important. Special attention should be given to non-structural developments, such as placement of fill and alterations of stream channels, and to the "floodway" requirements. Some communities have separate "floodway" maps and Flood Insurance Study (FIS) booklets. Some have "floodways" included on the Flood Insurance Rate Maps (FIRMs). Generally, if the FIRM has "base flood elevations" on any part of the floodplain, the community has a "floodway " map.

Remember, that how the floodplain administrator conducts his or her business can have significant consequences for property owners and occupants of the floodplain. Whether it's savings on a flood insurance bill or protection from a flood, there will come a time when conscientious floodplain management will be rewarded.

The responsibility for reducing flood losses is shared by all units of government - local, state and federal - and the private sector.

Fulfilling this responsibility depends on having the knowledge and skills to plan and implement needed floodplain management measures. The fundamental floodplain management program that most others are built on is the National Flood Insurance Program (NFIP).

The NFIP provides the maps and regulatory basis for local floodplain management. It is also the primary source of insurance protection for flood-prone properties. Its success depends on the people responsible for administering its mapping, regulatory and insurance aspects.

This document can serve two purposes. First, it can be used as a study guide to enhance the knowledge and skills of local officials responsible for administering and enforcing local floodplain management regulations. It is also intended to broaden their understanding of floodplain management strategies that can be applied at the local level.

Second, the study guide can be used as a desk reference that you can refer to when specific issues arise as you implement your floodplain management ordinance. Guidance is included on how to handle many of these issues and information provided that will help you explain the requirements to citizens of your community. References are included on where to find more information or guidance on many issues. The FEMA documents that are referenced are available from the FEMA Distribution Center at 1-800-480-2520. The address is: Federal Emergency Management Agency, Attention: Publications, PO Box 2012, Jessup, MD 20794-2012. Most of these publications can also be can be downloaded from the FEMA website, http://www.fema.gov.

While any interested person may use this study guide and desk reference, it is written specifically for the local official who is responsible for administering his or her community's floodplain management regulations. Thus, references to "you," assume that you are a local official.

STUDY GUIDE OBJECTIVES

Upon completing this study guide, you should:

1. Be familiar with flood hazards and how human development interacts with the natural process of flooding.

2. Understand the purpose of the NFIP and your community's role in it.

3. Understand the basis for flood maps and data.

4. Be able to use floodplain studies and maps to support your floodplain management program.

5. Be able to explain the minimum regulatory requirements of the NFIP.

6. Be familiar with additional regulatory standards that your community could adopt.

7. Understand your responsibilities in administering your community's floodplain regulations for new construction.

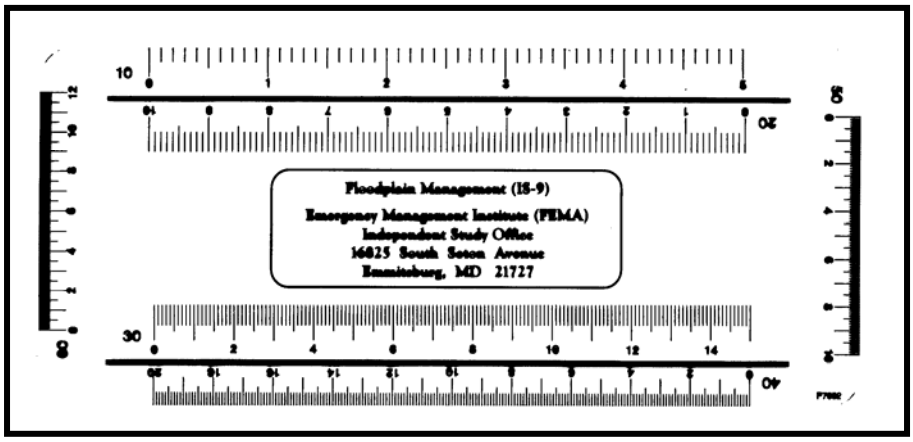
8. Understand how to administer your community's floodplain regulations for repairs and improvements to existing buildings.

9. Be familiar with how flood insurance policies are written and how they relate to your community's regulations.

10. Be prepared to administer your floodplain regulations following a disaster.

These 10 objectives are the topics of the chapters in this study guide.

Engineers Scale. You should obtain a clear plastic engineer's scale or similar measuring devise for use in several of the exercises in Volume 4, Appendix H, of this study guide and for day-to-day implementation of your ordinance. A scale helps convert measurements on a map to distance on the ground.



B. USING THE STUDY GUIDE

To administer a floodplain management program, you need to know about regulations and procedures under the National Flood Insurance Program. This study guide is designed to prepare you to serve as your community's floodplain management administrator. As you can tell by the number and size of these volumes, you need to acquire a daunting amount of information. Most of what you need is covered in these pages, as these documents are a comprehensive guide to the NFIP and your role as administrator. By design, this study guide will help you learn. Key words and phrases appear with underlines and they are listed in the glossary in Appendix D. Each chapter has frequent learning checks and a comprehensive review at the end. Be sure to do all of these – you learn best when you practice using the materials. The study guide does not have an index. However, each of the ten chapters covers a specific topic or area. At the beginning of each volume is a detailed Tables of Contents. You should be able to find where an issue is addressed in the study guide by scanning the Table of Contents. Special "Arkansas Inserts" supplement the main text.

WHERE TO GET HELP

For help in understanding any of the course content, contact your FEMA Regional Office or NFIP State Coordinator. These offices are listed in Appendices A and B.

C. ACKNOWLEDGMENTS

This study guide and desk reference is based on **FEMA Publication 480: National Flood Insurance Program (NFIP) Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials.** The FEMA document has been expanded by including information specific to Arkansas. Detailed discussions of coastal floodplains and other topics which do not affect Arkansas have also been omitted. Still, the increase in number of pages has led to a division of the single volume guide into four (4) volumes.

TABLE OF CONTENTS

VOLUME 1

Orientation

Chapter 1: Floods and Floodplain Management

Chapter 2: The National Flood Insurance Program

Arkansas Insert 1: State Floodplain Management Legislation

VOLUME 2

Orientation

Chapter 3: NFIP Flood Studies and Maps

Chapter 4: Using NFIP Studies and Maps

Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) for Paragould, Arkansas

Arkansas Insert 2: Guidance to Determining Base Flood Elevations in Approximate Zone A Areas in Arkansas

VOLUME 3

Orientation

Chapter 5: The NFIP Floodplain Management Requirements

Chapter 6: Additional Regulatory Measures

Chapter 7: Ordinance Administration

Chapter 8: Substantial Improvement and Substantial Damage

VOLUME 4

Chapter 9: Flood Insurance and Floodplain Management

Chapter 10: Disaster Operations and Hazard Mitigation

CHAPTER 3

NFIP FLOOD STUDIES AND MAPS

A. NFIP FLOOD STUDIES

FLOOD STUDY TERMINOLOGY

Before describing how flood studies are developed, we first need to introduce some of the common terms used in floodplain analysis and in the National Flood Insurance Program (NFIP). The following terms are integral for understanding the basis for flood studies and flood maps:

- The base flood,
- The 100-year flood (one percent – 1% - chance) flood,
- Special Flood Hazard Area, and
- Base Flood Elevation.

The base flood

Floods come in many sizes - with varying degrees of magnitude and frequency.

Rivers and coastlines are expected to flood, as all bodies of water have floodplains. But rivers and coastlines are different, as well; each has its own probability of flooding. **Probability** is a statistical term having to do with the size of a flood and the odds of that size of flood occurring in any year.

For each river, engineers assign statistical probabilities to different size floods. This is done to understand what might be a common or ordinary flood for a particular river versus a less likely or a severe flood for that same river.

In order to have common standards, the NFIP adopted a baseline probability called the **base flood**. The base flood is the one-percent annual chance flood. The one-percent annual chance flood is the flood that has a one-percent (one out of 100) chance of occurring in any given year. The base flood, which is also informally referred to as the 100-year flood, is the national standard used by the NFIP and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development.

The one-percent annual chance flood was chosen as a compromise between a more frequent flood (such as a 10-percent chance flood), which would permit excessive exposure to flood risk, and a more infrequent flood (say, a 0.1-percent chance flood), which would be considered an excessive and unreasonable standard.

The 100-year flood

The one-percent annual chance flood is also called the **100-year flood** because the inverse of one percent (one divided by one percent or 0.01) equals 100. This calculation gives us the flood's recurrence interval, in terms of probability, which is 100 years.

The term "100-year flood" is often misconstrued. Commonly, people interpret the 100-year flood definition to mean "once every 100 years." This is wrong. You could experience a 100-year flood two times in the same year, two years in a row, or four times over the course of 100 years. You could also not experience a 100-year flood over the course of 200 or more years.

To avoid confusion (and because probabilities and statistics can be confusing), the NFIP uses the term "**base flood**." A 100-year base flood is defined as having a one-percent chance of being reached or exceeded in any single year. Thus, the 100-year flood also is called the "one-percent annual chance flood."

To restate, "100-year flood" and "base flood" both refer to a flood that has a one-percent chance of occurring in any given year. The terms "base flood," "100-year flood," and "**one-percent (1%) annual chance flood**" are often used interchangeably.

WHAT ARE THE ODDS OF BEING FLOODED?

The term "100-year flood" has caused much confusion for people not familiar with statistics. Another way to look at flood risk is to think of the odds that a 100-year flood will happen sometime during the life of a 30-year mortgage - a 26% chance for a structure located in the SFHA.

Chance of Flooding over a Period of Years

Time Period	Flood Size 10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During a 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the only 1-2% chance that the house will catch fire during the same 30-year mortgage.

Special flood hazard area and base flood elevation

The land area covered by the floodwaters of the base flood is the **base floodplain**. On NFIP maps, the base floodplain is called the **Special Flood Hazard Area (SFHA)**. The SFHA is designated as Zone A, AE, A1-30, AO, AH, V, VE or V1-30 depending on the amount of flood data available, the severity of the flood hazard, or the age of the flood map (see the discussion of zones in this chapter for more information.).

The SFHA is the area where the NFIP's floodplain management regulations must be enforced by the community as a condition of participation in the NFIP and the area where the mandatory flood insurance purchase requirement applies.

The computed elevation to which floodwater is anticipated to rise during the base flood is the **Base Flood Elevation (BFE)**.

IDENTIFYING FLOODPRONE AREAS

The National Flood Insurance Act of 1968 directed the Federal Insurance Administration (FIA) to:

- Identify all floodprone areas within the United States.
- Establish flood-risk zones within floodprone areas.

Today, the Federal Emergency Management Agency's (FEMA) Mitigation Division is responsible for implementing this directive. FEMA has conducted flood studies and produced various forms of maps. The flood studies analyze the terrain and the factors that affect flood hazards. This information is used to draw the maps that delineate floodplain boundaries.

The maps and flood studies also show projected flood elevations, flood velocities, floodway dimensions, insurance rating zones, and descriptions of how the study was conducted and how the maps were prepared. This information is needed for flood insurance and floodplain management purposes.

All of this information is referred to as a community's Flood Insurance Study (FIS), which is conducted under standards set by FEMA for the NFIP. FEMA has prepared flood insurance studies for more than 19,000 communities.

In keeping with the directive of the National Flood Insurance Act of 1968, initial flood study and mapping efforts of the NFIP were focused on identifying all floodprone areas within the United States. Flood data and floodplain information from many sources — such as soils mapping, actual high water profiles, aerial photographs of previous floods, topographic maps, etc. - were used to overlay the *approximate* outline of the base (100-year) floodplain for specific stream reaches on available community maps, usually U. S. Geological Survey topographic quadrangle maps.

These documents were referred to as **Flood Hazard Boundary Maps (FHBMs)** and were based on **approximate studies**. Most communities used a Flood Hazard Boundary Map when they first joined the NFIP.

As money was appropriated by Congress, FEMA performed more detailed studies for many communities, resulting in the publication of **Flood Insurance Study (FIS)** reports and **Flood Insurance Rate Maps (FIRMs)**. These studies provide communities with data needed to adopt and implement more comprehensive floodplain management measures and to enter the Regular Phase of the NFIP.

FISs, also referred to as **detailed studies**, were carried out for developed communities and for those areas experiencing rapid growth. FISs contain guidance on understanding the FIRM as well as information needed for new construction allowed in developing and developed areas.

Today, almost every community in the NFIP has a **FIRM**, which may contain approximate and/or detailed flood hazard analyses. The areas mapped with approximate studies are areas where, originally, there was little or no development or expectation of development. However, recent development may have created a need for future detailed studies in these areas.

Flood maps are one of the most vital parts of a floodplain management program, so it is important to understand how the maps were created and to be familiar with the information that is available within the accompanying flood study.

Flood Insurance Study

When a flood study is completed for the NFIP, the information and maps are assembled into a Flood Insurance Study (FIS). A FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community.

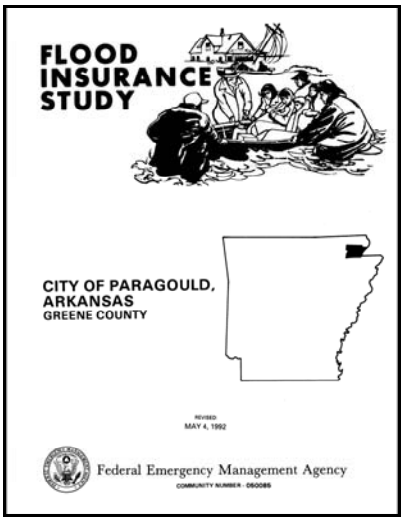
The FIS report and associated maps delineate the SFHA, designate flood risk zones and establish base flood elevations. They serve as the basis for rating flood insurance and for regulating floodplain development and carrying out other floodplain management measures.

The study has three components:

- The FIS - Flood Insurance Study report
- The FIRM - Flood Insurance Rate Map
- Prior to 1986, a separate Flood Boundary and Floodway Map (FBFM) was issued as a component of the FIS for each community studied.

The FIS report includes:

- An appraisal of the community's flood problems in a narrative that describes:
  - the purpose of the study,
  - historic floods,
  - the area and flooding sources studied, and
  - the engineering methods employed.
- A vicinity map of the community and, occasionally, photographs of historic floods.
- Tables summarizing various flood hazard data.
- Computed flood profiles for various recurrence probabilities, usually the 10-, 50-, 100-, and/or 500-year floods.



City of Paragould, Arkansas, Greene County

Included in the reference guide materials are the FIS report and maps for the City of Paragould. This community is being used to illustrate examples of riverine flood hazards.

This chapter uses these documents for the City of Paragould:

- The FIS report, and
- The FIRM, accompanying Map Index, and panels 5 and 10.

Paragould is subject to flooding from several flooding sources; they are:

- Eight Mile Creek and tributaries, Johnson Creek, and Village Creek.

As you look at Paragould, you may find that some street names do not appear on the FIRM. This is because flood hazard maps are created to show details related to identified floodplains. If your community flood maps lack street names, use a supplementary street map to assist you in locating properties accurately.

As you work through this chapter, we recommend that you locate similar sections in your community's FIS and see how this information pertains to your situation. The outline is similar for all FISs, so you should be able to locate the same tables and exhibits in the table of contents.

B. RIVERINE STUDIES

Detailed flood studies are conducted differently for different types of flooding, which are:

- Riverine flooding of rivers, streams or other waterways,
- Lacustrine flooding of lakes and ponds,
- Coastal flooding caused by hurricanes or severe storms, and
- Shallow flooding, ponding, and sheet flow.

As you recall from Chapter 1, there are other types of flooding, such as alluvial fans, ice jams, and mudflows. This chapter does not cover how these areas are studied because each situation is unique. If your community has these unique hazards, Appendix C lists some reference materials that may be of assistance.

Riverine flooding occurs in rivers, streams, ditches or other waterways that are subject to overbank flooding, flash floods, and urban drainage system flooding. Riverine studies involve, among other factors, the collection and analysis of information about the river's watershed, the topography or the lay of the land along the river, precipitation, and the characteristics of the river itself.

HYDROLOGY

In order to determine the depth of flood waters and to determine the size or width of floodplains, engineers must first examine the watershed to determine the amount of water that will reach a stream and be carried by the stream during a flood event.

Hydrology, a science dealing with the distribution and circulation of water in the atmosphere, on land surfaces, and underground, is used to determine flood flow frequencies. The study of a watershed's behavior during and after a rainstorm is, therefore, hydrology. A hydrologic analysis determines the amount of rainfall that will stay within a watershed - absorbed by the soil, trapped in puddles, *etc.* - and the rate at which the remaining amount of rainfall will reach the stream.

The rainfall that reaches the stream is called **runoff**. Increased runoff will, in turn, increase flood **discharge**. Discharge is the amount of water flowing down a stream channel. Discharges are measured in cubic feet per second or **cfs**. (A cubic foot of water is about 7.5 gallons.) Data for this measurement is taken by stream gauges at specified locations along a given stream also known as **gaging stations**.

Significant development or other changes in the watershed (both within a community and any upstream communities) can significantly change the flood discharges. Often, the increase in impervious areas associated with urbanization causes increase in stream discharges. In addition, new technical data such as new regional equations, new design storms, and in some circumstance, increase in the length of gage records, might significantly affect the base discharge estimation.

Runoff amounts and discharge rates vary depending on soil type, ground slope, land use, and the presence of storm sewers. In general, more runoff occurs on non-vegetated land, on paved and built-on urban land, and on steeper slopes.

Discharges are estimated by using rainfall and snowmelt data and historical stream records or by using regional equations that represent such data. Computer models allow engineers to incorporate numerous watershed characteristics into the hydrologic analyses. Discharge rates also generally increase as the size of a watershed increases.

Upon completion of the hydrologic analysis, engineers have flood discharges for various size rainstorms that are measured at different points along a stream, such as at the confluence with another stream and at the mouth of a tributary stream.

CROSS SECTIONS

All detailed flood studies examine the areas through which floodwater will flow. This requires a determination of ground elevations and obstructions to flow (such as vegetation, buildings, bridges, and other development) for these areas. Accurate data on the channel geometry and changes in the floodplain are obtained from ground surveys, aerial photography, or topographic maps.

To locate the true elevations at a site, surveyors have established **elevation reference marks** or **bench marks** that are referenced to a common vertical elevation reference called a datum. The use of a datum ensures uniformity of references to land elevations and avoids misinterpretation of flood elevations.

Established reference marks and bench marks with a recorded elevation allow surveyors to describe the changes in the ground levels or stream characteristics as elevations relative to the referenced datum. They are also used by surveyors to determine the elevations of buildings that are at risk of flooding.

A **cross section** is a graphical depiction of the stream and the floodplain at a particular point along the stream. It is taken at right angles to the flow of the stream. At each cross section, the engineer has accurate information on the size and geometry of the channel, the shape of the floodplain, and the changes in the elevation of the ground. A typical surveyed cross section is shown in **Figure 3-1**.

Cross sections are taken of the floodplain at locations along the stream that are representative of local conditions. Cross sections are taken at each bridge or other major obstruction and at other locations, depending on how much the stream or adjacent floodplain conditions change **(Figure 3-2)**. The more changes there are in topography (perhaps steep riverbanks changing to large flat overbank areas), the more cross sections are needed to define the floodplain accurately.

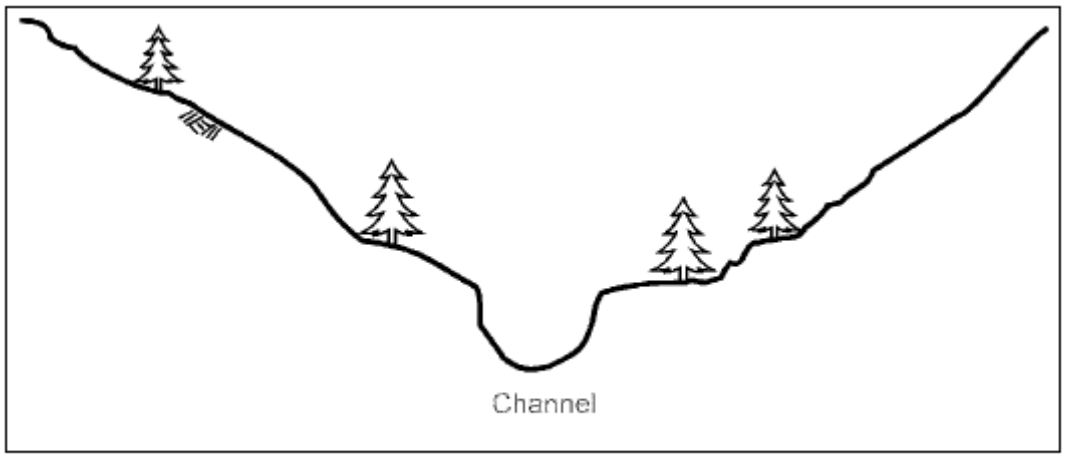


Figure 3-1: Surveyed cross section

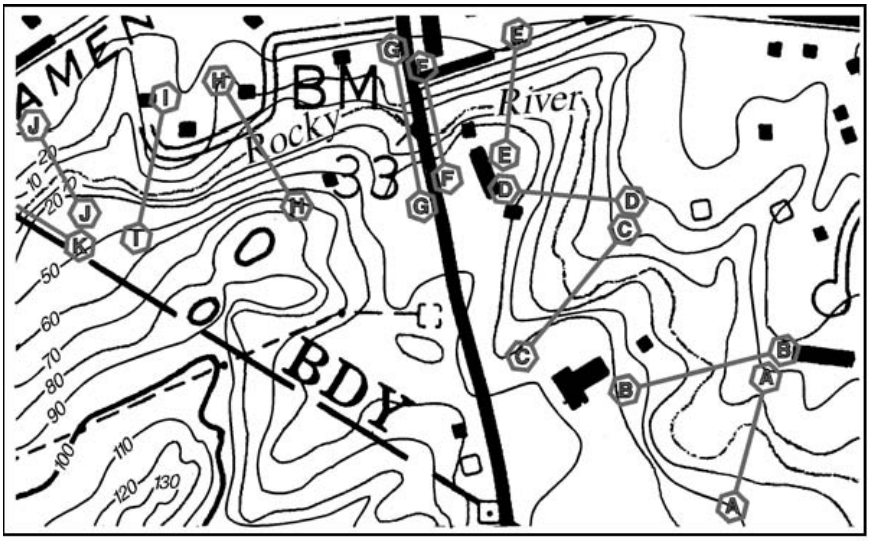


Figure 3-2: Typical cross section locations

The surveyors and engineers also estimate the **roughness** factor along the floodplain to determine how fast floodwater will flow through the area. Roughness factors are related to ground surface conditions, and they reflect changes in floodwater velocity due to ground friction. For example, water will flow faster over mowed grass and pavement than it will over an area covered in bushes and trees, or planted in tall crops.

A portion of the collected survey information is used in the hydrologic analysis, but the surveyed cross sections and other survey information are the building blocks of the hydraulic analysis and mapping efforts.

About Datums and Elevations

During the 1920s, the U.S. government created a network of 21 tidal gages in the U.S. and five in Canada to provide a fixed continental datum that would bring a consistent relationship to all vertical elevation determinations in the U.S. This new datum was known as the Mean Sea Level (MSL) Datum of 1929 and is the base elevation to which all relief features and elevation data are referenced in the contiguous United States. In 1973, to avoid confusion in many communities that used a local mean sea level datum, the name was changed to the National Geodetic Vertical Datum (NGVD) of 1929. NGVD is also the datum of reference for the vast majority of FISs.

Most permanent elevation reference marks (or bench marks) are referenced to the NGVD (see example). Reference marks are not always brass caps; they can be chiseled squares or other designated markers left by surveyors. The city or county surveyor or engineer's office should have a list of bench marks in the community. An ultimate goal of the NFIP is to convert all FISs to a newer standard called the North American Vertical Datum (NAVD) of 1988. This latest standard will eliminate inconsistencies caused when the NGVD is not consistent at all 26 tidal stations.

When reporting elevations for structures, cross sections, or topographic mapping, it is very important to note the datum to which the survey is referenced. Differences between NAVD 88 and NGVD 29 vary by as much as –1.5 feet along the east coast of southern Florida to + 4.9 feet in the Rocky Mountains of Colorado. Software for converting between NAVD 88 and NGVD 29 is available from the National Geodetic Survey.

There are now 600,000 permanent benchmarks associated with the NAVD of 1988. See *Flood Insurance Study: Guidelines and Specifications for Study Contractors,* FEMA-37 (1995), for further information.

HYDRAULICS

Hydraulics, a science that deals with fluids in motion, is used to determine how a quantity of water will flow through a channel or floodplain. For purposes of floodplain analysis, hydraulics is the study of floodwaters moving through the stream and the floodplain. Hydraulic analysis combines:

- Flood hydrology, or discharges,
- The cross section data on how much area there is to carry the flood, and
- Stream characteristics - roughness, slope, locations and sizes of structures.

The data are usually processed using a computer model, most commonly **HEC-2** or **HEC-RAS**, which were developed by the U.S. Army Corps of Engineers' **H**ydrologic **E**ngineering **C**enter.

Changes in hydraulic conditions of a stream usually occur when new bridges, culverts and road crossings are constructed, and when there are changes in the physical characteristics of the stream. If a bridge or culvert is not properly sized, it can cause flood waters to back-up, which increases flood levels upstream.

Although most bridge openings and culverts are designed to allow stream flows associated with frequent storm events to pass without such **backwater** effects, they may still cause increase in the base flood elevation. Therefore, any bridges, culverts, or other road crossings that have been constructed since the analyses for the effective FIS and FIRM were completed should be evaluated for their potential effect on the base flood and the associated floodway. In addition, any significant changes in the stream channel or floodplain geometry could affect the floodplain and floodway. One should always ask the questions: 1) has any portion of the floodplain been filled? 2) has the stream channel migrated or changed location because of significant erosion and/or depositions? 3) have any portions of the stream been channelized, widened, or dredged? 4) have there been significant changes in the vegetation in the floodplain? Aerial photographs are useful tools in evaluating changes in stream channels and floodplains.

The hydraulic study produces determinations of flood elevations, velocities, and floodplain widths at each cross section for a range of flood flow frequencies **(Figure 3-3)**. These elevations are the primary source of data used by engineers to map the floodplain.

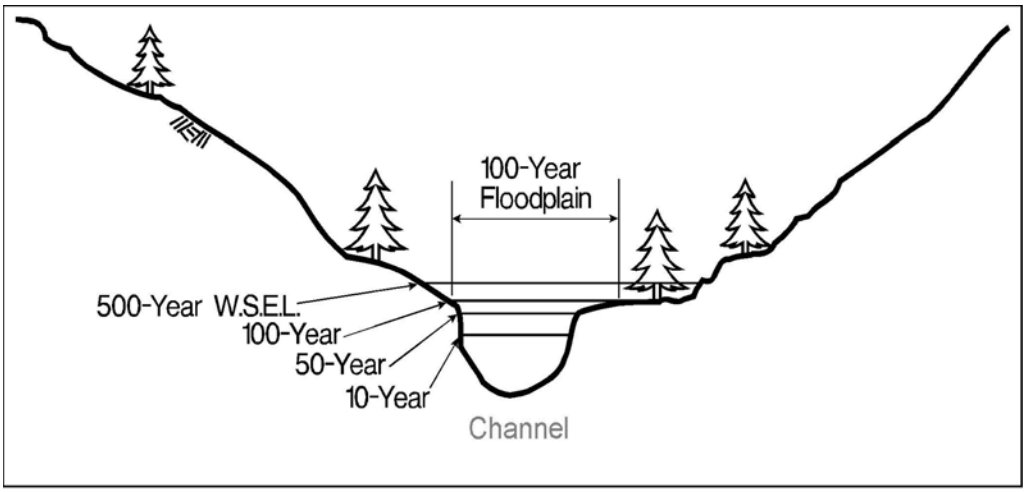


Figure 3-3: Cross section with flood elevations

A FIS typically produces elevations for the 10-, 50-, 100-, and 500-year floods. **Water-Surface Elevations** for the 10-, 50-, and 500-year floods are typically used for other floodplain management purposes. For example, the 10-year flood data may be used for locating septic systems, the 50-year flood for placing bridges and culverts, and the 500-year for siting critical facilities, such as hospitals or emergency operation facilities.

FLOOD PROFILE

The hydraulic computer program generates potential flood elevations at each cross section, but flood elevations at locations between the cross sections need to be determined as well. This is done by plotting the elevations at the cross sections on a graph and connecting the plotted points. Such a graph is called a **flood profile**.

Figure 3-4 shows a portion of the flood profile for the Tributary No. 2. The entire profile is found in the back of the City of Paragould FIS report in this volume.

The bottom of the graph (the horizontal axis or x-axis) shows the distance along the stream, which is commonly called **stationing**. For stationing, you start at the mouth of a stream (its point of discharge into a larger body of water) and look upstream. Generally, when profiles are plotted, the slope of the streambed will rise as you read the graph from left to right.

River distances are measured in either feet or miles (1mile=5280 feet), or meters and kilometers (1 kilometer=1000 meters). For most profiles, the distance is measured above the mouth of the stream or above its confluence (where it meets with another stream). In the case of Paragould, the stream distances for the Tributary No. 2 are measured above the confluence with Eight Mile Creek.

The left and right sides of the graph (the vertical axis or y-axis) show elevations in feet (NGVD). The legend at the bottom right corner shows the symbol for each flood profile plotted. Bridges are indicated with an “I” shaped symbol. The bottom of the “I” represents the bridge’s low chord (lowest beam) and the top of the “I” represents the top of the roadway or the top of a solid bridge railing.

Additional information is provided on the profiles, such as corporate limits and confluences of smaller streams. Profiles also provide a picture of stream characteristics, such as steep sections of the streambed and where restrictive bridge openings cause floodwaters to back up (see the West View Street bridge in **Figure 3-4**).

By reading a profile, you can determine the flood elevation at any point along the stream. Reading profiles is covered in Chapter 4.

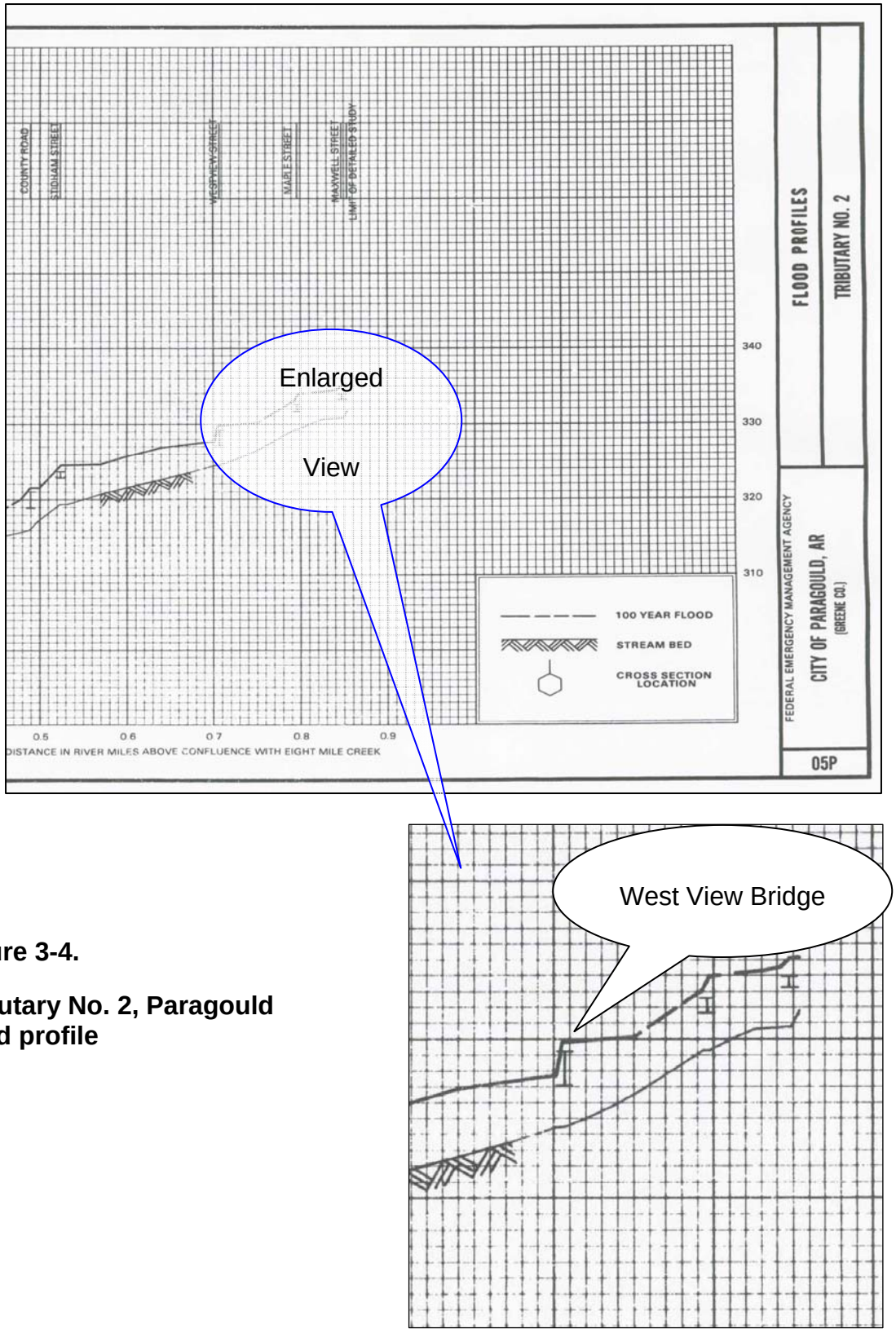


Figure 3-4.

Tributary No. 2, Paragould flood profile

FLOODPLAIN MAP

The next step in the mapping process is to transfer the flood elevation data onto a map showing ground elevation data. This is called a **topographic map** or **contour map** because points with the same elevation are connected by a contour line. The topographic or contour map is often referred to as the base map.

The most common topographic maps used are produced by the U.S. Geological Survey. Some communities have prepared their own topographic maps and provided them to FEMA during the study process to improve the accuracy of their floodplain maps.

The base flood elevations from the cross sections and profiles are plotted on the topographic map. Floodplain boundary lines are drawn connecting these points using the contour lines as a guide. The completed map illustrates the SFHA **(Figure 3-5)**.

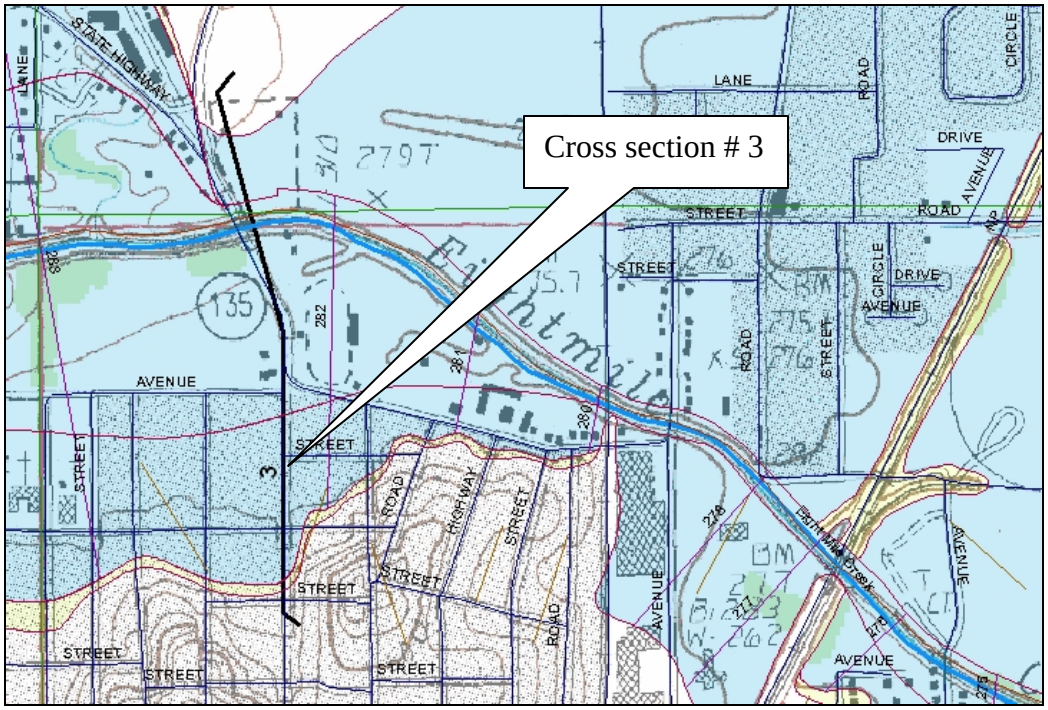


Figure 3-5 The BFEs at the cross sections from Eight Mile Creek, Paragould, are used to plot BFEs on the contour map

It is important to remember that floodplain map boundaries are only as accurate as the topographic map on which they are drawn. Since the U.S. Geological Survey topographic quadrangle maps have so small a scale, the SFHA boundaries cannot be precisely mapped. This is important to remember when determining if a building is in or out of the floodplain, and, therefore, the use of other relevant measurements may be required and is recommended.

Correlating map features with ground features requires care, because maps do not always represent exact conditions on the ground. Where there is an apparent discrepancy between floodplain boundaries shown on a map and actual ground conditions, as the local administrator, you can use elevation data to resolve the matter by locating the flood elevation on the ground via an elevation survey. This elevation represents the actual extent of flooding for that particular flood.

> Note: Banks, lending institutions and others who must read the FIRM to determine if flood insurance is required must go by the map. They cannot make on-site interpretations based on data other than the FIRM. However, they may recommend that the property owner submit a request for a map revision or map amendment so the map can be officially changed to reflect the more accurate data (see Unit 4, Section D).

FLOODWAY ANALYSIS

The final step in preparing most riverine flood studies is to produce the floodway analysis, which identifies where encroachment by development will increase flood elevations significantly and worsen flood conditions. The **floodway** is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters generally are deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. FEMA has mapped designated floodways in more than 8,000 communities.

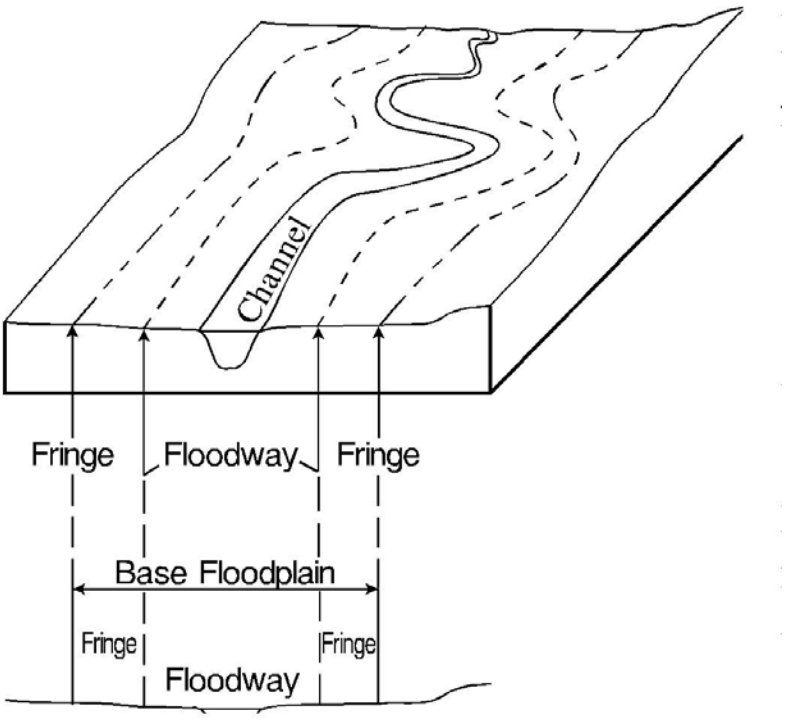


Figure 3-6: Floodway cross section and map

The remainder of the floodplain is called the **flood fringe (Figure 3-6)**, where water may be shallower and slower. The floodway and the flood fringe together comprise the base floodplain or special flood hazard area. On the flood map these areas will be designated as Zone A1-30 or AE. NFIP minimum standards provide that other areas outside the boundaries of the floodway can be developed without further analysis. Consequently, most communities permit development in the flood fringe if the development is elevated or otherwise protected to the base flood level (or any higher state or local standards).

Development in the floodway is allowed if it can be demonstrated that no rise in the base flood elevation will occur. It is recommended, however, that floodway development be discouraged or even prohibited because of the hazardous nature of this area.

A floodway analysis determines the boundaries of the floodway using these floodplain management concepts:

- Continued development in the floodplain will likely further obstruct flood flows, which will back water up or divert it to other properties.
- Properties on both sides of a river or stream should be treated equitably. The degree of obstruction permitted now for one should be permitted in the future for the other.
- Property owners should be allowed to develop their land, provided they do not obstruct flood flows, cause damage or create a nuisance to others. (A community may allow development in the flood fringe that cumulatively increases the BFE, but NFIP regulations specify that such total increases cannot exceed one foot at any point along the stream. Some states or communities have more restrictive standards that must be met.)

A floodway analysis is done with a computer program that can make the necessary calculations of the effects of further development. Beginning at both edges of the floodplain, the computer model starts "filling" the floodplain. This "squeezes" the floodwater toward the channel and causes the flood level to rise. At the point where this process reaches a one foot rise, the floodway boundaries are drawn **(Figure 3-7)**.

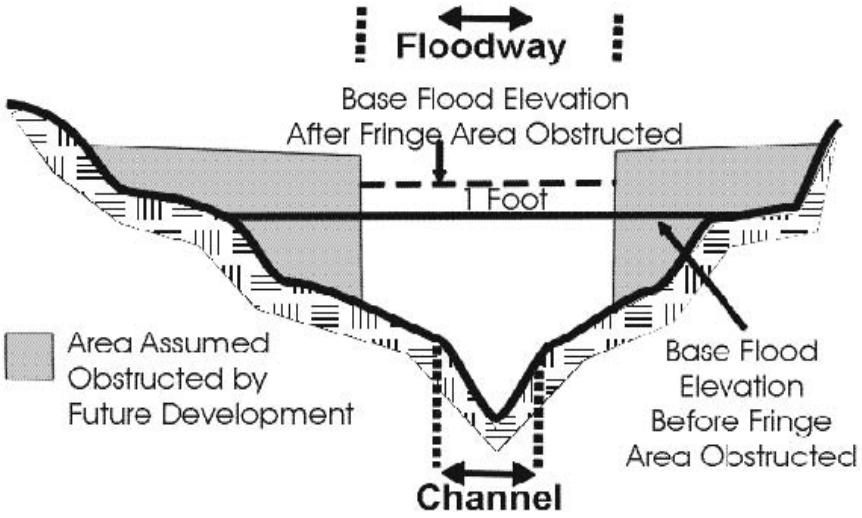


Figure 3-7. Computer floodway analysis

The floodway boundaries at each cross section are transferred to the topographic or contour map that shows the SFHA boundaries. The plotted points are connected to show the floodway and flood fringe on the floodplain map.

Not every cross section will show an exact one-foot rise. Topographic conditions and the need to “smooth out” the floodway line will result in some cross sections having increases of less than one foot.

Allowing flood heights to rise up to one foot is a compromise standard. Prohibiting any rise in flood heights would prohibit most types of new development or redevelopment. On the other hand, allowing development to cause significant increases in flood heights can cause great problems for others.

States and communities may use a more restrictive standard for delineating a floodway. Some may allow only a 0.5-foot or 0.1-foot rise in the base flood elevation in the floodway analysis. This results in wider floodways and less area in the flood fringe.

A floodway analysis should be prepared with close coordination between the modeling engineer and those who are responsible for community planning and floodplain management.

The number of possible floodway configurations is almost limitless. Therefore, in choosing a regulatory configuration, the interests of individual property owners and the community as a whole must be weighed.

C. SHALLOW FLOODING STUDIES

For the NFIP, **shallow flooding** is defined as flooding with an average depth of one to three feet in areas where a clearly defined channel does not exist. Shallow flooding can exist in any of the following situations:

- *Ponding:* In flat areas, water collects or "ponds" in depressions.
- *Sheet flow:* In steeper areas where there are no defined channels or on flat plains, water will spread out over the land surface.
- *Urban drainage:* Local drainage problems can be caused where runoff collects in yards or swales or when storm sewers back up.
- *Coastal flooding:* Wave runup will send water inland over flat areas or over dunes. Often it may collect or pond behind an obstruction which keeps it from draining back into the ocean.

For the purposes of the NFIP, shallow flooding is distinguishable from riverine or coastal flooding because it occurs in areas where there is no channel or identifiable flow path.

Shallow flooding is mapped based on historic flood experiences and a study of the topography. In some areas, the techniques used for riverine studies are used. The result will either be a BFE or a **base flood depth** (in feet above the ground). A shallow flooding study usually produces data for the base flood, but not for the 10-year or other floods.

On Paragould's FIRM in the back of this volume, there is an of Zone AO (Depth 1') on the west side of the city on Panel 5 of 10, indicating that the base flood depth is one foot above the ground. Therefore, it is a sheet flow area. Sheet flow areas (which usually have depths established) are **AO Zones**, and ponding areas (which have BFEs established) are usually designated **AH Zones** on a FIRM.

D. APPROXIMATE STUDIES

Detailed studies are expensive - a riverine study typically costs $5,000 to $10,000 per mile of stream that is to be mapped - so it is not cost effective to perform a detailed study in watersheds where there is little or no development and none is anticipated, such as in rural areas.

Therefore, some NFIP maps show floodplains that were mapped using approximate study methods. Flood data and floodplain information from a variety of sources - such as soils mapping, actual high water profiles, aerial photographs of previous floods, and topographic maps - were used to overlay the approximate outline of the base floodplain for specific stream reaches on available community maps, usually U.S. Geological Survey topographic quadrangle maps.

In addition, many flooding sources have been studied by other Federal, State, or local agencies. Some of these studies do not meet the NFIP standards for a FIS, but often contain valuable flood hazard information, which may be incorporated into the NFIP maps as approximate studies. Those types of studies typically cover developed or developing areas. They often contain flood elevation profiles that can be used as “best available data” for floodplain management purposes.

See “Arkansas Insert 2”, later in this volume, for how to obtain or estimate a BFE in approximate floodplains.

E. NFIP MAPS

This section will explain how flood hazards and flood insurance zones are depicted on NFIP maps. The Paragould maps will be referenced wherever possible. As this information is presented, look for similar types of maps or map features on your community's maps.

Maps published with an FIS are:

- The **Flood Insurance Rate Map (the FIRM)**, which is published in an old format in studies prepared before 1986 and a new format in studies prepared after 1986.
- The **Flood Boundary and Floodway Map (the FBFM or Floodway Map)**, which was included in studies prepared before 1986.
- Again, since 1986, the Flood Boundary and Floodway Map information has been incorporated into the Flood Insurance Rate Map.

The maps allow you to identify SFHAs, determine the location of each specific property in relation to the SFHA, determine the BFE at a specific site, and locate regulatory floodways.

The flood maps, particularly the FIRMs, come in many formats because of the mapping of additional hazards, the need for more regional flood maps, and the increased use of computer generated maps. Several general features are included on all maps.

Originally, the FIRMs were designed for use by insurance agents and lenders. The Floodway Maps were created for use by local floodplain managers and administrators. For all studies conducted since 1986, the FIRM contains both the flood insurance rate zones and floodways.

GENERAL MAP FEATURES

Flood maps are either flat or Z-fold. **Flat maps** are on 11-inch-by-17-inch "ledger" size paper. **Z-fold maps** are on larger pages and get their name from the way they are folded. The current flood maps for most communities are now Z-fold.

All flood maps are prepared with general features or elements that may include an index, a legend (or key to map), a title block, community name and number information, panel or map number information, an arrow pointing north on the map, and effective date or revision date information.

Many communities, especially counties, are geographically too large to fit on one map or panel at a usable scale. Maps for these communities are divided into two or more panels with unique panel numbers. Whenever a community requires more than one panel, a Map Index for both the FIRM and Floodway Map is prepared.

In this section, we will discuss the Map Index, elevation reference marks, and map scales and direction. Other map features will be presented as we discuss FIRMs and Floodway Maps.

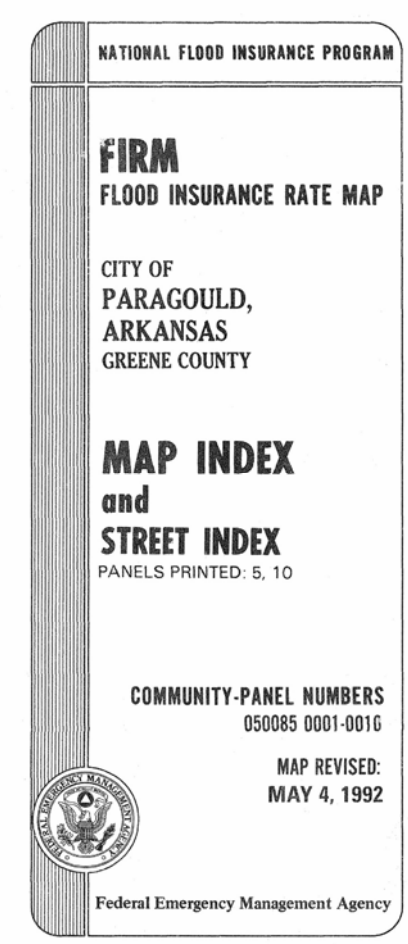
MAP INDEX

The Map Index shows the community's boundaries, highlighting prominent features such as major highways, railroads, and streams. The map index shows how the community is displayed on the various panels.

Paragould's Map Index shows that the city's FIRM has two panels, 5 and 10. In cases where panels have no identified flood hazard areas (or no floodways on a Floodway Map), they are not printed. If a panel is not printed, it is indicated on the index by an asterisk (*).

The actual Index and FIRMs for Paragould are z-fold maps which fold similar to highway maps. They have been reduced to be able to print on 11 X 17 inch paper and included at the back of this volume.

The number of panels that have been printed for the City of Paragould appears in the title block ("Panels Printed: 5, 10).


NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
PARAGOULD,
ARKANSAS
GREENE COUNTY

MAP INDEX
and
STREET INDEX
PANELS PRINTED: 5, 10

COMMUNITY-PANEL NUMBERS
050085 0001-0010

MAP REVISED:
MAY 4, 1992

Federal Emergency Management Agency

Title block

The title block is the lower right portion of the opened map for both the Map Index and the FIRM panels. The FIRM panel title block includes:

- the community's name -- City of Paragould, Arkansas, Greene County,
- the six-digit community identification number or map number -- 050085,
- the panel number, such as "0005" or "0010",
- a map panel suffix – "D," which indicates the number of revisions that have been made (e.g., "D" is the fourth publishing of that panel), and
- a map effective or revision date – "May 4, 1992."

Map revision date

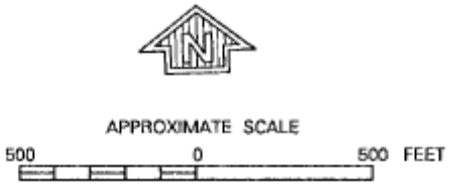
The date in the title block shows the map's most recent revision. As changes occur within a community that results in a change in flood elevations or floodplain delineations, FEMA republishes *only the Map Index and the changed map panels*. Any revised panels are given a new map revision date and a new suffix letter.

Once the panels are issued to the community, the date on the panel is referred to as the *effective date*. Some communities have map panels with different effective dates. The Map Index lists the current effective date for the most recently revised panel of a FIRM or of the FIRM itself, if all panels were revised.

With each revision comes a new panel suffix. Note that Paragould's panels were last revised in 1998 and have the suffix "D."

Map scales and north direction

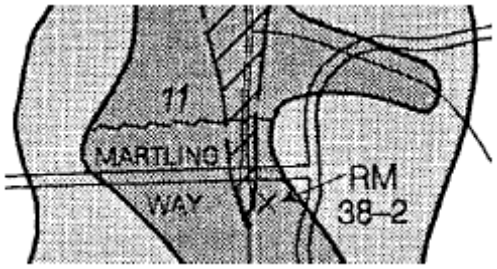
Different scales may be used for a single community with more than one panel. As an example, the map scale on the City of Paragould FIRM Panel 0038 is 1 inch = 1,000 feet. Another common scale is 1 inch = 500 feet. It is common, where several panels are required to map a community, for the scale to vary from panel to panel. Generally, a larger scale (more detail) is used for highly developed areas and a smaller scale (less detail) is used for more rural areas.



An arrow pointing north is shown on all maps, including the map index. For FIRMs and Floodway Maps, the north direction arrow is located near the map scale. The north direction on the maps may be "turned" to maximize the mapped area that can be shown on a panel and to minimize the number of panels. To ensure correct orientation and accurate use of the FIRM, it is very important to pay attention to the direction of the north arrow on the panel.

Elevation reference marks

Elevation reference marks are located on FIRMs and Floodway Maps. For these two types of maps, locations are identified with a small "x" and the designation "ERM" or "RM" simply followed by a reference mark number. For the newer Digital FIRMs (DFIRMs), locations are identified with a small "x" and the designation "ERM" or "RM" followed by the panel number and the number of the reference mark. Descriptions of the marks, including their elevations, appear either on FIRM panels, on Floodway Maps, or in the FIS text. Note that some ERM and RM descriptions may appear on a different map panel than the mark itself due to space limitations.



ERMs and RMs are important sites. They provide a ground elevation reference for surveyors to start from when they determine the elevation of a building, a cross, section, or topography for a site. Occasionally, an ERM cannot be found as described on the FIRM or Floodway Map because new construction or some other change in the area has obliterated the monument. In these instances, the next closest ERM may be used. Alternatively, USGS, USC&GS, or NGS bench marks, which are marked on most USGS 7.5 minute series topographic maps, may be used.

FIRM Zones

FIRMs show different floodplains with different zone designations. These are primarily for insurance rating purposes, but the zone differentiation can be very helpful for other floodplain management purposes. The more common zones **found in Arkansas** are listed in **Figure 3-8**.

Zone A	The 100-year or base floodplain. There are six types of A Zones: A The base floodplain mapped by approximate methods, *i.e.,* BFEs are not determined. This is often called an unnumbered A Zone or an approximate A Zone. **AE** The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of **A1-A30** Zones. **AO** The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided. **AH** Shallow flooding base floodplain. BFEs are provided. **A99** Area to be protected from base flood by levees or Federal Flood Protection Systems under construction. BFEs are not determined. **AR** The base floodplain that results from the decertification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.
Zone D	Area of undetermined but possible flood hazards.

Figure 3-8: Flood Insurance Rate Map Zones
Note that the special Flood Hazard Area (SFHA) includes only A and V Zones.

FLOOD HAZARD BOUNDARY MAP (FHBM)

FHBMs **(Figure 3-9)** were initially prepared to provide flood maps to many communities in a short period of time. They were made in the 1970s and early 1980s without benefit of detailed studies or hydraulic analyses for nearly all floodprone communities in the nation (over 21,000). They were intended for interim use in most communities until more detailed studies could be carried out.

FHBMs are still being used where detailed Flood Insurance Studies have not been prepared or cannot be justified. They are to be used for floodplain management, in conjunction with other local studies and other available data.

On the FHBM, the SFHA is designated as a shaded area labeled "Zone A," and no base flood elevations are given (see **Figure 3-9**).

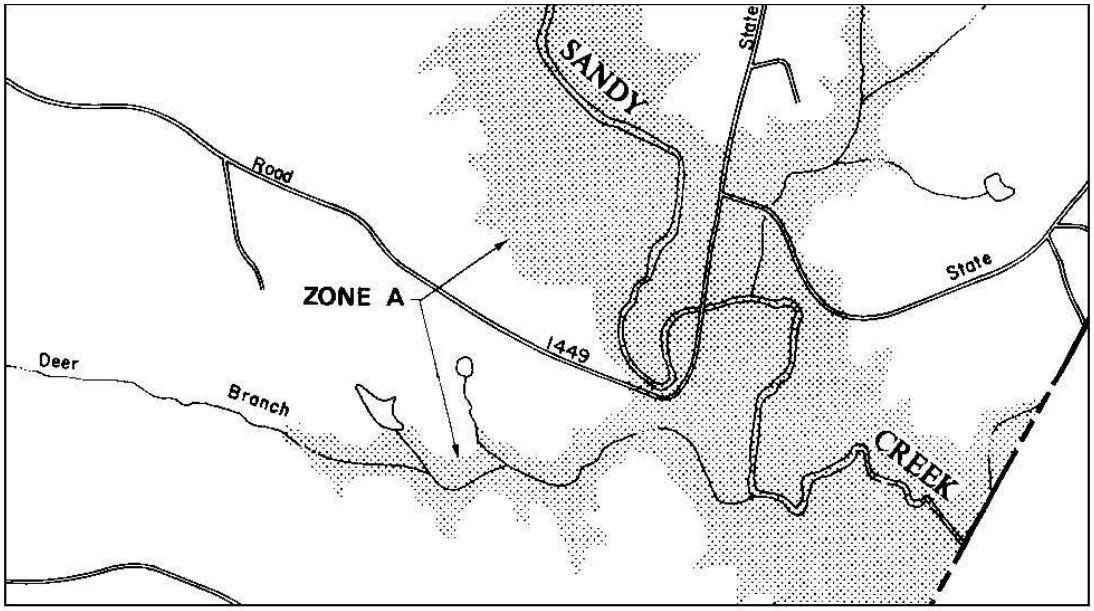


Figure 3-9. Flood Hazard Boundary Map (FHBM)

In some cases, FEMA simply converted the FHBM to a FIRM by issuing a letter to the community stating that the FHBM shall be considered a FIRM. In those cases, the community was instructed to line out FHBM on the map's title box and write in FIRM.

FLOOD INSURANCE RATE MAP (FIRM) — OLD FORMAT (PRE 1986)

The FIRM is used to generally determine:

- Whether a property is in the floodplain.
- The flood insurance zone that applies to the property.
- The approximate base flood elevation (BFE) at the site.

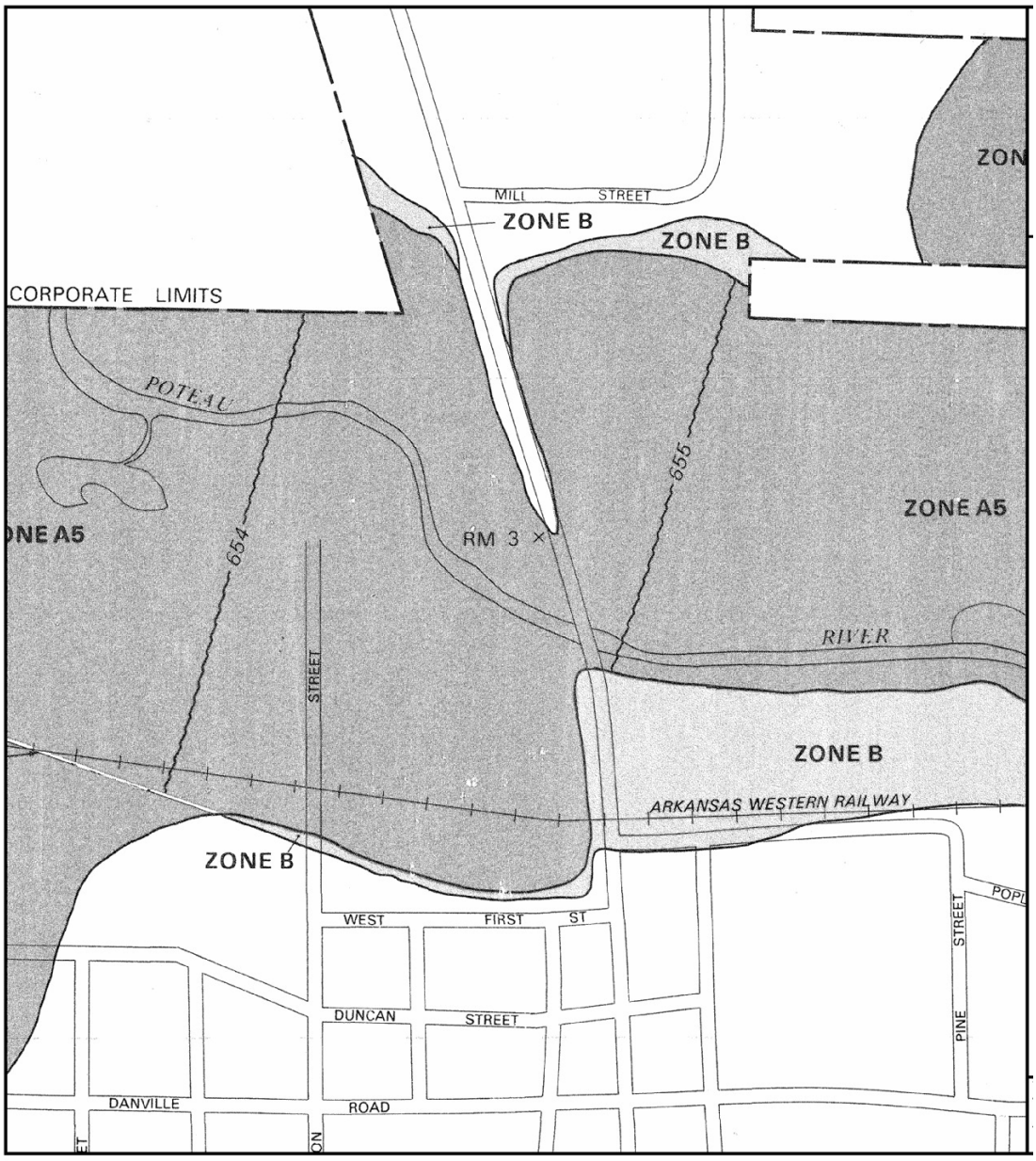


Figure 3-10 Old Format FIRM for the City of Waldron. BFEs shown, but no floodway

Date: Several dates may be listed in the FIRM legend, including **(Figure 3-11):**

- Initial Identification — date of the first Flood Hazard Boundary Map (FHBM).
- Any dates of revisions to the FHBM that have occurred since the initial identification.
- Flood Insurance Rate Map Effective - the date of the initial or first FIRM. This is the date used to determine whether a building is "pre-FIRM" or "post-FIRM."
- Flood Insurance Rate Map Revisions – dates of subsequent revisions to the FIRM.

****

The FIRM also will show in **Figure 3-12**:

Base (100-year) floodplain or SFHA: Designated by the dark-shaded areas (Insurance Zones A, A1–A30, A99, AO, AH, AR, V, V1–V30).

500-year floodplain: Designated by the lighter-shaded areas (Insurance Zone B).

Base Flood Elevation (BFE): The water surface elevation of the base flood at that point of the stream is denoted in whole numbers by wavy lines running across the floodplain. Coastal Zones within the area of 100-year tidal flooding, as well as some AH Zones, may have BFE lines, and some lake AE Zones have the base flood elevation noted in parentheses beneath the zone designations.

Zone break line (Gutter line): The thin white line separates flood insurance rate zones within the 100-year floodplain.

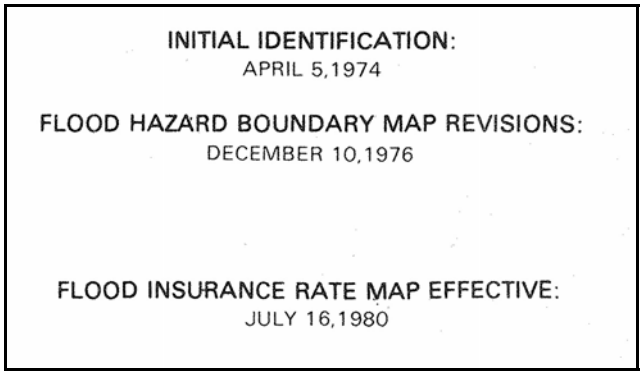


Figure 3.11 Dates on Title Block for City of Waldron FIRM panel 2.

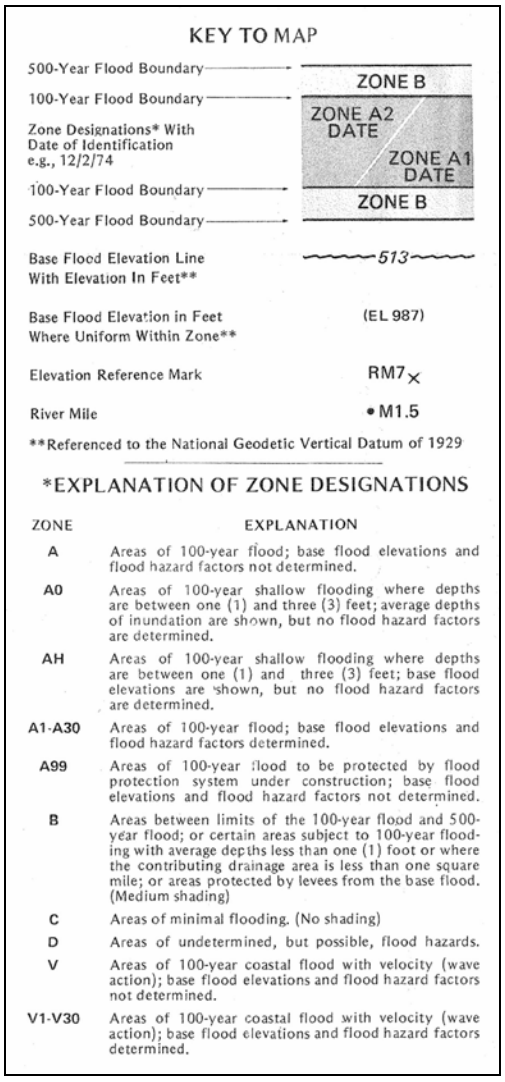


Figure 3-12 Flood zones on Title Block for City of Waldron FIRM panel 2.

Approximate floodplain areas: The 100-year floodplain areas are delineated using approximate methods. No BFEs are shown in approximate floodplain areas; these areas are classified as (unnumbered) A Zones.

FLOOD BOUNDARY AND FLOODWAY MAP (FLOODWAY MAP) – OLD FORMAT (PRE 1986)

The Flood Boundary and Floodway Map is also known as the FBFM or, simply, the Floodway Map **(Figure 3-14).** The Floodway Map shows how the floodplain is divided into the floodway and flood fringe where streams are studied in detail. They also show general floodplain areas where floodplains have been studied by approximate methods.

Floodway Maps have these features:

Title block: Includes the community name, county name, panel number, community number, and the map date. The panel numbers may be different from the FIRM panel numbers.

Map scale: The Floodway Map may have the same or a different scale than the FIRM for the same community.

Cross section line: These lines represent the location of some of the surveyed cross sections used in the computer model of the stream for calculating 100-year flood elevations. These cross sections can be used to relate a specific point on the Floodway Map to the flood profile and floodway data table.

Floodway: The 100-year floodplain has been divided into two areas, the channel is the floodway. The shaded area is the fringe.

One problem with this method of delineating floodways is that sometimes people confuse the white floodway with the white area representing land that is free from flooding **(Figure 3-13)**. Also, because the floodway is mapped separately, often property owners, lenders, real estate agents, and others do not have easy access to the Floodway Maps and do not know of the severe flood hazard associated with the floodway.

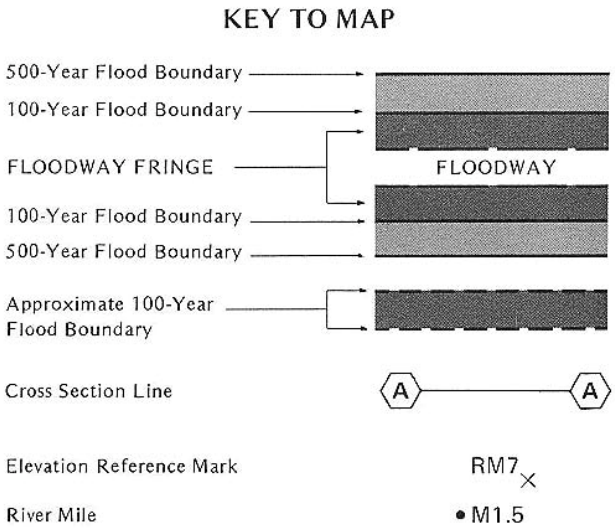


Figure 3-13. Key to Map

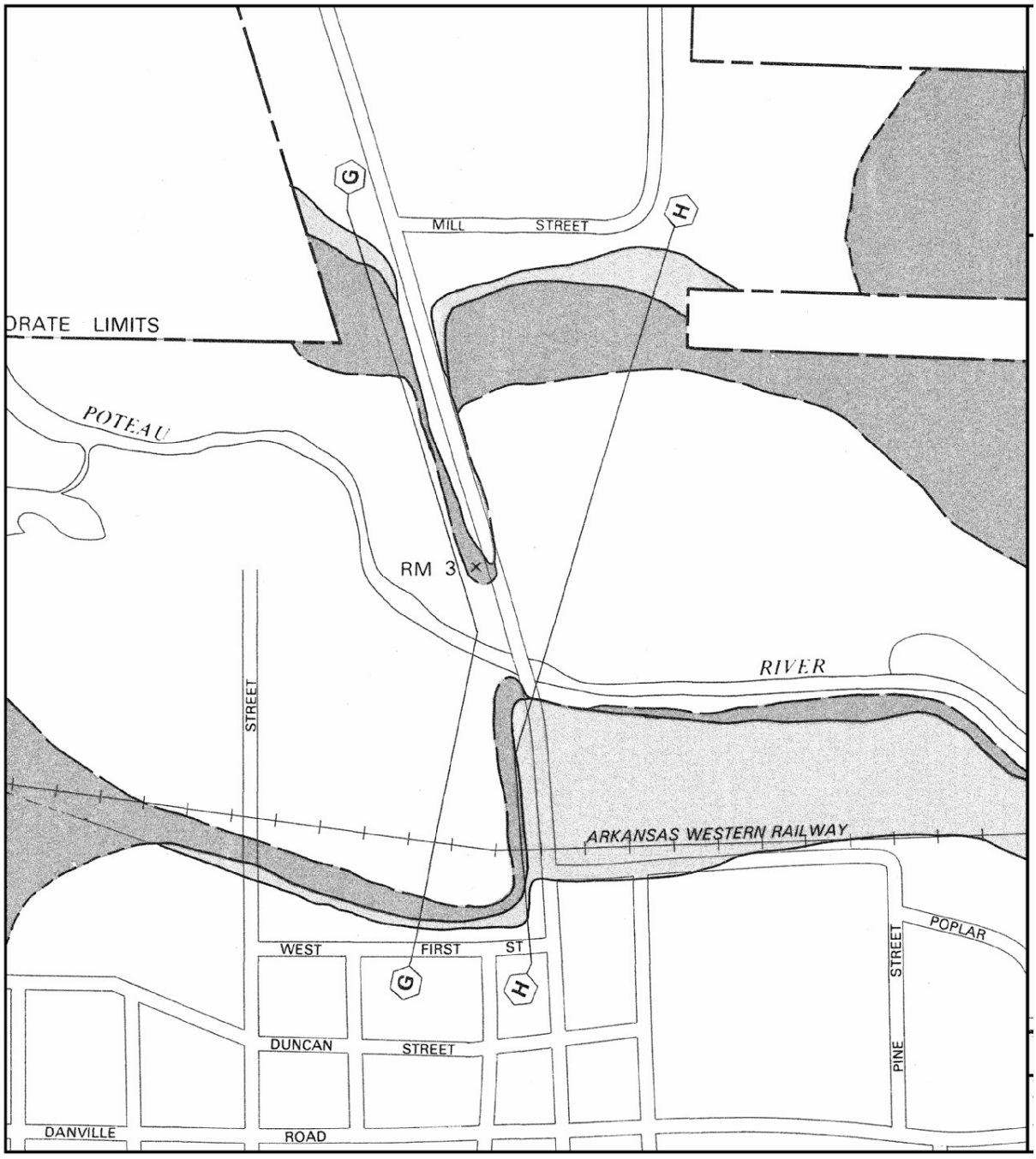


Figure 3-14 Old Format floodway map for the City of Waldron, Arkansas

FISs published since 1986 have corrected this problem — they do not have separate FIRM and Floodway Maps. Floodways are delineated on the newer FIRMs as a diagonally hatched area (see **Figures 3-15)**.

Note that no BFEs or flood zone names are shown on the Floodway Map.

The floodway is usually wider in flatter, wider floodplains and narrower in steeper areas where floodplains are narrower.

If a map panel area does not include any detailed study streams or floodways, a Floodway Map will not be printed; only a FIRM panel will be printed. Because coastal studies do not have floodways, all of the data needed are shown in the FIS report and on the FIRM.

Flood fringe: The fringe is shown as a shaded area outside of the floodway but still within the 100-year floodplain. The flood fringe and the floodway together comprise the special flood hazard area.

500-year floodplain: More lightly shaded areas adjacent to, but outside of, the 100-year floodplain delineate the 500-year floodplain for streams studied in detail.

Approximate floodplain areas: The 100-year floodplain areas are determined using approximate methods. The boundaries of the approximate floodplain on the Floodway Map are shown as dashed lines.

FLOOD INSURANCE RATE MAP — NEW FORMAT (SINCE 1986)

Flood maps have been redesigned over the years since the first FISs were prepared in the late 1960s, making them easier to use. A new format for FIRMs was introduced in 1986 that includes:

- Floodways and other floodplain management information, such as cross sections, that were previously provided on separate Flood Boundary and Floodway Maps (Floodway Maps). (Except in a few instances, Floodway Maps are no longer being prepared.)
- Simplified flood insurance zone designations. The previous Zones A1-A30 and V1-V30 were replaced by the designations AE and VE; Zones B and C were replaced by Zone X. The 500-year floodplain is still shown as “shaded” portions of Zone X.

Figure 3-15 shows the legend for the new FIRM format. **Figure 3-16** is an example of a new format FIRM with a floodway. With these changes, the FIRMs are more easily used by community officials for floodplain management, by lenders to determine the need for flood insurance, by insurance agents to rate policy applications, and by land surveyors, engineers, property owners and others to determine flood hazards in a given location. The City of Paragould map uses the newer format.

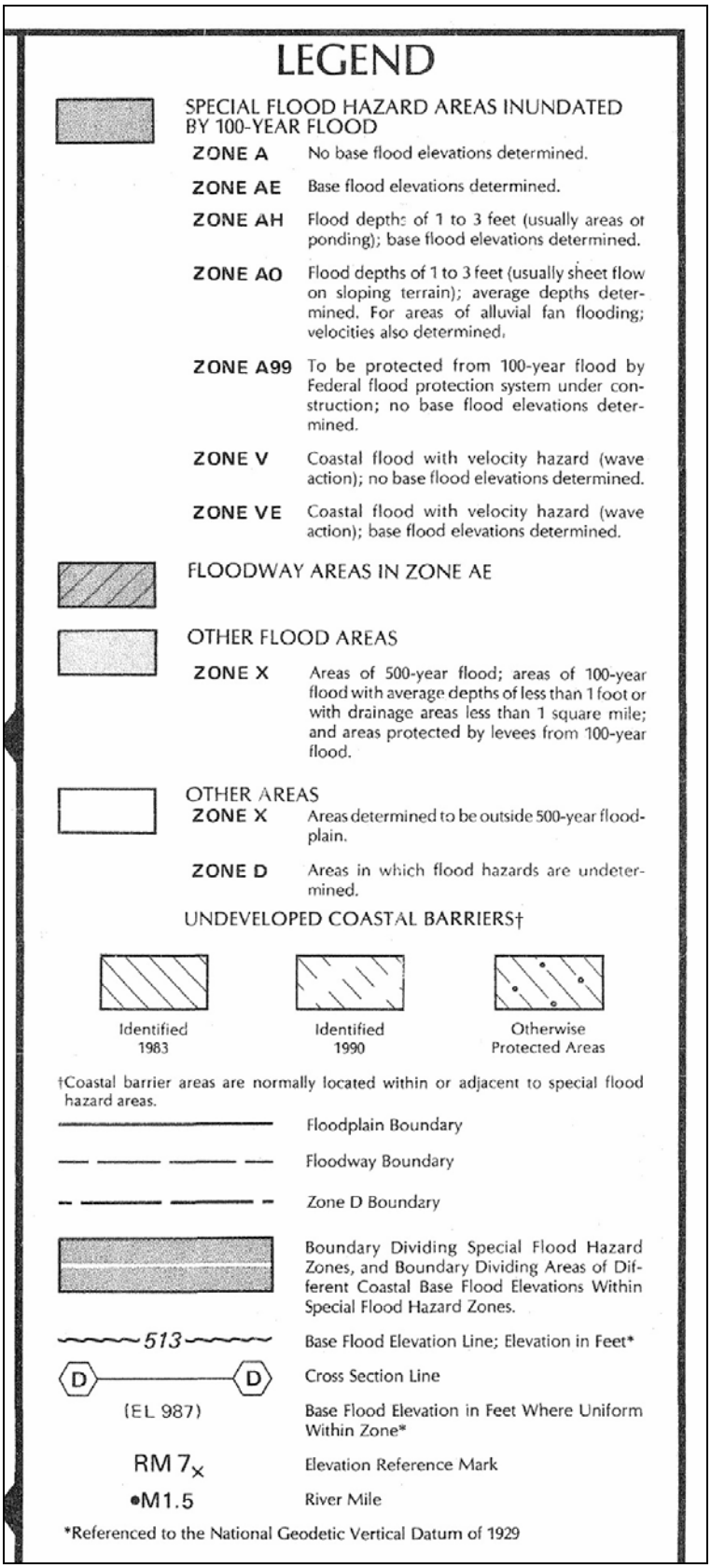


Figure 3-14 Legend for New Format FIRM

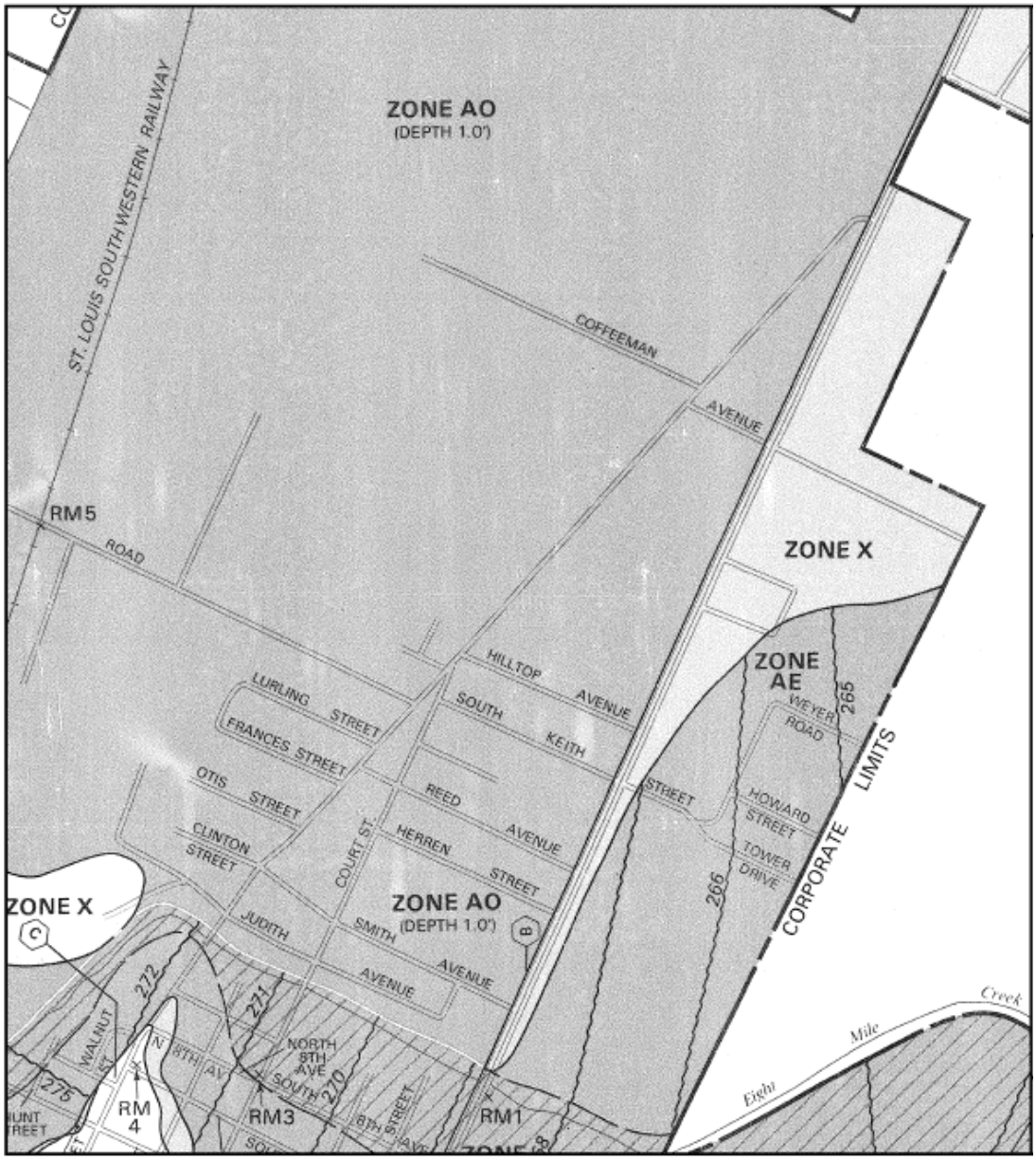


Figure 3-15 New Format FIRM with floodways shown with diagonal lines

PARTIAL MAP INITIATIVES FIRM

In some cases, it is more cost efficient for FEMA to update and print only a portion of the total FIRM and FBFM panels for a community in the new format. This is referred to as Partial Map Initiatives FIRM. Here, instead of printing the entire set of separate FIRM and FBFM panels for the community, only those panels affected by the revision elements are combined into the new format FIRM panel. To clarify this for the community, the FBFM index would show that those FBFM panels were no longer printed and that the floodway mapping information would appear on the new format FIRM showing that same area. The FIS report would also indicate on the Notice to User Page the combination of FIRM and FBFM panels and the differentiation between the old and new format zone labeling.

FIRMS WITH LAKE FLOODPLAINS

Lakes

Most lakes have a BFE, shown in parentheses below the flood zone that has been rounded off to the nearest whole number (see **Figure 3-16**). The actual BFE, to the nearest tenth of a foot, can be obtained from the FIS report. However, many long lakes, especially reservoirs, have a higher BFE at the upstream end than at the outfall. These types of lakes and reservoirs have BFEs shown with wavy lines, the same as riverine BFEs. They also appear on the stream profiles in the FIS report.

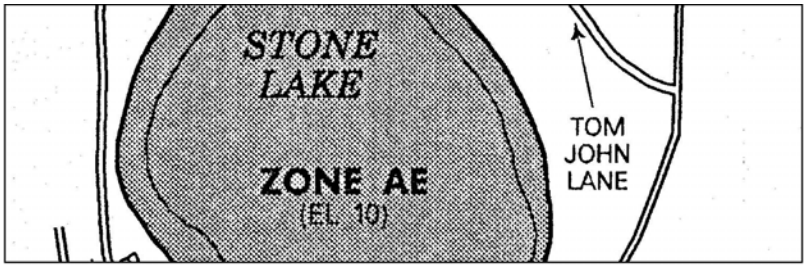


Figure 3-16. FIRM with lake floodplain

Where studies have been carried out for lakes and reservoirs, information on BFEs is contained in Section 3.0 of the FIS report. A *Summary of Stillwater Elevations* table is provided in the FIS report **(Figure 3-17)**. Note that the actual BFEs to the nearest one-tenth of a foot appear in the table, but the BFE on the FIRM is shown in parentheses rounded to the nearest whole number. For the most accurate BFE, use the “100-year flood elevation” from the table, not the FIRM. For a shortcut method, you can add 0.4 foot to the elevation shown on the FIRM. This will get you an elevation at least as high as the number shown in the table.

FLOODING SOURCE AND LOCATION	ELEVATION (ft. NGVD)			
	10-YEAR	50-YEAR	100-YEAR	500-YEAR
STONE LAKE Entire shoreline within Flood County	7.0	9.0	10.2	12.8

Figure 3-17: Summary of stillwater elevations for a lake

SHALLOW FLOODING FIRMS

Under the NFIP, ponding or sheet flow constitutes shallow flooding, which is mapped based on historic flood experiences and study of the topography.

An example of a shallow flooding area is on the Paragould FIRM, panel 0005, in the northeast area marked “Zone AO (Depth 1’).”

We don’t know how high the base flood is in relation to sea level in Paragould “Zone AO (Depth 1’).” However, we do know that the base flood should be no deeper than one feet above the highest adjacent grade. See Glossary in Appendix D for definition of highest adjacent grade.

FIRMS WITH FLOOD PROTECTION PROJECTS

Some FIRMs may show areas protected from flooding by the 100-year flood because of the presence of a levee, concrete dike, floodwall, seawall, or other structure. These areas are usually designated as shaded Zone X and marked with the following note:

- This area protected from the 100-year flood from (Flooding Source Name) by LEVEE, DIKE, or other structure subject to failure or overtopping during larger floods.
- This is an indication that the flood protection structure has either been evaluated and found to meet all of the NFIP requirements for flood control structures, or has been certified by a Federal agency with levee design responsibility as having been adequately designed and constructed to provide protection from the 100-year flood.
- Floodways will be delineated at the landside toe of a levee that is recognized as providing 100-year flood protection.
- A levee that provides a lower level of protection, and that is not certified or does not meet the requirements for levees, may be shown on the FIRM, and flood elevations are computed as if the levee did not exist.

COUNTYWIDE FIRMS

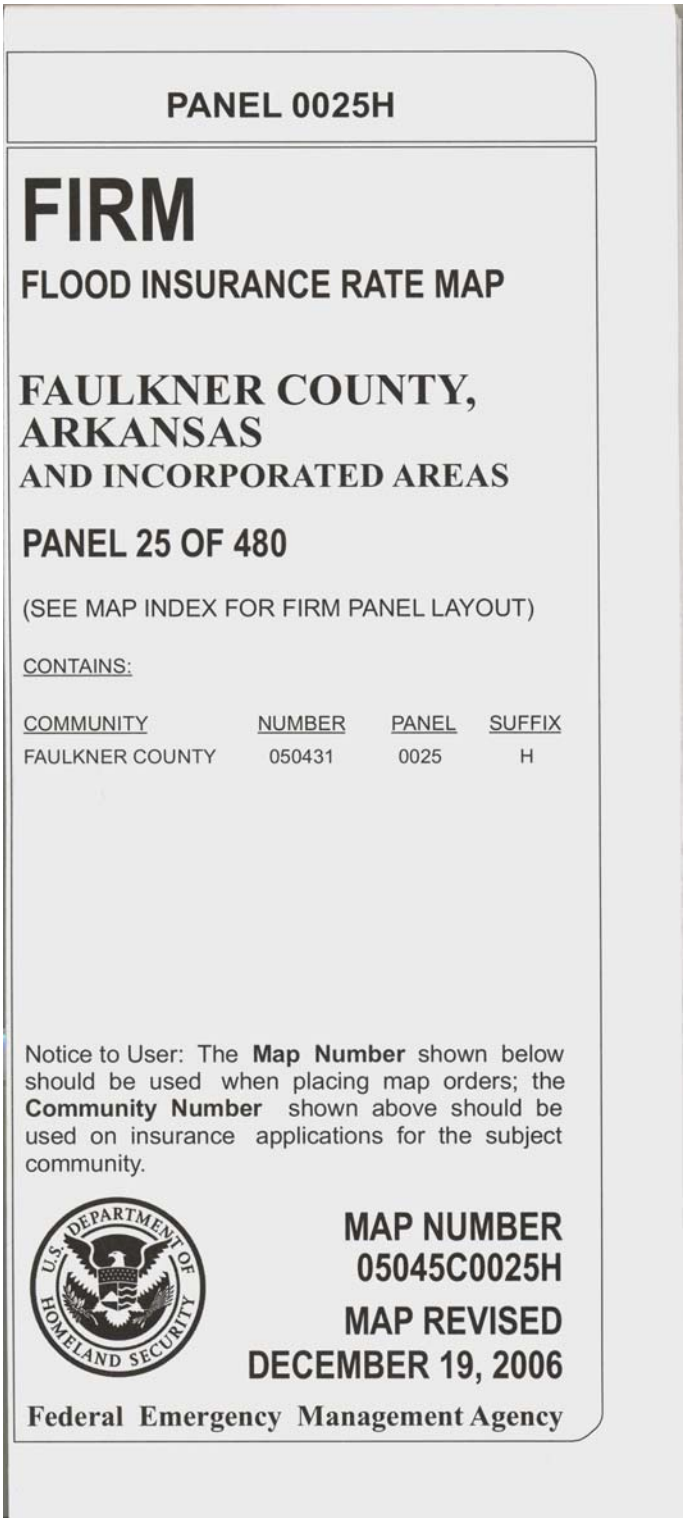
Newer FIS reports and FIRMs covers the unincorporated areas and all incorporated areas within a county. Therefore, they are referred to as a *countywide FIRMs*. Countywide FIRMs show flood hazard information for all geographic areas of the county, including other jurisdictions such as villages, towns, and cities.

Previously, FHBM, FIRM and FBFM maps were prepared separately for each jurisdiction. County FIRMs, for example, showed the flood hazards identified only in the unincorporated areas of the county and did not show any flood information inside the corporate limits of a municipality. In countywide mapping, once the countywide map is produced, all of the identified flood hazard areas within the boundaries of the county are shown on one set of maps along with all floodway information maps (see section titled Flood Insurance Rate Map - New Format).

The countywide FIRM format has a number of advantages, and one in particular is that the user can see the relationship and simultaneous effect of each floodplain on a number of communities. In addition, FIRMs do not need to be updated when municipal boundaries change. Although boundaries might change, communities will continue to find the flood hazard information they need on the same countywide FIRM.

Figure 3-18 shows the title block of a countywide FIRM panel. The title block lists the communities mapped on that panel and their six-digit NFIP community ID numbers. The FIRM panel has a map number with five digits consisting of the NFIP-assigned state number as the first two digits and the NFIP-assigned county number as the next three digits followed by the letter "C," which stands for "countywide," and then the four digit panel number and suffix. Do not confuse the map panel number with the community number.

All previous map dates for each floodprone community in a countywide FIS are located on the community map history Table. The initial FIRM date for each community is shown on the FIRM index. These are the "post-FIRM" dates for insurance rating. Don't confuse them with the effective date of the latest FIRM panel, which is shown in the title block.



PANEL 0025H

FIRM

FLOOD INSURANCE RATE MAP

FAULKNER COUNTY, ARKANSAS
AND INCORPORATED AREAS

PANEL 25 OF 480

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FAULKNER COUNTY	050431	0025	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
05045C0025H
MAP REVISED
DECEMBER 19, 2006

Federal Emergency Management Agency

Figure 3-18. Title block of countywide FIRM for Faulkner County, Arkansas

DIGITAL FIRMS

The conversion of FIRMs to a digital format has many benefits. For example, they can be revised and updated easily with just a few keystrokes, and they can be incorporated in the community's mapping system and tied in with other geographic information systems, such as the zoning map.

Users must bear in mind that the simple conversion of FIRMs to a digital format does not inherently improve the engineering quality of the product. Many of the same difficulties with interpretation of flood risk data — and the requirement that users apply sound judgment in methods selected for decision making and map interpretation — remain unchanged.

FEMA charges a fee for all digital FIRM data products. Any questions regarding these products may be directed to:

Federal Emergency Management Agency
Map Service Center
P.O. Box 1038
Jessup, Maryland 20794-1038

Phone: 800/358-9616
Fax: 800/358-9620
Internet: http://www.fema.gov

Digital Flood Insurance Rate Map (DFIRM)

The FIRM in **Figure 3-19** is as paper copy of a Digital Flood Insurance Rate Map, or DFIRM. This is because was created with new digital methods; however, whether the maps are new DFIRMs or conventional FIRMs, they are still generally referred to as FIRMs. The DFIRM is comprised of all digital data required to create the hardcopy FIRM. These data include base map information, graphics, text, shading, and other geographic and graphic data.

The majority of DFIRMs are produced in a countywide format, where all flood hazards for the county and incorporated communities are shown on one set of maps. It can be used for floodplain management purposes in a manner similar to other flood maps, but it can also be combined with other digital map information to create new information for planning purposes. DFIRMs are also produced for single jurisdictions when producing a countywide map would not be cost effective.

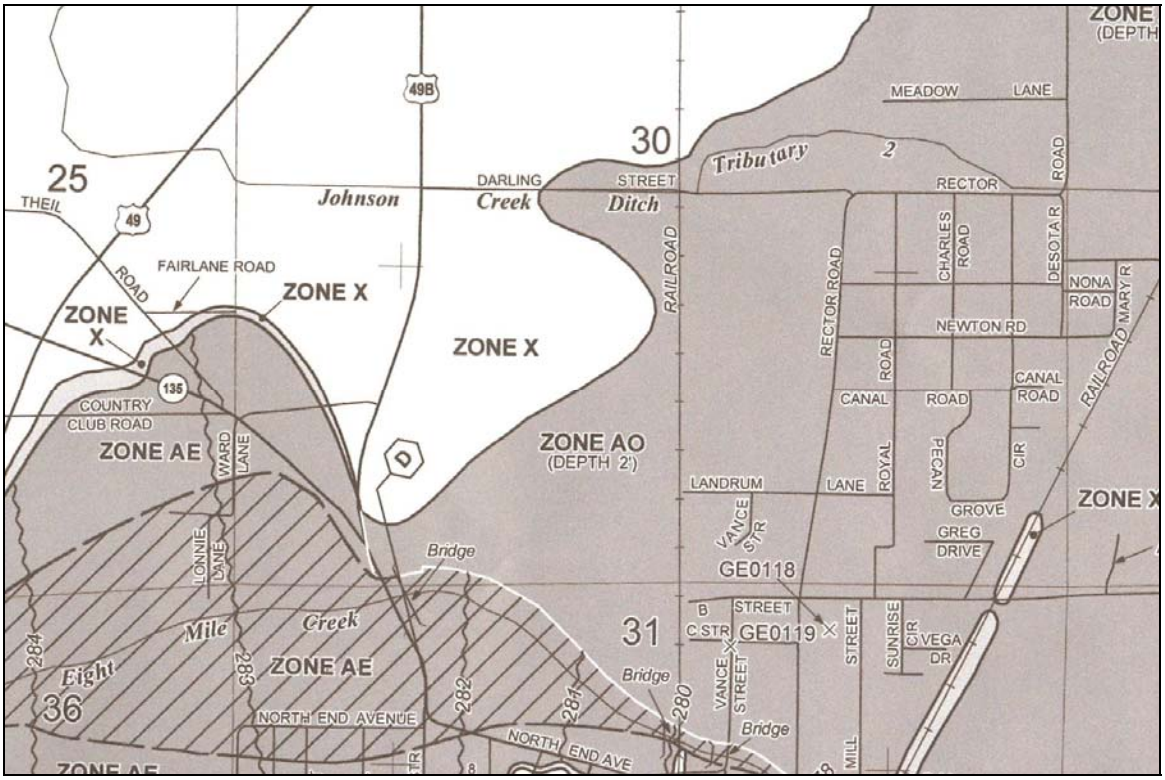


Figure 3-19 Hardcopy DFIRM

Digital Flood Insurance Rate Map – Digital Line Graph

The Digital Flood Insurance Rate Map - Digital Line Graph (DFIRM-DLG) is intended to be the primary means of transferring flood-risk data depicted on FIRMs to Geographic Information Systems (GIS). GISs are computer-based map systems that allow the user to keep a map updated easily and to correlate geographic information with other data, such as tax records on properties.

The Digital Flood Insurance Rate Map - Digital Line Graph (DFIRM-DLG) is a database created by extracting certain flood risk data from the DFIRM. The DFIRM-DLG does not include base map information, nor does it include graphic data required to create a hardcopy FIRM.

Communities whose digital base mapping files were used as the base map for the DFIRM will find that they may easily use the DFIRM-DLG files for determination of flood zones and for enforcement of regulations. A graphic image of a DFIRM-DLG is shown in **Figure 3-20**.

The digital data captured from the hardcopy DFIRM consists of FEMA hydrography (location of water bodies), flood hazard zones, BFEs, cross-section locations, and elevation reference marks.

All lines and area features in DLG files are encoded with one or more seven-digit attribute codes that provide the user with detailed information about the features. FEMA intends to make the DFIRMDLG available on CD-ROM compatible with Insurance Services Office (ISO) 9660 standards.

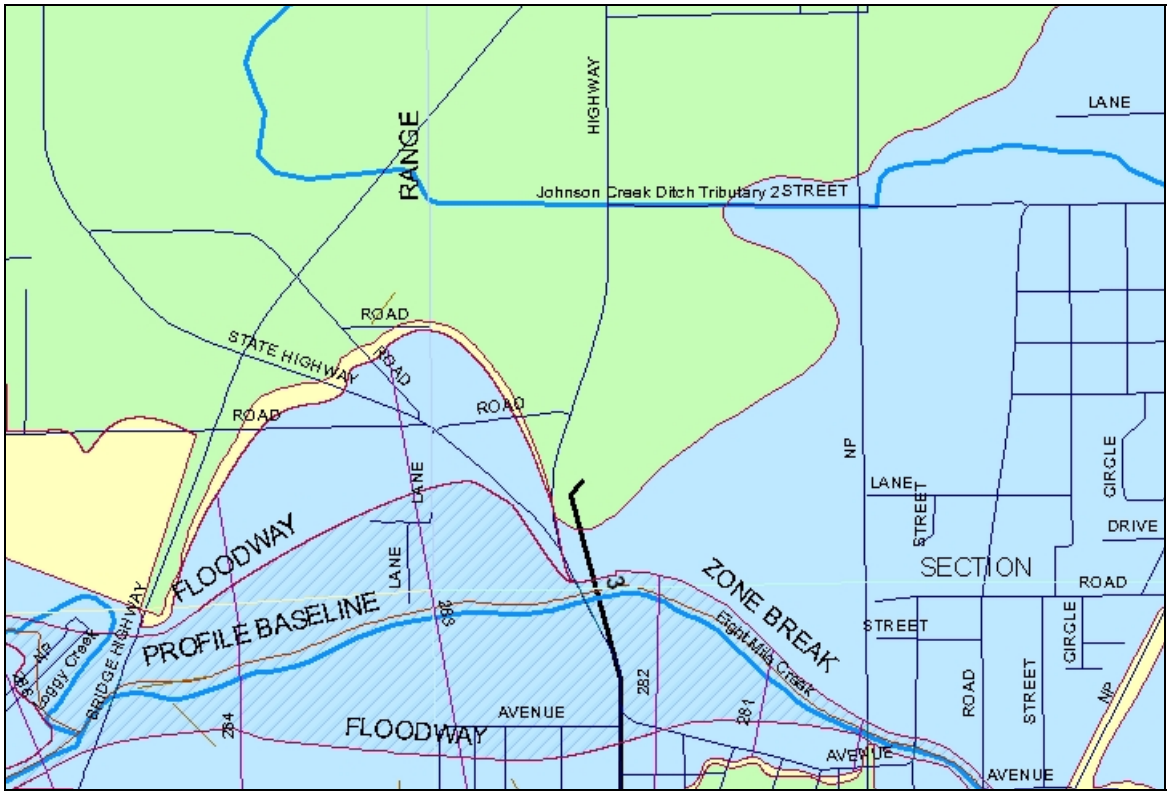


Figure 3-20 Graphic image of a DFIRM-DLG with colored flood zones

With many commercially available GIS software packages, DLG data can be directly converted into vector data usable within the GIS environment. Third-party conversion software is also available that will convert DLG data to other proprietary GIS formats.

The DFIRM-DLG, when coupled with digital base map files or the local community digital base, can be used in a GIS to determine whether a structure is located within an SFHA. It should be noted that if a GIS is used to determine that a structure is within or near an SFHA, and a different base map source was used to generate the hardcopy DFIRM, the determination should be confirmed by referencing the printed hardcopy DFIRM.

Q3 Flood Data

In the Q3 Flood Data Product, FEMA has developed a graphical representation of certain features of the FIRM. The Q3 Flood Data are in three formats that are usable with desktop mapping and GIS software packages. These formats are:

- Digital Line Graph
- ARC/INFO
- MapInfo

Q3 Flood Data are created by digitally capturing certain key features from the current effective paper FIRMs. These features are converted into area features in one countywide data layer. The following vectorized (lines and areas) data features are included:

- SFHA and 500-year floodplain,
- Flood insurance zone designations,
- Floodway boundaries (if available),
- COBRA zones,
- Political boundaries,
- Community/map panel identification numbers,
- Boundaries between FIRM panels, and
- U.S. Geological Survey 7.5 minute (1:24,000 scale) quadrangle neatlines.

Several features are *not* included. They are:

- Hydrographic features,
- Base flood elevations,
- Cross section lines,
- Roads, road names or address ranges, and
- Elevation reference mark locations and elevations.

Q3s were developed to support insurance-related activities and are designed to provide guidance and a general proximity of the location of SFHAs. Q3s do not replace paper FIRMs as the legal document.

The data are not suitable for applications such as detailed site design and development plans or flood risk determinations. They cannot be used to determine absolute delineations of floodplain boundaries, but instead should be seen as portraying zones of uncertainty and possible risks associated with flooding.

Q3 Flood Data incorporate map revisions and letters of map revision and amendment. However, they do not correct for edge-matching errors, overlaps, etc., that were in the original paper FIRMs.

FEMA has produced Q3s for almost 900 counties nationwide. They are organized by county and contain data from all existing paper FIRM panels for the incorporated and unincorporated areas of the county.

Q3 Flood Data are available on CD-ROM from the FEMA Map Service Center. You can access the list of Q3 counties on the Internet and download sample data, data standards, and other Q3 information (http://www.fema.gov).

CHAPTER 4

USING NFIP STUDIES AND MAPS

A. USING FIS REPORTS

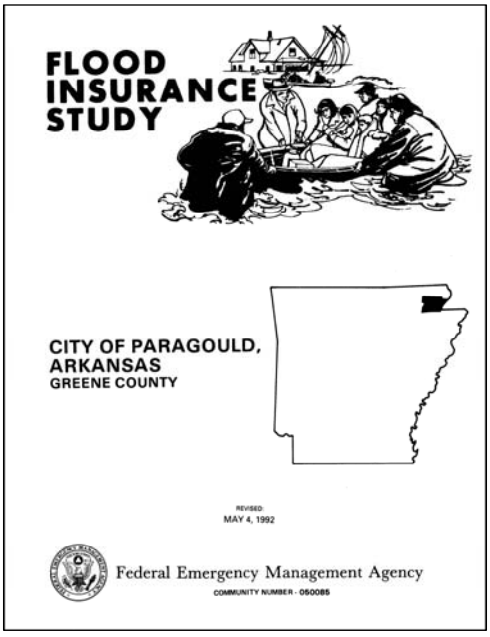
The majority of Flood Insurance Study (FIS) reports use the same outline and numbering system. In this section, we will highlight the report's contents; explore the report's data, tables, and profiles; and describe how they are related to the Flood Insurance Rate Map (FIRM) and Floodway Map.

The most important reason for using a FIS report, in conjunction with a Floodway Map and/or a FIRM, is to determine whether or not a site is located in a Special Flood Hazard Area (SFHA) and/or a floodway, and to determine the Base Flood Elevation (BFE). **The City of Paragould is used for most examples in this chapter.**

Important: Because the elevation determinations for riverine floodplains are typically used to establish flood elevations for construction in SFHAs and other purposes, accuracy is critical. You may want to have another person double check your determinations before using them in the permit application process.

FIS REPORT CONTENTS

The Paragould FIS report cover has an outline map. Note that the location of Paragaould is pinpointed on the outline map. The date of the FIS and the community identification numbers are also indicated on the cover page.



Section 1.0 of all FIS reports states the purpose of the FIS, authority of and acknowledgments by its authors, and coordination steps taken during the preparation of the study.

Section 2.0 provides background information on the community, its flood problems, which areas were studied, and what flood protection measures are in effect.

Section 3.0 discusses the engineering methods used. Section 3.1 covers the hydrologic analysis — how much water will flow through the floodplain during peak floods. Section 3.2 describes the hydraulic analysis — how high the water will get. Development of this information was described in Chapter 3.

Section 4.0 discusses how the flood map was prepared from flood data for floodplain management applications. Section 4.1 covers mapping the floodplain boundaries — where the water will go. If the study included a floodway determination, Section 4.2 describes the floodway study and mapping. Section 4.0 also includes the Floodway Data Table. How to interpret and use these and other data is covered later in this chapter.

Section 5.0 covers data related to flood insurance, some of which you will not need to use. This section can be a useful reference, as it describes the flood insurance zones identified on the map.

Completing the FIS report are the following four sections: Section 6.0, Flood Insurance Rate Map; Section 7.0, Other Studies; Section 8.0, Location of Data; and, Section 8.0, Bibliography and References.

Most riverine FIS reports include flood profiles as an exhibit at the end of the document.

USING FLOOD DATA AND TABLES

Flood discharges

Turn to Table 1, ***Summary of Discharges***, in Section 3.1 on page 8 of the Paragould FIS report. An excerpt from that table is shown below **(Figure 4-1*)***.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
EIGHT MILE CREEK					
At mile 10.79	16.7	6,814	8,181	8,972	11,636

Figure 4-1: Paragould, FIS Report Table 1 - Summary of Discharges

Figure 4-1 (***Table 1 – Summary of Discharges***) summarizes the peak amount of water discharge for various flood frequencies at locations within the study area. The hydrologic study procedures for arriving at these amounts were discussed in Chapter 3, Section B. The sizes of the drainage areas (watersheds) contributing to the water runoff producing the floods are also shown in the table.

The 100-year flood discharge for Eight Mile Creek at mile 10.79 (10.79 miles above its confluence with the St. Francis River) is 8,972 cubic feet per second (cfs). This means that during the peak of the base or 100-year flood 8,972 cubic feet of water will pass this point each second.

Those administering the local ordinance may never have a need for these data. They are, however, important in making subsequent calculations of flood elevations as part of the hydraulic engineering study.

Floodway Data Table

The Floodway Data Table in Section 4.2 of the FIS report presents data from the hydraulic analysis (Table 2, page 12 in the report). Part of this table is reproduced below **(Figure 4-2)**.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Eight Mile Creek								
A	11.170[1]	1588/923[3]	3,390	2.0	263.0	263.0	264.0	1.0
B	12.000[1]	800	1,896	3.6	268.9	268.9	269.6	0.7
C	12.560[1]	172	1,366	4.9	274.0	274.0	274.5	0.5
D	13.590[1]	1100/1070[3]	7,179	1.2	282.5	282.5	283.4	0.9
E	14.660[1]	421	2,164	5.1	288.8	288.8	289.2	0.4
F	15.200[1]	481	2,391	2.9	293.2	293.2	293.6	0.4
G	16.880[1]	90	710	9.3	305.8	305.8	305.9	0.1
H	18.270[1]	84	757	6.6	324.4	324.4	324.6	0.2

Figure 4-2: City of Paragould, FIS Report Table 2 - Floodway Data

All numbers in the table are calculated at each floodplain cross section. The first two columns under “Flooding Source” identify the stream name and the cross sections used in the FIS, and the distance of the given cross section from some reference point, usually the mouth of the flooding source, a corporate limit, or a county boundary. The footnotes at the bottom of the Floodway Data Table identify this reference point.

The locations of these cross sections are shown on the accompanying FIRM and Flood Profile (unless otherwise indicated on the Floodway Data Table). Cross-section A of the Eight Mile Creek is approximately 11.17 miles above the confluence with the St. Francis River. You can find cross-section A on FIRM panel 5. It is the line that crosses the Eight Mile Creek and has the letter “A” in a hexagon at each end.

Remember that a floodway’s width usually is not symmetrical; it varies with the topography at each cross section. The next three columns (“Floodway”) provide data at each cross section. At cross-section A, on Eight Mile Creek, the floodway is 1588 feet (923 feet within the city limits} wide. This means that from the floodway boundary on one side of the stream of this cross section to the floodway boundary on the other side of the stream is 1588/923 feet. This is useful for double-checking the width of the floodway portrayed on the FIRM.

Figure 4-3 is a representation of the description of cross-section A given in Table 2.

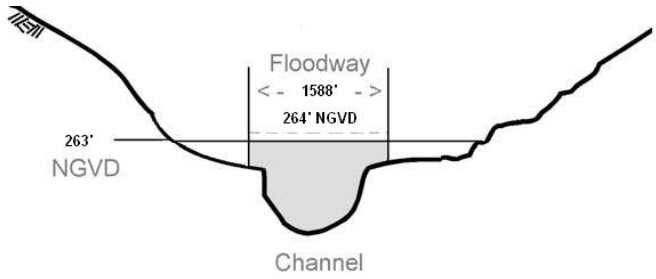


Figure 4-3: Representation of cross-section A of Eight Mile Creek

The cross sectional area of the floodway here is 3,390 square feet. This is the cross sectional area of the floodway below the elevation of the base flood at this location (the shaded area of **Figure 4-3**). The average or mean velocity of the base flood in the floodway is 6.1 feet per second. This is an average velocity. Velocities will generally be higher in the channel than in the over bank areas.

Of the last four columns under "Base Flood Water Surface Elevation," you should be primarily concerned with the first one, "Regulatory," which provides the regulatory flood elevation. This is equivalent to the 100-year flood elevation or BFE. The other columns depict the increase in water-surface elevation if the floodplain is encroached upon so that the water-surface elevation is increased no more than 1 foot. This amount of encroachment is used to define the floodway width. Notice that no cross section has an increase of more than 1.0 foot, in accordance with NFIP standards. Some States and communities regulate to the "With Floodway" elevation to take into account possible future increases in flood stage that will occur as the floodplain is developed.

LAKE ELEVATIONS

Lake flood elevations. On inland lakes and reservoirs, the FIS generally does not include the effects of waves. For these areas, information on base flood elevations is contained in Section 3.0 of the FIS report, and data is presented in a table titled *Summary of Stillwater Elevations*. Note that in this table the BFE is shown to the nearest one-tenth of a foot, but the BFE shown in parentheses on the FIRM is rounded to the nearest *whole* number in Chapter 3 (**Figure 3-20**).

For lakes and reservoirs, *use the base flood elevation from the table, not the FIRM.*

RELATING REPORT DATA TO MAPS AND PROFILES

Chapter 3 described the data that are developed and used in preparing an FIS for a community. Each set of data is used for calculations needed to produce additional data for the FIS.

The data contained in the FIS report are consistent with those found on the accompanying profiles and FIRM. For example, the base flood water-surface elevations at each identified cross section can be found in the Floodway Data Table, read from the flood profiles, and interpolated from the FIRM. Within the limits of map accuracy, you should obtain the same answer regardless of which source you use.

In the same way, the distances between cross sections, or their distance from some reference, can be found using any or all of the above data sources. Again, the answers should be about the same.

The elevations of the computed profiles contained in the FIS report are used with ground elevation data to determine the limits of the various zones shown on the FIRM. Again, flood elevations can be determined at any location along the studied stream using either the flood profiles or the FIRM. All the data fit one another. If obvious mistakes are found, please advise the FEMA Regional Office.

Note: Due to the limited detail and large scale of the base maps used for most FIRMs, much interpolation between contour lines is done in mapping the floodplain boundaries. This is why you may find discrepancies when actual ground elevations are surveyed: the maps are just the best available graphic representations of the BFEs.

Here's the order of precedence for identifying the BFE at a particular location:

- The most accurate BFEs are found in the Floodway Data Table (for a riverine floodplain) and the Summary of Stillwater Elevations table (for a lake). These BFEs are listed to 0.1 foot. However, the Floodway Data Table is only good for sites on or next to a cross section.
- The next most accurate source of elevation data is the profile. This plot of the cross-section data is difficult to read accurately.
- The least accurate source of elevation data for a riverine floodplain is the FIRM. BFEs are rounded to the nearest whole foot. However, the FIRM is the only source of base flood elevations for coastal floodplains and AO and AH Zones.

BFEs take precedence if there is a dispute between the BFE and the boundaries of the SFHA shown on the maps. As a local permit administrator, you can make your decisions based on the most accurate source of data.

It must be noted that banks (and others who must read the FIRM to determine if flood insurance is required) must go by the map. They cannot make on-site interpretations based on data other than the FIRM. However, they may recommend that the property owner submit a request for a Letter of Map Revision based on Fill (LOMR-F) or a Letter of Map Amendment (LOMA) so the map can be officially changed to reflect the more accurate data (see Chapter 4, Section D).

Again, only FEMA can amend or correct the maps. Discrepancies should be brought to FEMA's attention through a request for a map change, such as a **Letter of Map Amendment (LOMA)** (see Section D in this chapter).

Reading and using flood profiles, the last set of data contained in a Flood Insurance Study report, will be covered in Section C of this chapter.

B. USING THE FLOOD MAPS

LOCATING A SITE

How easily you can locate a site on an NFIP map will depend on your familiarity with properties in the community and with the scale of the flood maps. For the exercises which follow, the flood maps and the flood insurance study for the City of Paragould are used. The actual FIRMs for Paragould are large maps which fold similar to highway maps. They have been reduced to be able to print on 11 X 17 inch paper and are included in the next section of this volume.

Areas which show sites used in the exercises have been enlarged so they are easier to read and make measurements. These maps are printed as FIRMettes from FEMA's website, www.fema.gov. Flood maps may be viewed, printed and ordered from the Map Service Center page on the FEMA website.

For our exercise purposes here, the general location of the sites are shown on the Paragould Map Index. (Remember to check your north arrow. The top of the map is not always north.) In reading the following exercises, try to apply the principles to your own community's flood maps.

For Site A

To locate a site, follow these steps:

- If your community has more than one map panel, use the map index to determine which panel to use. The City of Paragould has two panels, numbered 5 and 10. Use map landmarks —highways, streets, or streams —to find the Site A on the index.

  The Map Index for Paragould shows the Site A to be north of Highway 412 on Panel 5.

- Find the area Site A on the map panel. Be sure the map panel is the most recent one — compare its suffix letter with the suffix letter for that panel on the current Map Index. Remember, in many communities, panels will have different effective dates due to revisions that do not affect the whole community.

  Site A is shown at the upper right side of panel 5.

- If there is an asterisk on the panel number, either no flood hazard has been identified in that area or it is entirely one flood zone and the panel was not printed.

  All panels for the City of Paragould have been printed.

- Locate the site as accurately as possible. Use a detailed street or road map as well as the tax appraiser's plat map to identify the property boundaries, if necessary. You will probably have to obtain the distance on the ground between the site and one or more identifiable points, such as the centerline of a road or street, a bridge, or some other feature on the map. Locate these points on the flood map.

  Using the appropriate enlarged FIRMette ***(*Figure 4.4*)*** *which contains Site A. Site A is bounded to the south by Court Street and to the west by Reed Avenue. I extends 75 feet north of Court Street and 150 feet east of Reed Avenue, forming a rectangular lot.*

- Convert the distance to the map scale and plot the site on the FIRMette map.

  Paragould published panel 5 has a scale of 1 inch = 1000 feet. The map scale on the FIRMette is also 1 inch = 1000 feet. So the FIRMette is essentially a replica of a portion of the FIRM.

DETERMINING STATIONING

In order to identify the BFE at a development site, the stream stationing for the site must be determined. The stationing of a site will allow us to read the flood profiles. In some cases stationing may be referred to as mileage.

- Locate Site B on the Paragould FIRM panel 10 as indicated on the Index map. that shows cross sections. Identify which labeled cross sections (on the enlarged area map) are nearest to your site, both upstream and downstream.

  *Site B is 1750 feet south of the intersection of Reynolds Park Road and McPherson Street and 1000 feet east of McPherson Street. This location marks the center of a site which borders Loggy Creek. Follow the steps in the previous discussion to locate this site on the Paragould FIRM. Use the maps (***Figures 4.5 and 4.6***) to help find the site. Note the difference in road names between the following street map and the FIRMette. The base map for the FIRMette is out-of-date, and the name Country Club Road has been replaced by Reynolds Park Road. Often other maps are needed to supplement the FIRM map to locate a site on the FIRM.*

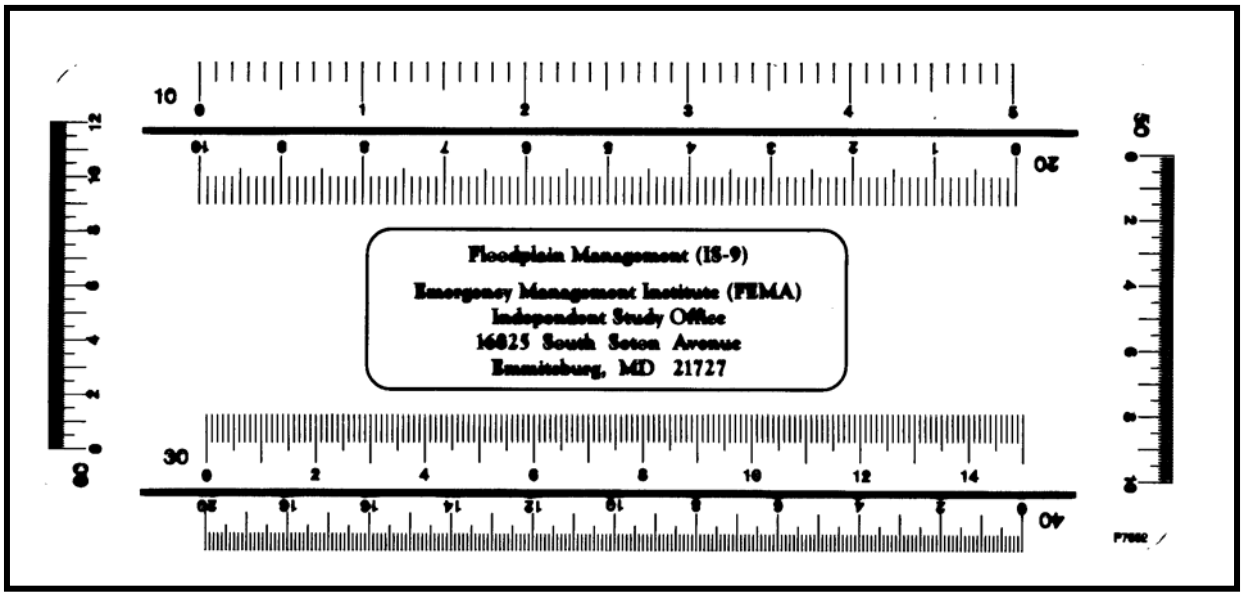
- Check the map scale used for the panel. The scale is in the map legend or key.

  For the FIRMette, the map scale is 1 inch = 1000 feet.

Use an engineer's scale to measure the distance along the stream from the site to the nearest cross section, ***following all bends and curves of the stream***. It would be worthwhile to measure the distances to both cross sections to check accuracy.

Site B is approximately 875'' downstream of cross-section D and approximately 1050' upstream (west) of cross-section C, north of Loggy Creek.

.



- If the stationing is based on mileage, convert these distances to miles by dividing by 5,280. In the case of Paragould, the stationing is based on feet.

  When converting to miles, we lose a little accuracy. Rounding the numbers, our site is 0.166 mile downstream of cross-section D and 0.20 mile upstream of cross-section C.

Keep these numbers in mind; they will be used shortly. This approach will also work by measuring from another point that shows up on the profile, such as a bridge or confluence with another stream.

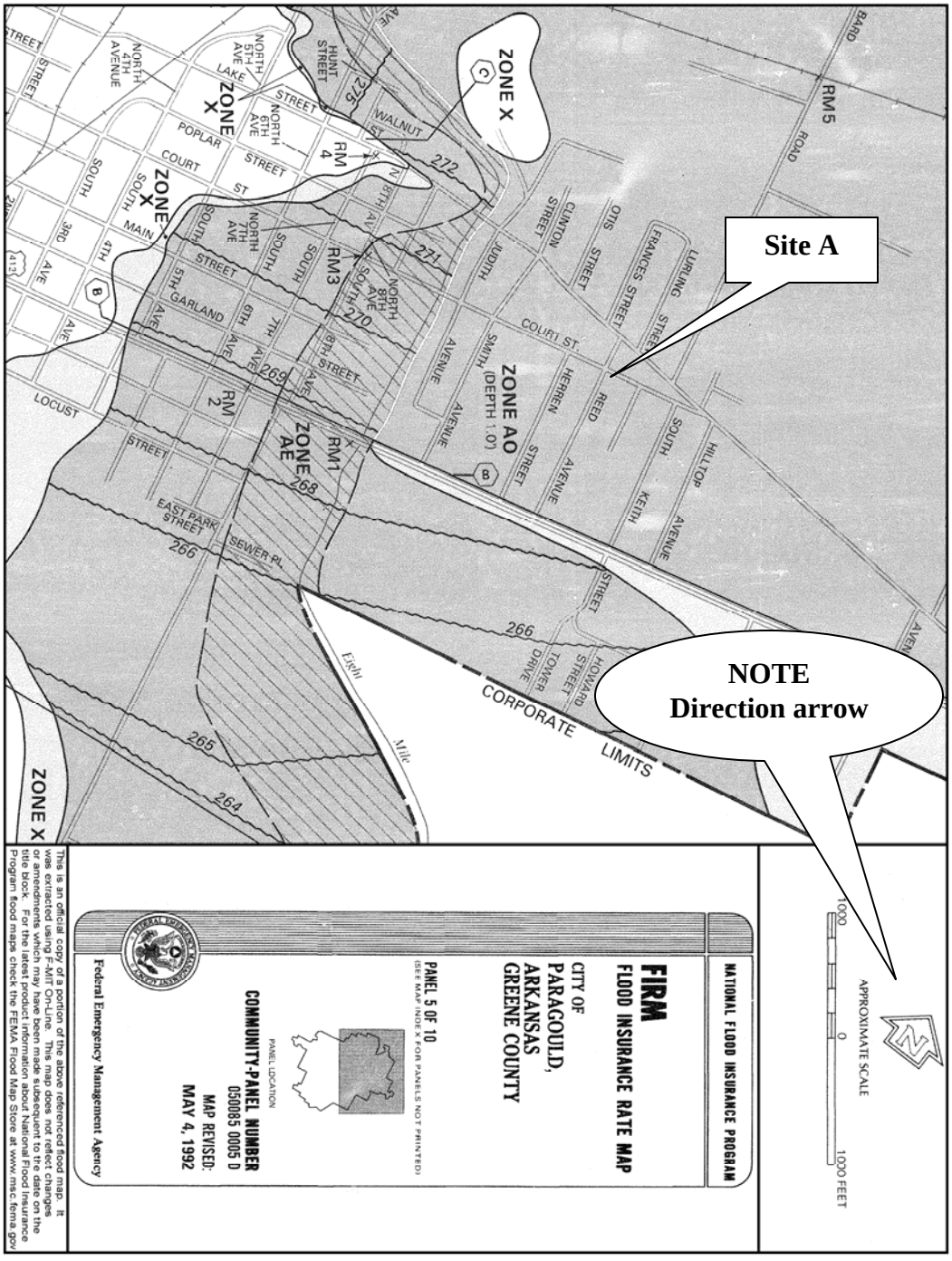


Figure 4.4 Portion of Paragould FIRM Panel 5

BASE FLOOD ELEVATIONS FROM MAPS

BFEs are shown on the FIRMs as whole numbers. For AE Zones, or lake floodplains, use the BFE printed in parentheses below the flood zone designation. *No interpolation is necessary*. The same holds true for AH Zones with whole number base flood elevations.

For other numbered AE Zones, read the BFE from the nearest wavy "base flood elevation line." Refer to the map legend or key if you are unsure of the line markings.

> *For the Site B example, the base flood elevations on the FIRM, are marked "300," above and "299" below the site. We could interpolate to find a correct base flood elevation at Site B based on the distance of the site from the base flood elevation lines. We could also locate the site on the profile based on how far upstream or downstream it is from cross-section C or D. Lastly, we could chose the higher base flood elevation, (e.g., 300') to best ensure protection from flooding.*

Zone A areas indicate approximate floodplain boundaries. No detailed study has been performed to determine base flood elevations in these areas.

> *Note the Zone A area on the map in Figure 4.6. Note there are no base flood elevations. No detailed study was conducted.*

There are no base flood elevations in AO Zones with base flood depths. Instead, the equivalent flood protection level is the number of feet shown in parentheses after the "Zone AO." This is not an elevation above sea level, it is the depth of flooding measured above ground level. The zones are also described in the Paragould FIS report Section 5.0, page 14, *Insurance Applications.*

> *Site A located earlier on FIRM panel 5 is in a large area of Zone AO (Depth 1 feet). The base flood elevation for a site in this zone would be one feet above the highest adjacent grade (HAG).*

LOCATING THE FLOODWAY BOUNDARY

If the site is at a surveyed cross section, floodway width data from the Floodway Data Table may be used as a more accurate measure than field and map measurements. Remember that the width listed in the table is the distance from the floodway boundary on one side of the stream to the floodway boundary on the other side of the stream.

If the floodway width measured on the map at that site is at a cross section, the map should be used because it is the floodway officially adopted by the community. If there is a significant difference between the map width at the site and the closest cross section width in the Floodway Data Table, contact the FEMA Regional Office for an interpretation.

Most sites won't fall conveniently on a cross section, so here are the steps using the map:

- Return to Site B described earlier.

Using the engineer's scale, measure the distance from the floodway boundary to a nearby feature on the ground. For streets, use the center of the street, both on the map and on the ground.

The floodway boundary is approximately 1400 feet south from Reynolds Park Road to Site B.

- If any portion of the building site, proposed grading, fill, bridge, or other obstruction is determined to be within the floodway, the floodway provisions of your ordinance also apply.

  Site B falls inside of the floodway.

Figure 4.5 Map Quest for Paragould for Site B

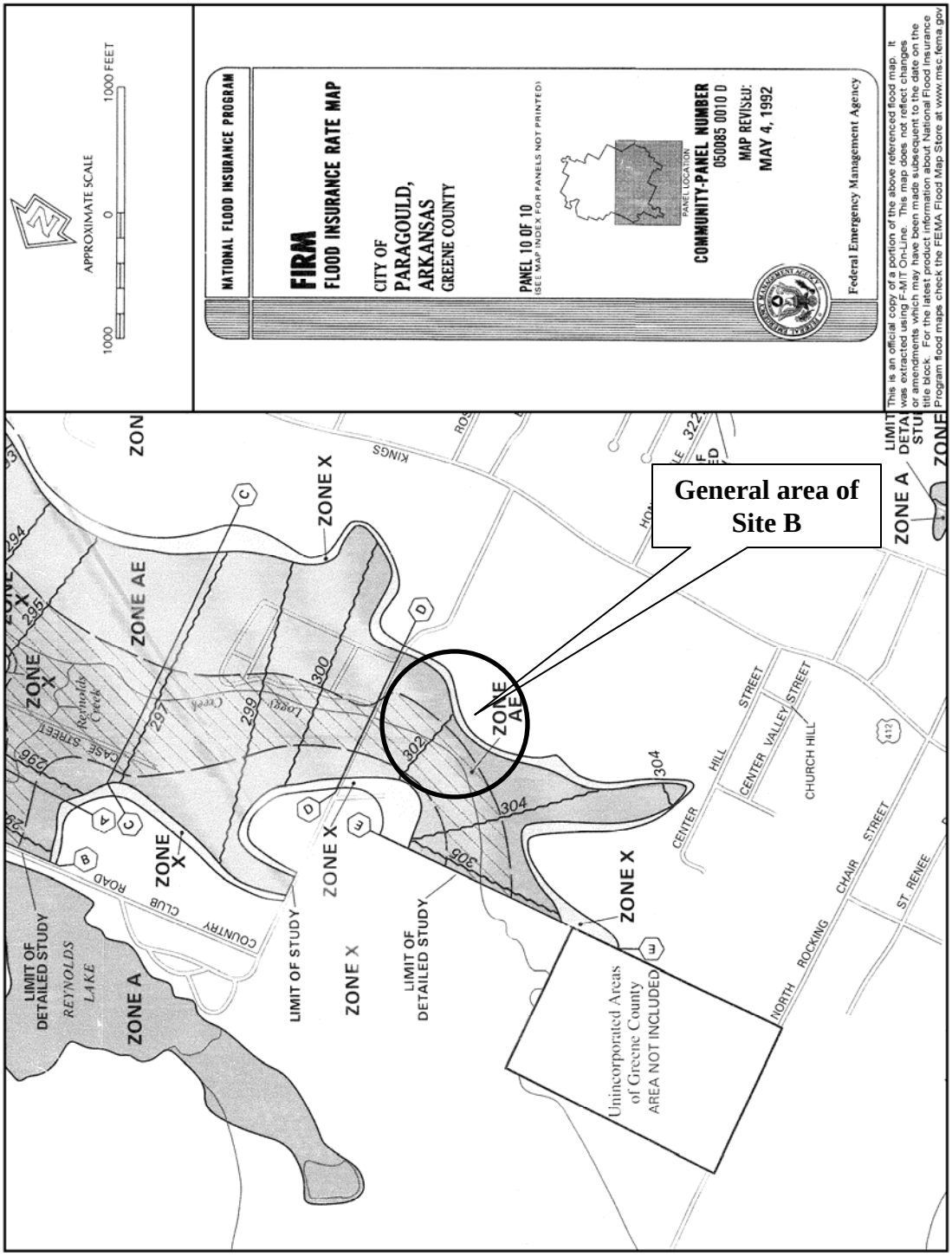


Figure 4.6 Portion of Paragould FIRM Panel 10

C. USING PROFILES

As discussed in Chapter 3, Section B, a flood profile is a graph of computed flood elevations at the floodplain cross sections. It can be used to determine elevations of floods of various frequencies at any location along the studied stream.

PROFILE FEATURES

Four flood levels are typically shown on the flood profile fold-out sheets at the back of the FIS report: the 10-, 50-, 100-, and 500-year (10%, 2%, 1%, and 0.2%) floods. Only the 100- year flood is used for compliance with NFIP standards; the others are useful for other floodplain management applications, such as septic system design and location, bridge and culvert design, urban stormwater management, selecting sites for critical facilities, and determining how frequently a site or facility will flood.

In addition to the flood elevation lines, FIS profile sheets contain:

- a plot of the stream bed elevation,
- the locations of the cross sections used in the FIS and shown on the FIRM (a letter within a hexagon),
- the locations of roads, and
- culverts and bridges (usually depicted as a large “I”).

The data are plotted on a grid to facilitate their interpretation. With few exceptions, the large grid squares are one inch on each side and are divided into 10 squares in both directions. This grid pattern makes taking measurements much easier.

Refer to the profile for Loggy Creek in **Figure 4-8**. The bottom, or x-axis, shows the distance along the river in miles upstream of the confluence with Eight Mile Creek. For this profile, each large square is 0.25 mile (1320 feet) and each little square is 0.025 mile (132 feet).

The left side, or y-axis, shows the elevation in feet NGVD. Each large square represents 5 feet and each small square is 0.5 foot. Be aware that profiles in other FIS reports may have different scales.

Figure 4-7 shows a sample of the data that are plotted on the profile shown for Loggy Creek in Paragould. Before you look at it, measure the distance (in feet) and base flood elevations from the profile for cross-sections C and D.

Cross section	Miles above confluence with Eight Mile Creek	100-Year Flood elevation
C	1.98	297.9
D	2.33	301.8

Figure 4-7: Plotted Data, Flood Profile 02P, Loggy Creek

DETERMINING BASE FLOOD ELEVATIONS

Profiles

Here are the steps to determine the BFE for a site using the flood profiles in the FIS report:

- Using the FIRM, locate features near the site that appear on the profile, such as a bridge or cross section.

  We'll work with the Eight Mile Creek profile at Site C ***(Figure 4-11)****. The site is located at he intersection of East Court Street and N. 9th Avenue* **(Figures 4.9 and 4-10)***. The site is on the east side of N. 9th Street. It is 200 ft. square.*

- Follow the stationing procedures described in the previous section to determine the site's distance from a cross section or other feature that appears on the profile.

  Site C is south of Eight Mile Creek, approximately 1250 feet upstream of cross-section B and approximately 1625 feet downstream of cross-section C.

- Find the feature(s) on the flood profile for that stream.

  Cross-section B is located 12 miles upstream from the confluence of Eight Mile Creek and the St. Francis River. Cross-section C is located at 12.55 miles. E. Court Street is shown on the 01P profile.

- Check the scale used for the profile, and, using the engineer's scale, measure the distance from the feature(s) to the site.

You can use the "50" scale on the engineer's scale, or you can count squares. At this scale, each little square is 0.1 miles (528 feet), so Site C is approximately 2.5 little squares (0.25 miles) upstream (right) of cross-section B.

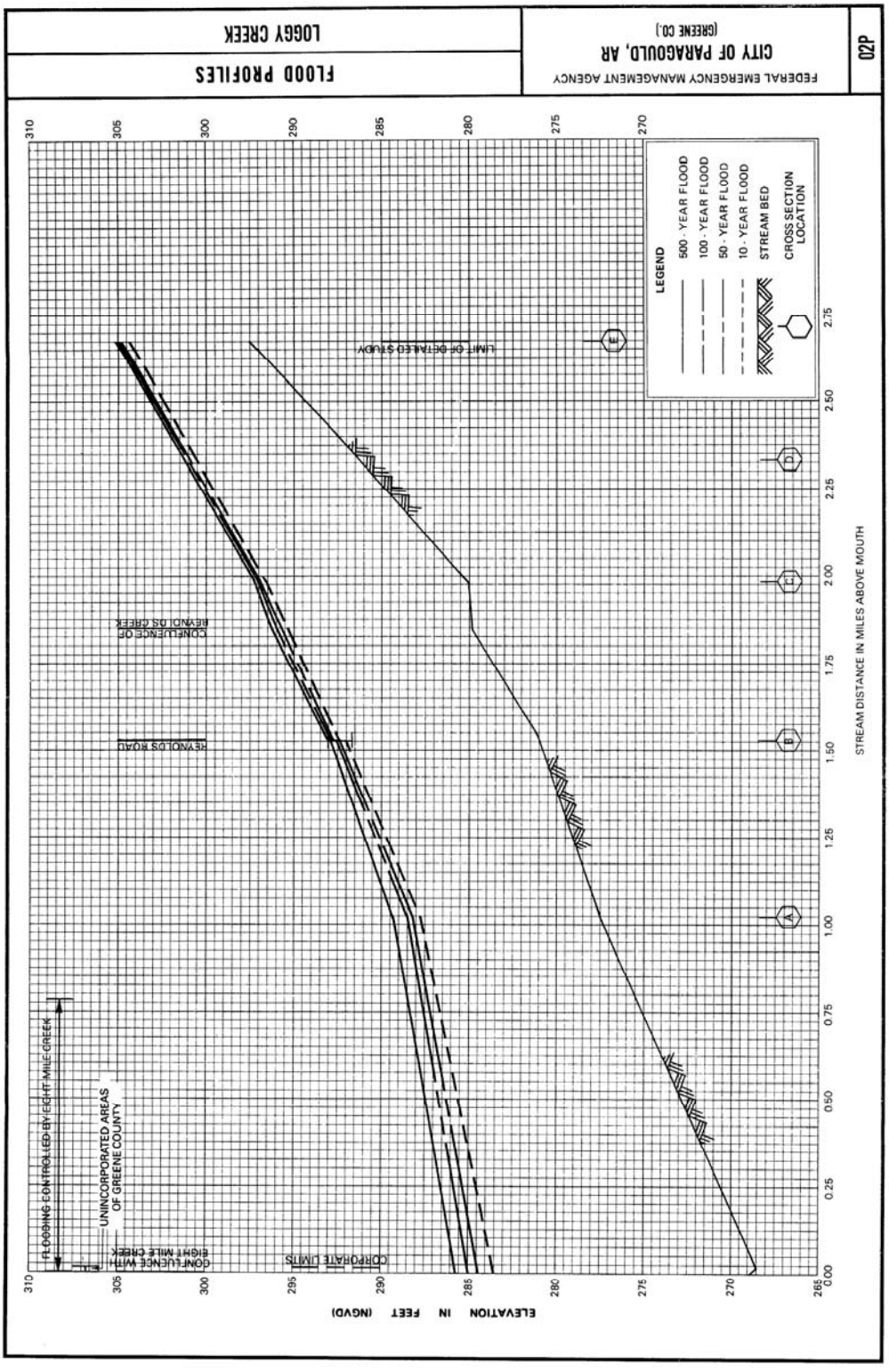


Figure 4-8 Profile for Loggy Creek

Figure 4-9 Map Quest for Paragould along Hwy 412

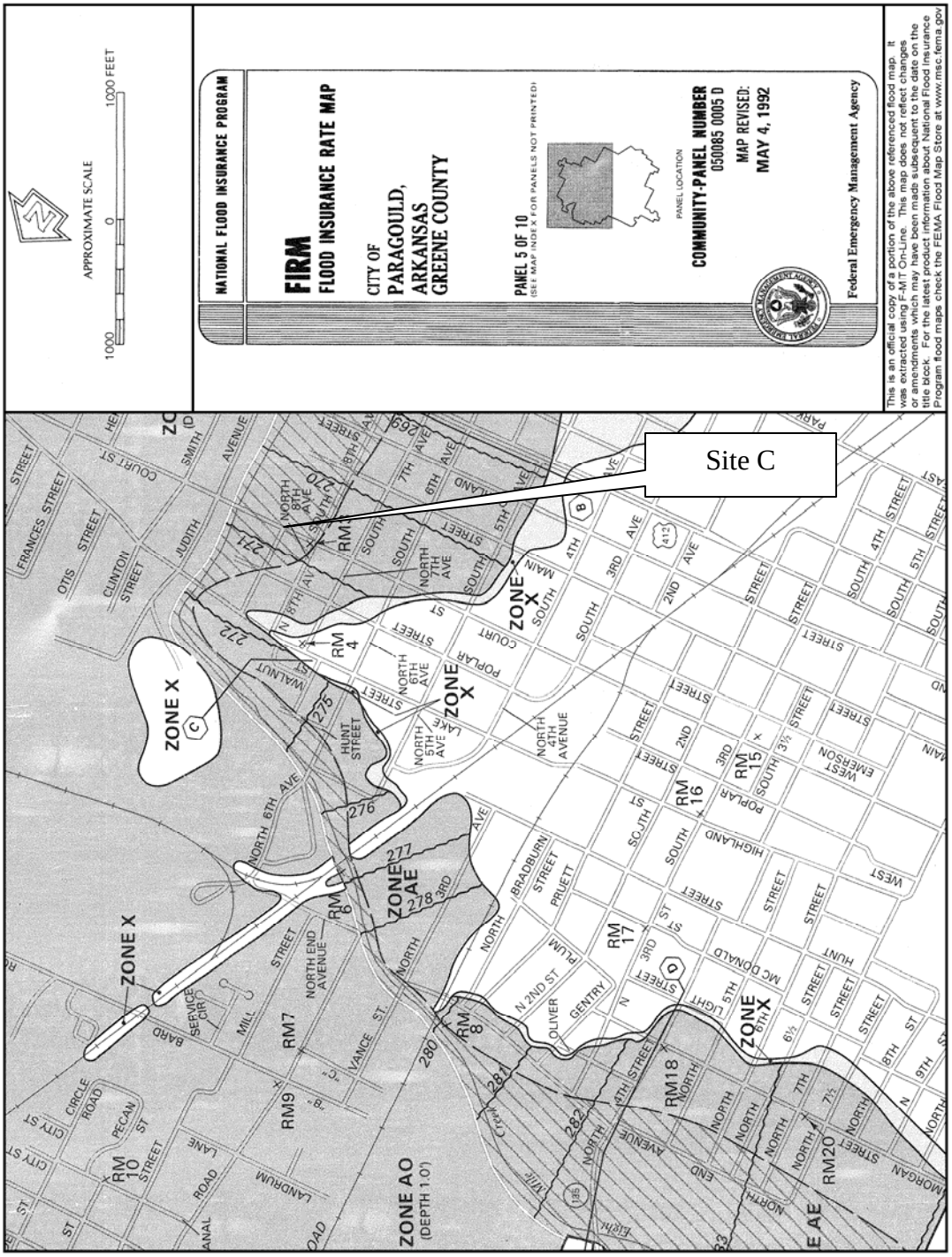


Figure 4-10 Portion of Paragould FIRM panel 5

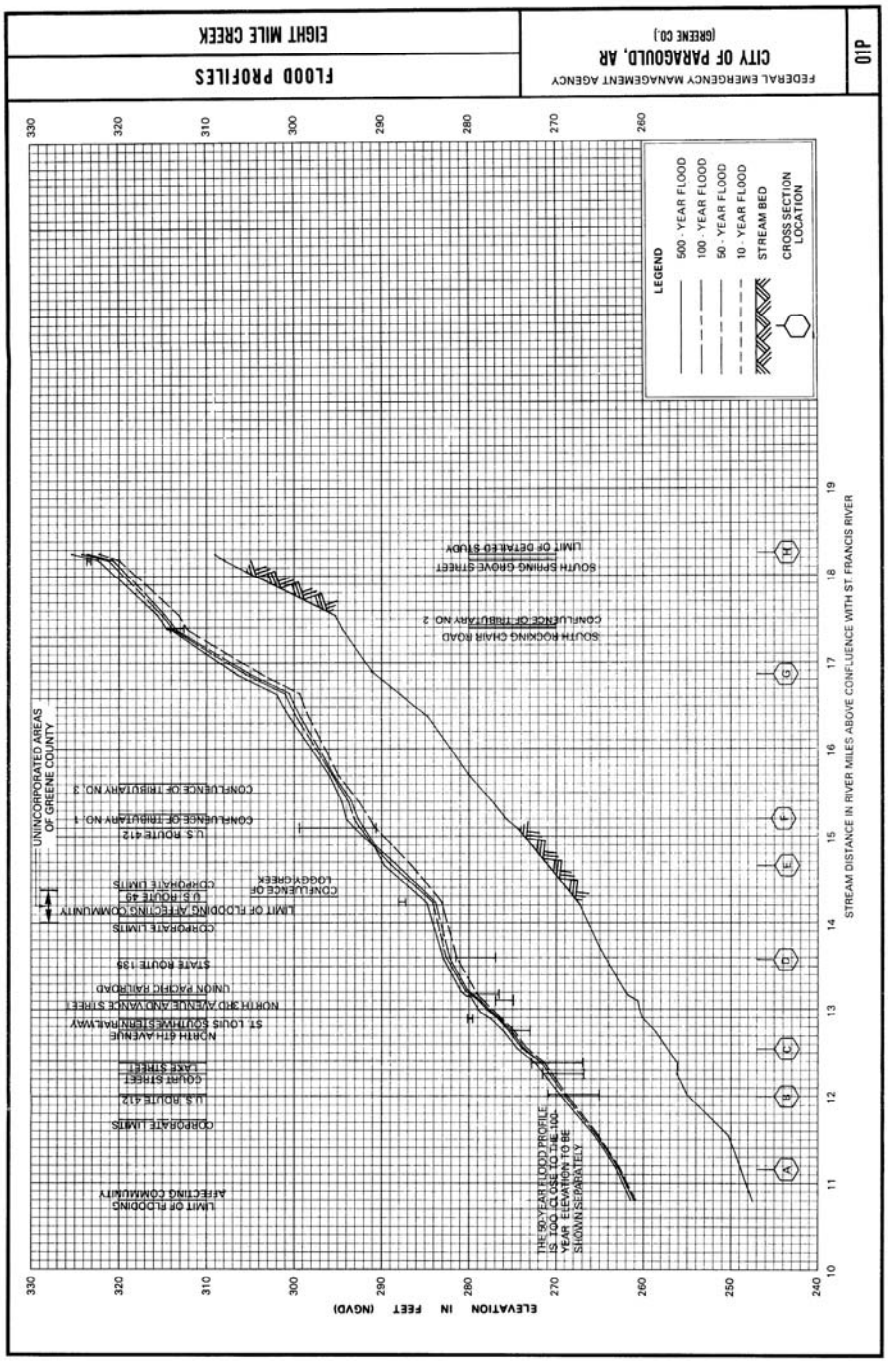


Figure 4-11 Profile for reach of Eight Mile Creek

- Find the site's location on the appropriate flood profile line and read the elevation on the y-axis. You can count squares or use the engineer's scale. Don't forget, the scale on the y-axis is different from the x-axis scale.

For the Eight Mile Creek profile, you may find it easiest to use the "50" scale on the y-axis because it is ten feet to the inch.

- Find where the site intersects the profile. Draw a straight line to the left or right edge of the graph.

  The second line down is the base (100-year) flood profile. Read the flood elevation off either the left or right edge of the page. At Site C, the base flood elevation is 270.5 feet. Check the 10-, 50-, and 500- year elevations and see if you get: 270.3, 270.5 and 270.75, respectively. Wide, flat floodplain often display little change in flood levels for a wide range of flood frequencies.

  Note how this produces a more accurate number than interpolating between the two wavy lines on the FIRM. Instead of guessing the elevation of the site between the BFE lines, we can tell that it is 270.5 feet.

- A surveyor can establish the flood elevation at the site so the owner or builder will know how high the base flood elevation is predicted to be.

  A surveyor can either shoot 270.5 feet at the site or shoot any elevation and tell the owner how high the base flood is in relation to the mark.

Be sure to check each profile's scale before you use it. On Flood Profile 01P in the FIS report for Paragould, the x-axis scale is 1 inch = 1.0 miles and the y-axis scale is 1 inch = 10 feet. Flood Profile 02P covers terrain which is less steep, and the y-axis is at a scale of (1 inch = 5) feet (each little square represents 0.5 foot); the x-axis is 1 inch = 0.25 miles.

Other types of floodplains

In coastal floodplains and areas of shallow flooding (AH or AO Zones), the base flood elevation or depth number is listed in parentheses below the zone designation on the FIRM. Use that elevation because there is no profile for these zones. Except for lake floodplains with stillwater elevation tables to 0.1 foot, the FIRM is the most accurate source for base flood elevations.

Relating flood elevations to the ground

If the site is clearly outside the boundary of the base floodplain, as with Site A, no floodplain regulations apply unless the site adjoins the SFHA and surveyed ground elevations are *below* the base flood elevation.

If it cannot be determined whether the site is in or out of the floodplain, additional information and/or investigation will be needed. In this instance, ground elevation and lowest floor elevations of any structures will be needed for the site, so one who wishes to apply for a Letter of Map Amendment (LOMA) of Letter of Map Revision based on Fill (LOMR-F) may need to hire a surveyor.

A field visit by the local administrator or designee and measurements on the ground may also be required. The actual site elevations are compared to the base flood elevation, read from the FIS flood profiles, for that location.

If the site elevations are above the base flood elevation, the site is outside the floodplain and the applicant should be advised about the map amendment/revision process. If they are lower, it is within the floodplain and subject to the provisions of the ordinance.

It must be noted that banks (and others who must read the FIRM to determine if flood insurance is required) must go by the map. They cannot make on-site interpretations based on data other than the FIRM. However, they may recommend that the property owner submit a request for a LOMR-F or LOMA so the map can be officially changed to reflect the more accurate data (see Chapter 4, Section

RELATING PROFILES TO MAPS

Base flood elevations shown on the FIRM are directly related to elevation data shown on the flood profiles. Within the limits of map accuracy, you should obtain the same elevation whether you use the map or profile.

However, the flood profiles should always be used to determine flood elevations along rivers and streams.

If you find obvious mistakes or discrepancies between the tables, profiles, and FIRM, contact the FEMA Regional Office.

These computations show that the FIRM and the FIS report profile are consistent and provide a double check to make you comfortable with your determination.

D. MAINTAINING AND REVISING NFIP MAPS

NFIP maps are vital to effective enforcement of your floodplain management responsibilities. They are also key to accurate flood insurance rating and fair determinations of the flood insurance purchase requirement.

As the primary repository for NFIP maps, it is important that the community maintain adequate copies and keep them updated. You should have at least one master map that includes all the changes, annexations, map revisions, etc.

It is also important that you keep copies of old, revised maps. They provide a historical record of what was known and the basis of what was required in the past. For example, a property may not have been shown in the SFHA on an old FIRM, so there were no building requirements. If that property is later flooded, you will need to show the old map as the basis for the community's action.

Similarly, people who purchased flood insurance based on the FIRM zone in effect at the time are entitled to keep that FIRM zone as the basis for their rates. You will be doing your citizens a valuable service if you have a copy of an old FIRM.

ORDERING MAPS

Additional copies of your community's FIS report, FIRM, and Floodway Map can be ordered by calling **1-800-358-9616**. The toll-free map distribution center number is staffed Monday through Friday from 8 a.m. to 8 p.m. Eastern Standard Time.

Requests may be faxed to 1-800-358-9620, or mailed to:

Map Service Center
P.O. Box 1038
Jessup, MD 20794-1038

Maps are provided at no charge to local government officials. The FIS report and Floodway Maps must be specifically requested, or only the FIRMs will be sent.

Be prepared to give your Community Identification Number.

CHANGING NFIP MAPS

No map is perfect and no flood situation is static. From time to time, FEMA, communities, or individuals may find it necessary for a FIRM or Floodway Map to be updated, corrected, or changed.

Common reasons why a map may need to be changed include:

- **To correct non-flood-related features,** such as a change in the community's corporate limits. The local government should send the correct information to its FEMA Regional Office. However, the community does not need a new map if it has annexed an area that is shown on an adjacent community's FIRM. It can regulate floodplain development using that FIRM and flood data.
- Since it is expensive to reprint and redistribute flood maps, corporate boundary changes are usually made only when maps are revised for new or better flood data. One way to minimize the need for such changes is for a municipality to adopt the adjacent community's FIRM. This would clarify the regulatory flood data for newly annexed properties and areas in the community's extraterritorial jurisdiction.
- **To include better ground elevation data.** As noted earlier, maps do not always represent site-specific ground elevations. If there is better information on natural ground elevations, the applicant may apply to have the map reflect the better topographic information.
- **To reflect changes in ground elevations in the floodplain.** If there has been a substantial change in ground elevation — for example, fill has been placed in the floodplain to raise building sites above the base flood elevation — the applicant may request a map change to reflect the new ground information.
- **To revise flood data.** A request may be made to revise the existing study, based on a new flood study. The applicant must demonstrate that the original study was in error or that the new study is based on more accurate or better technical data.
- **To submit new flood data.** When a flood study is prepared for a development in an unnumbered A Zone, the data can be submitted to FEMA for later incorporation into the FIS or revised FIRM.
- **To reflect a flood control project.** If a new levee, reservoir, or channel modification affects the flow of the base flood, the community must request that the map be revised to reflect the new conditions or new (lower) base flood elevations. The map cannot be changed until the project is constructed and/or operating.

It is important to note that many small projects, such as channel clearing or retention basins in new subdivisions, do not have a measurable effect on the base flood and, therefore, do not warrant a map change. The request for a change needs to be carefully prepared by an engineer who knows FEMA's flood study guidelines.

It must be remembered that a community participating in the NFIP is obligated by its agreement with FEMA to submit new or revised map information when it becomes available. Section 65.3 of the NFIP regulations states:

A community's base flood elevations may increase or decrease resulting from physical changes affecting flooding conditions. As soon as practicable, but not later than six months after the date such information becomes available, a community shall notify [FEMA] of the changes by submitting technical or scientific data.

Another point to keep in mind is that lenders, insurance agents, and communities must use the published flood maps. Lenders are affected by changes in a FIRM as they enforce the mandatory flood insurance purchase requirements. Communities are affected by changes in a FIRM and a Floodway Map as they enforce floodplain management regulations.

Consequently, uniform procedures have been established for requesting and administering map changes.

TYPES OF CHANGES

FEMA has four approaches to changing NFIP maps: restudies, limited map maintenance projects, amendments, and revisions. Requests for a restudy, amendment, or revision must be approved or made by the community, since they affect the local floodplain management program.

A ***restudy*** is a new Flood Insurance Study for some or all of the community. For example, FEMA may decide to conduct a restudy where development in a small watershed has substantially changed stormwater runoff conditions over the 15 or 20 years since the original FIS was completed. Or a restudy may be needed where growth is occurring along streams without base flood elevations.

A ***limited map maintenance project (LMMP)*** is a small-scale restudy that is limited in size and cost. It is frequently used for studies in unnumbered A Zones.

A ***map revision*** is used for other cases, including:

- scientifically based challenges to the flood elevations
- to incorporate new data that become effective after the construction of a flood control project
- to reflect fill placed in the floodplain after the flood study currently in effect was completed
- to change the floodplain or floodway boundaries
- to include new flood data

An ***amendment*** is used to remove an area that was inadvertently included in the SFHA. Often the ground is higher than depicted on the base map used for the FIRM. This typically happens because of the problem of accurately locating the floodplain boundary on a topographic map. For example, more detailed ground elevation data can be used to amend a FIRM to show a property that is higher than the BFE to be outside the SFHA.

FEMA will make map amendments based on the information submitted by the applicant. Unlike the three other types of changes, an amendment doesn't challenge the FIS or FIRM; it simply removes certain areas or buildings from the SFHA because they are higher than the base flood elevation.

MAPS AND LETTERS

FEMA uses two methods to make flood map changes.

The first is to actually change the map and publish new copies. Here the effective date of a map is changed. A restudy or limited map maintenance project will generally result in a new map. Sometimes revisions and amendments result in a reprinted map. However, republishing the map can be expensive and is done only if the change affects a large area.

The other method is to issue a letter that describes the map change. FEMA does this when the revision can be adequately described in writing or through use of a small, annotated map panel, such as when only one lot or building is affected.

There are two types of ***Letters of Map Change (LOMC)***: a ***Letter of Map Revision***, or ***LOMR***, and a ***Letter of Map Amendment***, or ***LOMA*** . The terms relate to the map changes described in the previous section. A "LOMR-F" refers to a LOMR based on new fill in the floodplain.

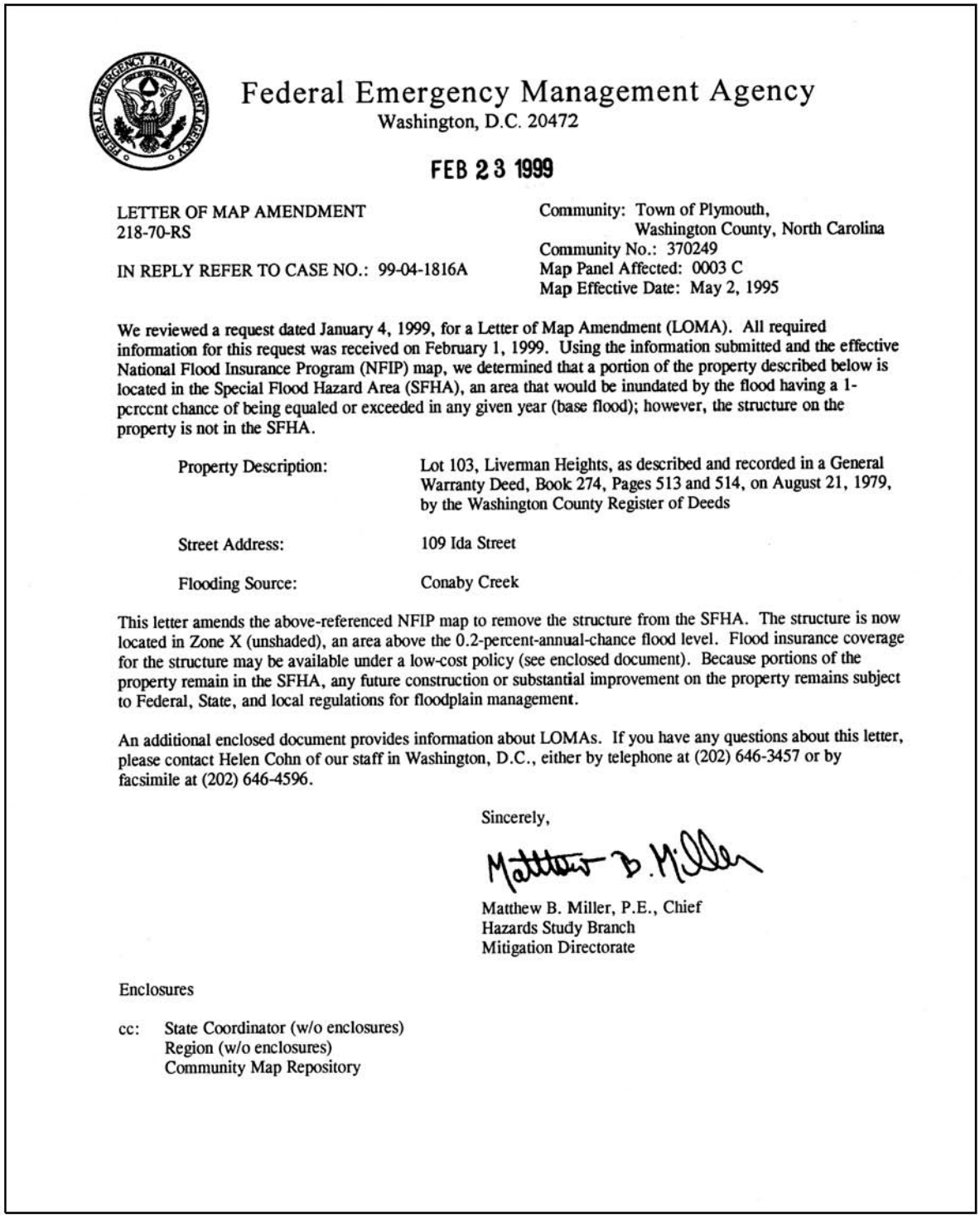
Because such a letter officially amends or revises the effective NFIP map, it is a public record that the community must maintain. Any LOMC should be noted on the community's master flood maps and filed by panel number in an accessible location.

If provided with a legal description of the land area above the BFE, FEMA can issue a LOMC for only a portion of the parcel. Or, a LOMC might state that only a specifically described portion (i.e. the front 70 feet with the exception of any recorded easements), is removed from the SFHA. However, the LOMC might then also state that portions of the rest of the property remain within the SFHA, subject to all floodplain management regulations.

NFIP maps are not changed based on *proposed* projects. However, an applicant may request a ***Conditional Letter of Map Revision (CLOMR)*** or a ***Conditional Letter of Map Revision based on Fill (CLOMR-F)*** based on proposed plans. A ***Conditional Letter of Map Amendment (CLOMA)*** can be requested for a vacant lot. These conditional letters inform the builder and others (such as the bank financing the project) that when the project is completed, it will qualify for a LOMR, LOMR-F, or LOMA. A LOMR, LOMR-F, or LOMA will still be required to officially change the NFIP map.

A processing fee is charged for LOMRs, CLOMRs , LOMR-Fs, and CLOMR-Fs and CLOMAs. There is no fee for requesting a LOMA.

An example of a LOMA is in **Figure 4-12**. For this site, the owner supplied the survey data needed to show that the lowest grade adjacent to his house was higher than the base flood elevation shown on the FIRM. Because the request affects only one property, a letter can be issued that describes the property and the type of map change ("This letter amends the above-referenced NFIP map to remove the structure from the SFHA.").



Federal Emergency Management Agency
Washington, D.C. 20472

FEB 23 1999

LETTER OF MAP AMENDMENT
218-70-RS

IN REPLY REFER TO CASE NO.: 99-04-1816A

Community: Town of Plymouth,
Washington County, North Carolina
Community No.: 370249
Map Panel Affected: 0003 C
Map Effective Date: May 2, 1995

We reviewed a request dated January 4, 1999, for a Letter of Map Amendment (LOMA). All required information for this request was received on February 1, 1999. Using the information submitted and the effective National Flood Insurance Program (NFIP) map, we determined that a portion of the property described below is located in the Special Flood Hazard Area (SFHA), an area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood); however, the structure on the property is not in the SFHA.

Property Description:	Lot 103, Liverman Heights, as described and recorded in a General Warranty Deed, Book 274, Pages 513 and 514, on August 21, 1979, by the Washington County Register of Deeds
Street Address:	109 Ida Street
Flooding Source:	Conaby Creek

This letter amends the above-referenced NFIP map to remove the structure from the SFHA. The structure is now located in Zone X (unshaded), an area above the 0.2-percent-annual-chance flood level. Flood insurance coverage for the structure may be available under a low-cost policy (see enclosed document). Because portions of the property remain in the SFHA, any future construction or substantial improvement on the property remains subject to Federal, State, and local regulations for floodplain management.

An additional enclosed document provides information about LOMAs. If you have any questions about this letter, please contact Helen Cohn of our staff in Washington, D.C., either by telephone at (202) 646-3457 or by facsimile at (202) 646-4596.

Sincerely,

Matthew B. Miller

Matthew B. Miller, P.E., Chief
Hazards Study Branch
Mitigation Directorate

Enclosures

cc: State Coordinator (w/o enclosures)
Region (w/o enclosures)
Community Map Repository

Figure 4-12: First page from a Letter of Map Amendment

REQUESTING MAP CHANGES

If you want a restudy or a limited map maintenance project, call your FEMA Regional Office or State NFIP coordinator and ask about the procedures.

If you want a map changed to reflect a new study that has already been done or to reflect better ground elevation data, use one of the following FEMA forms.

MT-1: Letter of Map Amendment (LOMA)
Conditional Letter of Map Amendment (CLOMA)
Letter of Map Revision (Based on Fill) (LOMR-F)
Conditional Letter of Map Revision (Based on Fill) (CLOMR-F)

MT-2: Letter of Map Revision (LOMR)
Conditional Letter of Map Revision (CLOMR)
Physical Map Revision

MT-EZ: Letter of Map Amendment (LOMA) for a single lot
Letter of Map Revision (Based on Fill) (LOMR-F) for a single lot

The MT-EZ is the shortest and simplest of the three forms. A copy is included in Appendix F. This is the form that would be used to request a LOMA like the one in Figure 4-6. A land surveyor is needed to certify the elevation data. Appendix F also includes a handout that explains the map change policies to property owners.

The building elevation certification requires some information not normally required on a FEMA Elevation Certificate, specifically, the lowest elevation on the parcel. This requirement is in addition to the lowest grade adjacent to the structure (including attached decks) and the lowest floor elevation (including the garage, crawlspace, or basement).

If the garage, crawlspace, or basement floor is below the base flood elevation and the building was built on fill that was placed in an identified SFHA, FEMA cannot issue a LOMA or LOMR even though the post-fill lowest adjacent grade is above the base flood elevation.

Except for the MT-EZ, requests for map changes should be completed by a qualified engineer or surveyor. The most common reason that a map change request is not completed is that the applicant did not submit adequate technical data to validate the change.

> Note that a bank still has the prerogative to require the purchase of a flood insurance policy on a building that has been removed from the SFHA. The bank can require flood insurance as a condition of the loan in order to protect its investment in the property. For example, lenders in Florida typically still require flood insurance coverage for structures determined to be in shaded Zone X or Zone B.

Filled, unimproved land can be removed from SFHA on only the basis of the filled elevation, if no construction of a structure has begun when the request is submitted to FEMA.

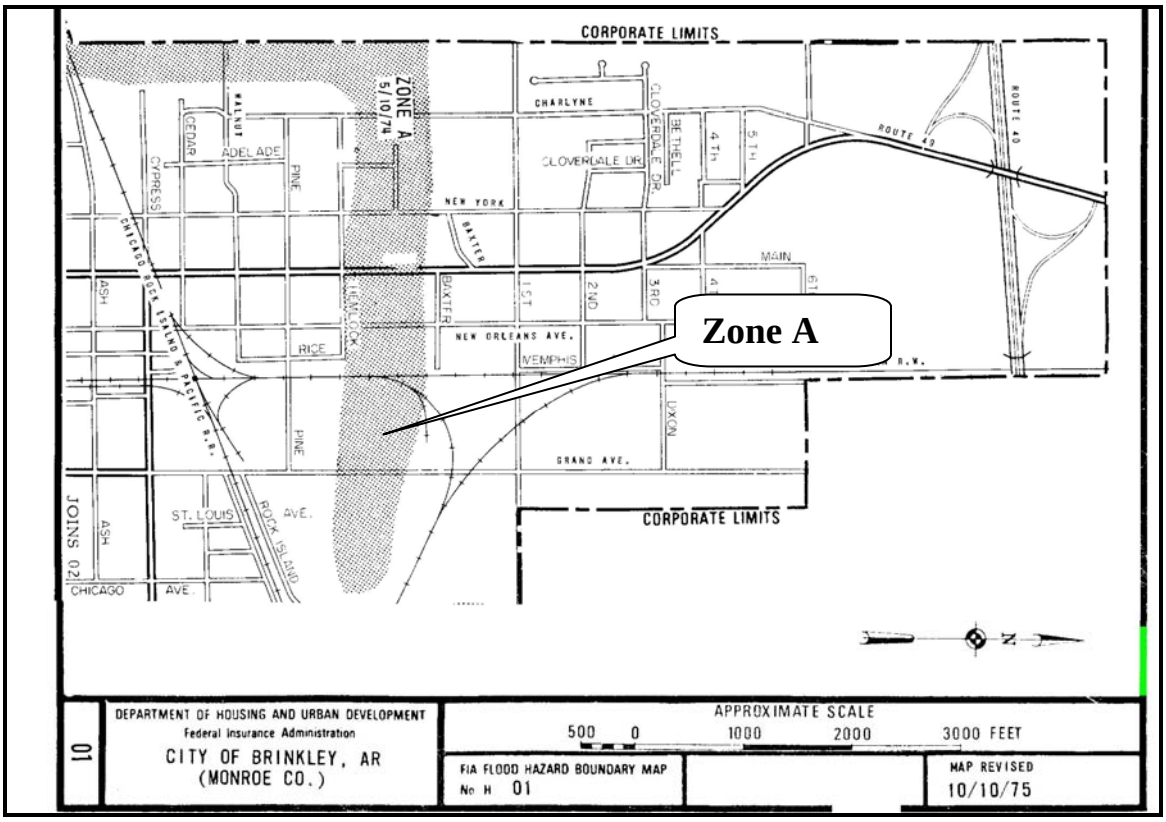
Effective June 4, 2001, FEMA revised to process for issuing Letters of Map Revision (Based on Fill) (LOMR-F) to require assurances from the community that, for the area to be remove from the floodplain, all requirements of 44 CFR 60.3 have been met and that any existing or proposed structures in that area will be "reasonably safe from flooding." If the community cannot make these assurances, the LOMR-F will not be processed. Further guidance on the community's responsibility for making these assurances can be found in Volume 3 (Chapter 5) and in the MT-2 instructions and Technical Bulletin 10-01 *Ensuring That Structures Built on Fill in or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding.*

Additional information on map changes can be found in *Answers to Questions about the National Flood Insurance Program*, questions 81 – 95.

ARKANSAS INSERT 2

GUIDANCE TO DETERMINING BASE FLOOD ELEVATIONS IN APPROXIMATE ZONE A AREAS IN ARKANSAS

Approximate Zone A or Unnumbered Zone A refers to Special Flood Hazard Areas (SFHAs) shown on Flood Insurance Rate Maps (FIRMs) produced by the Federal Emergency Management Agency (FEMA) which show areas subject to flooding by the 1% chance or 100-year flood, but which do not include the base flood elevation (elevation of the 1% chance or 100-year flood). They present considerable difficulty to local permit officials in determining how high to require structures to be elevated or floodproofed "to or above the base flood level". This guide provides examples of methods which may be used to "determine" or "estimate" the base flood elevation (BFE) in Approximate Zone A areas.



FEMA has published a document entitled, **"Managing Floodplain Development in Approximate Zone A Areas: A Guide for Obtaining and Developing Base (100-Year) Flood Elevations," FEMA Publication 265/July 1995**. This publication is available online on FEMA's website www.fema.gov or it can be ordered from the same website. This publication contains what are described a "simplified" methods and "detailed" or engineering methods. Some of this guide will utilize methods from FEMA 265.

This guide focuses on obtaining BFEs from published documents, government agencies, and private consultants (short of a detailed engineering analysis) and simplified methods which may be utilized in-house.

REGULATIONS REGARDING OBTAINING AND USING BFES FOR APPROXIMATE ZONE A AREAS

Local flood damage prevention ordinances or codes are based on Federal regulations contained principally in 44 Code of Federal Register (CFR), Section 60.3. For Approximate Zone A areas, Section 60.3 (b) is the relevant part. This section also references other sections to convey the context of the regulations. Below are some segments that are directly related to this guide:

Section 60.3 (b) (3)

> ***"Require that all new subdivision proposals and other proposed developments (including proposals for manufactured home parks and subdivisions) greater than 50 lots or 5 acres, whichever is the lesser, include within such proposals base flood elevation data;"***

Section 60.3 (b) (4)

> ***"Obtain, review and reasonably utilize any base flood elevation and floodway data available from a Federal, State, or other source, including data developed pursuant to paragraph (b)(3) of this section, as criteria for requiring that new construction, substantial improvements, or other development in Zone A on the community's FHBM or FIRM meet the standards in paragraphs (c)(2), (c)(3), (c)(5), (c)(6), (c)(12), (c)(14), (d)(2) and (d)(3) of this section;"***

Paraphrasing the above section to reference selected elevation criteria by inserting wording form cited paragraphs above;

> ***"Obtain, review and reasonably utilize any base flood elevation and floodway data available from a Federal, State, or other source, including data developed pursuant to paragraph (b)(3) of this section (subdivisions), as criteria for requiring that new construction and substantial improvements of residential structures have the lowest floor (including basement) elevated to or above the base flood level; require that all new construction and substantial improvements of non-residential structures within Zones A1-30, AE and AH zones on the community's firm (i) have the lowest floor (including basement) elevated to or above the base flood level or, (ii) together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; …; require that manufactured homes … be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist floatation collapse and lateral movement; …"***

Essentially, Section 60.3 (b)(4) requires that the lowest floor of structures be elevated to or above the base flood level. For non-residential structures, floodproofing is permitted; and there are more complicated criteria for manufactured homes as described in Sections 60.3 (c)(6) and (12). In order for this requirement to be met, both the base flood elevation and the elevation of the lowest floor must be determined. Since he lowest floor is based on the level of the base flood, the real problem is to determine the base flood elevation.

SOURCES AND METHODS OF DETERMINING OR ESTIMATING THE BASE FLOOD ELEVATION

> ***"Although BFEs are not provided, the community is still responsible for ensuring that new development within approximate Zone A areas is constructed using methods that will minimize flood damages."*** FEMA 265, page I-1

The community should establish procedures for determining or estimating the BFE. (Some methods may be said to actually determine a base flood elevation. Others are considered less rigorous and produce what would be best described as estimates.) For example, the local floodplain administrator may require the developer to employ a surveyor or engineer to utilize FEMA 265 or acceptable engineering methods to provide a BFE. A BFE provided by a Federal agency, such as the U.S. Army Corps of Engineers, Natural Resources Conservation Service or U.S. Geological Survey, may be considered as acceptable.

Recommendations for choosing sources and methods will be given at the end of this guide.

1. Sources of Base Flood Elevation Data: Publications and Agencies

• U.S. Army Corps of Engineers

Three (3) Corps districts operate within the State of Arkansas. They are:

- o Little Rock District 501-324-5531
- o Memphis District 901-544-3221
- o Vicksburg District 601-631-5010

The Corps has many sources of flood data. These include numerous publications and file documents. In addition, these districts may research flood data upon request by a local government official. The Corps also has cost-sharing programs to conduct floodplain management studies. Floodplain administrators should become familiar with the Corps personnel who are contacts for information on floodplain management.

• Natural Resources Conservation Service (NRCS) – formerly known as the Soil Conservation Service (SCS)

The NRCS has a presence in all 75 counties in Arkansas. Staff are housed in the County Conservation District Office, usually in a U.S.D.A. complex. NRCS has technicians and engineers who may provide assistance. Floodplain administrators should get to know their District Conservationist.

NRCS has produced several floodplain management studies which contain BFEs that can be used for Approximate Zone A areas.

Phone: 501-301-3100

• U.S. Geological Survey

U.S.G.S. maintains an office in Little Rock. U.S.G.S. is the primary collector of flood elevation data through a network of stream gages. These data are published in books and are also available over the Internet. The U.S.G.S. also publishes topographic maps which show surface elevations using contour lines and spot elevations.

Arkansas Water Science Center: 501-228-3600

• Arkansas Highway and Transportation Department

In designing highways and bridges, the AHTD conducts hydrologic and hydraulic studies to determine flood heights for the required design storm. For major highways and bridges, this may be the 100-year flood.

Phone: 501-569-2589

• Other sources of published flood information and assistance

- o Local public works departments
- o Private engineers

2. Simplified Methods

• High water marks

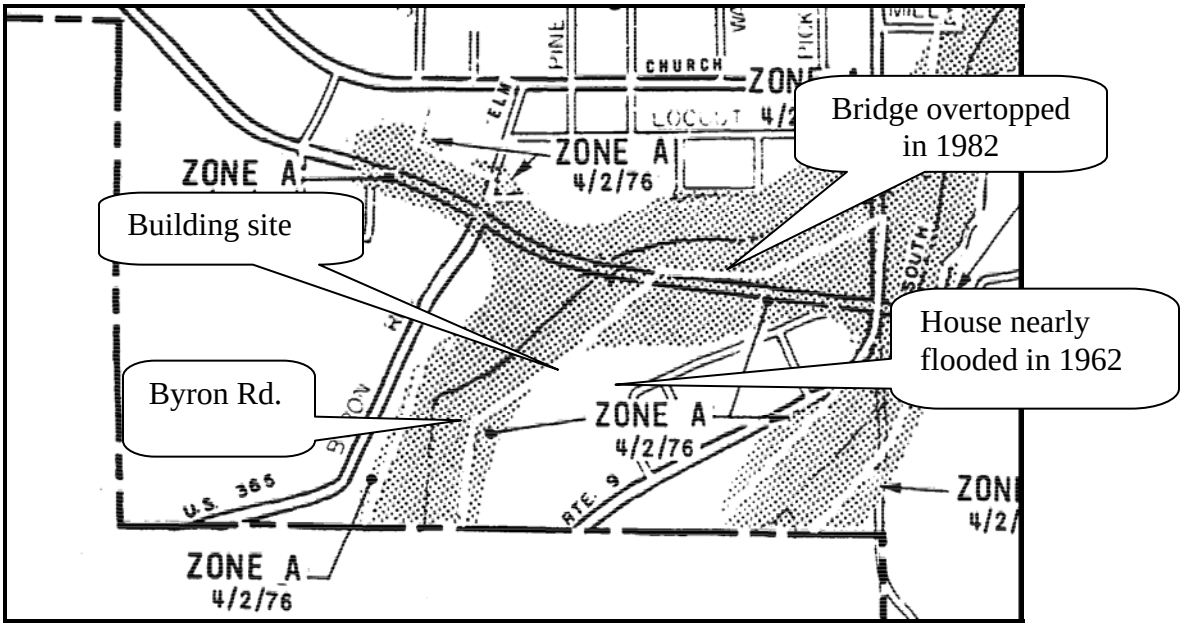
High water marks from major flood events could be used to estimate the 100-year flood. Preferably, there should be a way to determine if the frequency for the flood.

Example 1: Salem, Arkansas

On the following page there is a portion of the FIRM for Salem, Arkansas. A building was proposed for a site along the Byron Rd.

In 1982 and 1962, there were memorable flood events in Salem. In 1982, observers obtained high water marks from a bridge which was monitored throughout the storm. In 1962, a homeowner who lived across the creek watched water get up to the threshold on his front door before floodwaters receded.

Published maps in the National Weather Service (NWS) Technical Paper No. 40, commonly known as "TP-40", indicated the 100-year rainfall for the areas is 7.5 inches. Rainfall for the 1982 and 1962 storms equaled or exceeded this amount from rain gages maintained by the NWS. The creek drains a small area where the rainfall would be close to the measured amounts, so that it is reasonable to expect that the flood produced for each event was the 100-year flood. Therefore, the high water marks could be used to extend to the proposed building site. Adjustments would need to be made for distances upstream and downstream of the site. Even if the depth of floodwaters is the same, since the ground elevation increases going upstream, the flood elevation would increase also.
In using the depth of the water over the bridge, backwater effects may need to be considered. Again, this method should be used with caution and experience with basic principals of hydraulics would be helpful.

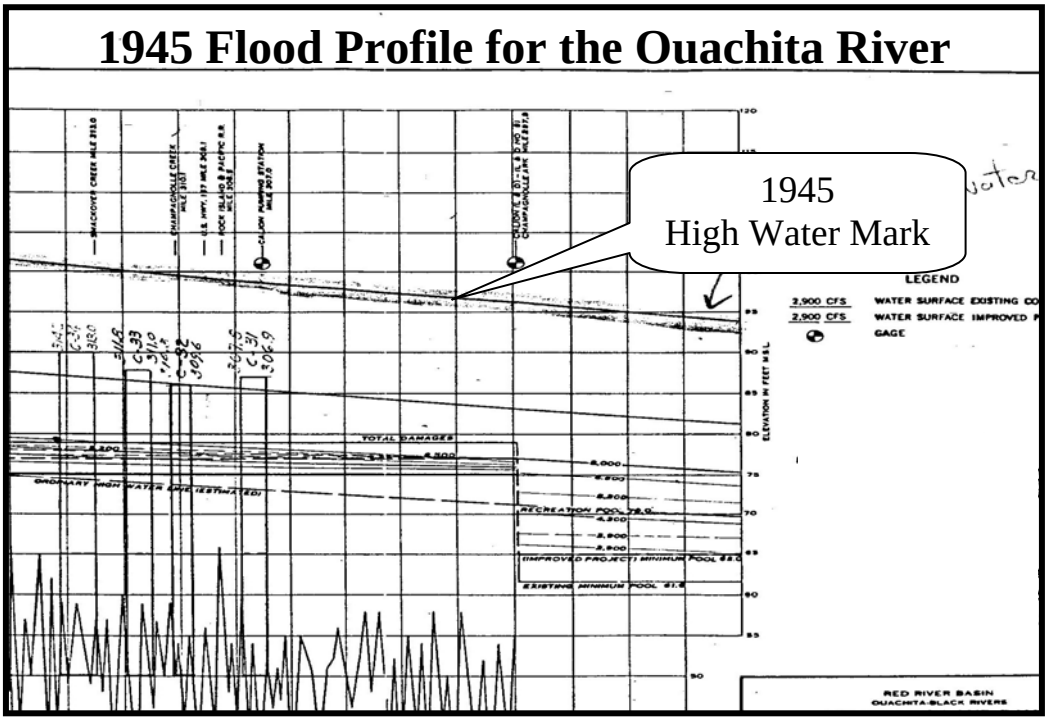


Example 2: Williford, Arkansas

The elevation of the same 1982 flood in Salem is recorded by a stain on the wall inside the Williford post office. A surveyor can use this as a benchmark for building sites in Williford that are affected by the Spring River.

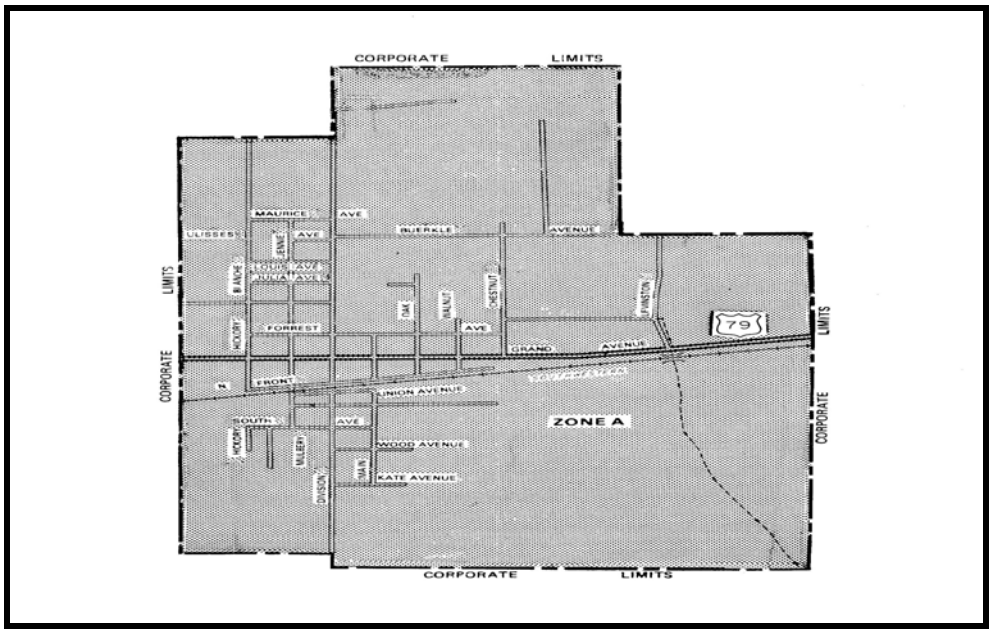
Example 3: Ouachita River

The Corps of Engineers has elevation profiles of the 1945 flood on the Ouachita River. For portions of the Ouachita River where 100-year flood elevations have been determined, the 1945 flood is almost exactly equal to the 100-year flood. Therefore, the 1945 flood profile would be a reasonable estimate for the 100-year flood elevation along the Ouachita River.



Example 4: Humphrey, Arkansas

As the following FIRM shows, the entire City of Humphrey is within the Special Flood Hazard Area (SFHA), in this case, Zone A. There are no flood elevations on the map or areas outside the floodplain to compare with. Fortunately, there is a stream gage on the nearby Crooked Creek just east of town.



The data table which follows the FIRM shows the high water mark for each year between 1939 and 1980. The height is given above a gage with a zero "0" elevation at 169.94 ft. above sea level. The high water mark for the entire period of record occurred on February 18, 1950 at 23.51 ft. on the gage. Adding the gage reading to the 169.94 ft. gives a flood elevation of 193.45 ft.

While the land in this area is very flat over a large area, it is not certain that the 193.45 ft. extended across the City of Humphrey. If local residents can recall high water in the City during that flood event or for other years when the flood heights were 1-2 ft. below the record in 1950, a flood elevation could be estimated for the City.

In addition to using the high water mark during the period of record, the gage data may be used to determine a 100-year flood using statistical analysis. This is a fairly simple task for someone with knowledge of statistics.

07265000 Crooked Creek near Humphrey, Arkansas

Location.--Lat 34°25'35", long 91°40'04", in SE 1/4 sec.20, T.3 S., R.6 W., near center of span on downstream side of bridge on U.S. Highway 79, 100 ft upstream from St. Louis-Southwestern Railway bridge, 2 mi east of Humphrey, and at mile 5.8.

Drainage area.--79.2 mi^2.

Gage.--Nonrecording gage October 1, 1938 to June 19, 1950, and since September 30, 1954. Recording July 20, 1950 to September 30, 1954. Datum of gage is 169.94 ft above sea level.

Bankfull stage.--20 ft.

Remarks.--See Bayou Meto near Stuttgart.

07265000 Crooked Creek near Humphrey, Arkansas

Water year	Date	Gage height (feet)	Discharge (cubic foot per second)
1939	02-15-39	22.70	1,780
1940	02-22-40	16.20	585
1941	04-26-41	16.68	528
1942	04-29-42	20.46	1,100
1943	03-27-43	18.59	767
1944	04-05-44	20.04	1,180
1945	04-08-45	21.62	1,610
1946	01-20-46	22.05	1,740
1947	05-28-47	15.90	422
1948	03-06-48	21.84	1,760
1949	02-06-49	22.73	1,880
1950	02-18-50	23.51	2,010
1951	01-19-51	20.61	1,330
1952	03-15-52	18.52	883
1953	05-21-53	21.97	1,820
1954	01-31-54	19.51	1,250
1957	02-08-57	22.40	1,950
1958	05-10-58	22.82	2,080
1959	02-28-59	20.92	1,490
1960	07-04-60	21.82	1,760
1961	04-15-61	21.59	1,700
1962	03-06-62	21.95	1,820
1963	03-19-63	16.51	507
1964	04-30-64	22.40	1,950
1965	02-19-65	20.51	1,380
1966	05-06-66	21.15	1,580

07265000 Crooked Creek near Humphrey, Arkansas--Continued

Water year	Date	Gage height (feet)	Discharge (cubic foot per second)
1967	05-12-67	19.86	1,270
1968	05-26-68	22.11	1,920
1969	02-12-69	21.34	1,670
1970	01-08-70	19.10	1,180
1971	08-07-71	15.80	690
1972	12-20-71	16.84	900
1973	05-03-73	22.07	2,370
1974	12-10-73	21.10	2,070
1975	03-31-75	20.32	1,830
1976	03-12-76	17.32	1,010
1977	03-16-77	15.86	700
1978	01-31-78	17.65	1,090
1979	06-06-79	21.10	2,070
1980	04-01-80	18.90	1,420

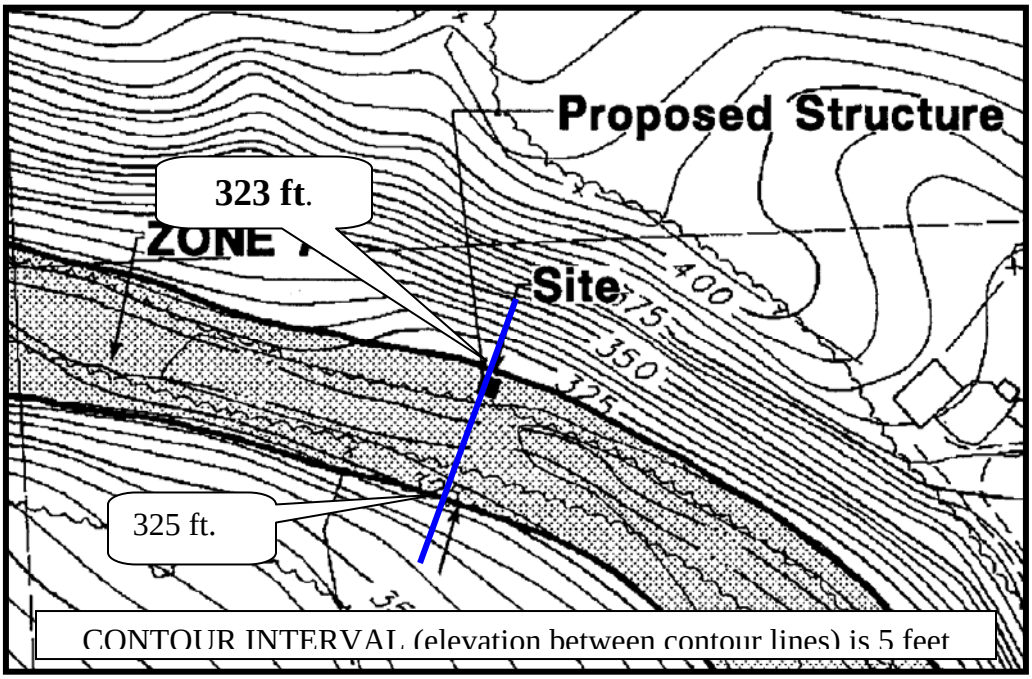
Record Flood Height for Period of Record

Year	Date	Gage Height (ft.)	Streamflow (cfs)
1950	02-18-50	23.51	2,010

• Contour interpolation

Contour interpolation involves superimposing approximate Zone A boundaries onto a topographic map in order to estimate a BFE. BFEs obtained by this method can only be assumed to be as accurate as one-half of the contour interval of the topographic map that is used. Therefore, the smaller the contour interval of the topographic map, the higher the accuracy of the BFE determined from the map.

1. Obtain a topographic map showing the site being analyzed
2. Reduce or enlarge the FIRM or topographic map as necessary so that the two are at the same scale
3. Superimpose (overlay) the approximate Zone A (100-year) flood boundary from the FIRM onto the topographic map
4. Determine if this method is within the acceptable accuracy limits. The floodplain boundary must generally conform with the contour lines along the flooding source in question. The difference between the water-surface elevations determined on the right overbank and the left overbank must be within one-half of the map contour interval. Otherwise, this method is not acceptable. (For lake flooding sources, the difference between the highest and lowest determined water-surface elevations around the flooding source must be with one-half of the map contour interval.)
5. If the method is acceptable, the determine the BFE.



• Determining BFEs for Riverine flooding:

On each side of the stream in the vicinity of the site, determine the ground elevation at which the superimposed Zone A boundary lies by interpolating between two contour lines. Add one-half of the map contour interval to the lower of the two interpolated elevations. This is the approximate BFE for the site (be sure to perform this method at each structure location). By adding one-half of the contour interval to the lowest interpolated elevation, two things are achieved:

1) The final BFE is within one-half of the contour interval of both interpolated water-surface elevations and, therefore, is still within the acceptable tolerance of the topographic map (generally regarded as ± one-half of the map contour interval);
2) It is a conservative estimate of the BFE. If the BFE determined under this procedure seems too high, then a detailed analysis may be performed to justify lowering it.

In the example above, the flood elevation is 323 ft. above mean sea level on one side of the floodplain and 325 ft. on the other. The contour interval is 5 ft. Since the difference between the two elevations is 2 ft., which is less that one-half the contour interval (5/2=2.5 ft.), the contour method is acceptable to estimate the BFE.
The BFE is determined by adding one-half the contour interval to the lowest elevation (2.5 ft. + 323 ft. = 325.5 ft.). The BFE is estimated to be 325.5 ft. above mean sea level.

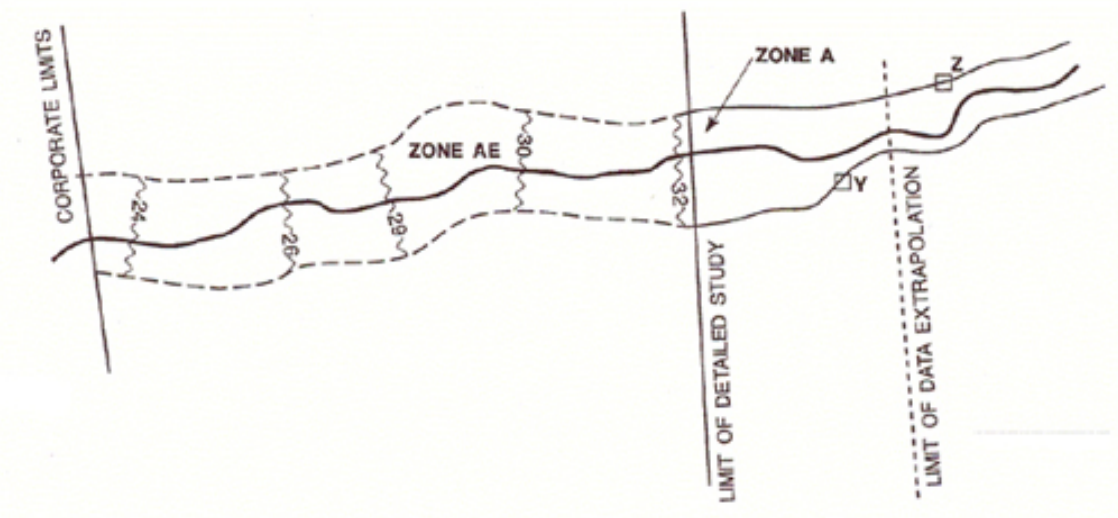
This method works best for topographic maps with small contour intervals.

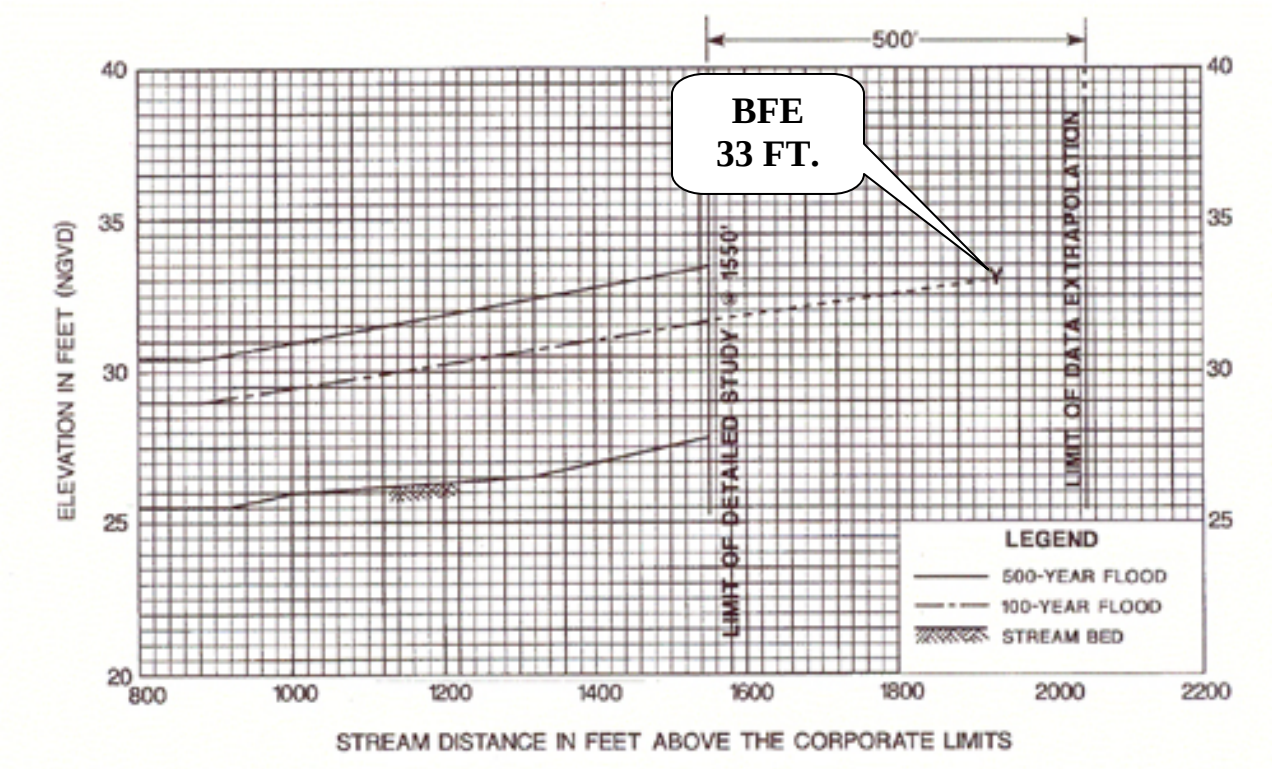
• Data Extrapolation

If a site is within 500 feet upstream of a stream reach for which a 100-year flood profile has been computed by detailed methods, and the floodplain and channel bottom slope characteristics are relatively similar to the downstream reaches, data extrapolation may be used to determine the BFE. The stream in the vicinity of the site, however, must be free of backwater effects from downstream hydraulic structures. The procedure for using this method is outlined below.

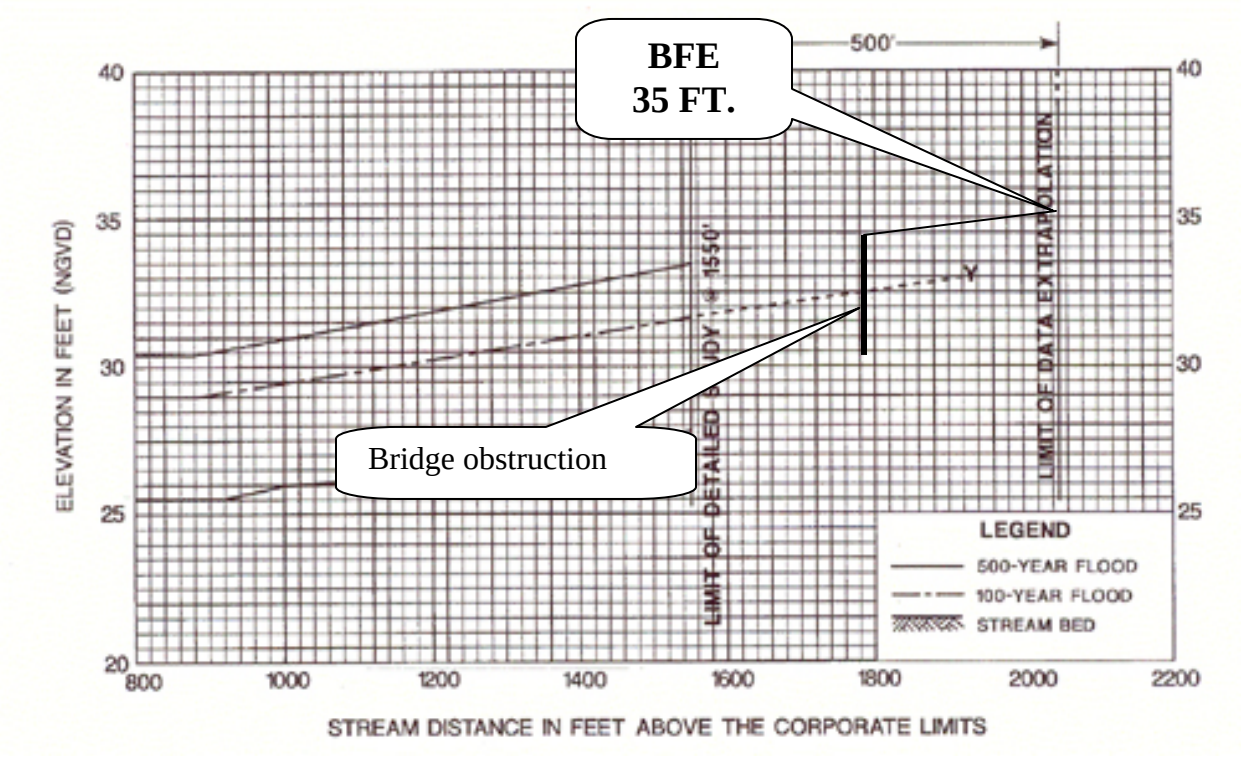
Step 1 - Determine the location of the site on the flood profile for the detailed study stream

Step 2 - Extrapolate the last segment of the 100-year flood profile that has a constant water-surface slope to the location of the site. The BFE at the site can then be obtained directly from the profile


CORPORATE LIMITS
ZONE A
ZONE AE
Z
Y
24
26
28
30
32
LIMIT OF DETAILED STUDY
LIMIT OF DATA EXTRAPOLATION


500'
BFE
33 FT.
ELEVATION IN FEET (NGVD)
40
35
30
25
20
800
1000
1200
1400
1600
1800
2000
2200
LIMIT OF DETAILED STUDY @ 1550'
LIMIT OF DATA EXTRAPOLATION
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
STREAM BED
STREAM DISTANCE IN FEET ABOVE THE CORPORATE LIMITS

If a bridge obstructs flow, the backwater may elevate floodwaters upstream as illustrated below. Not knowing the amount of this effect, data extrapolation should not be use.



If a stream forms the boundary between two communities, if one community has BFEs printed on the FIRM, those elevations may be extended across the stream to the adjacent community with Approximate Zone A. For example, where the White River flows along the boundary between Stone County and Izard County, BFEs from the Stone County map can be used to obtain a BFE for the Approximate Zone A in Izard County.

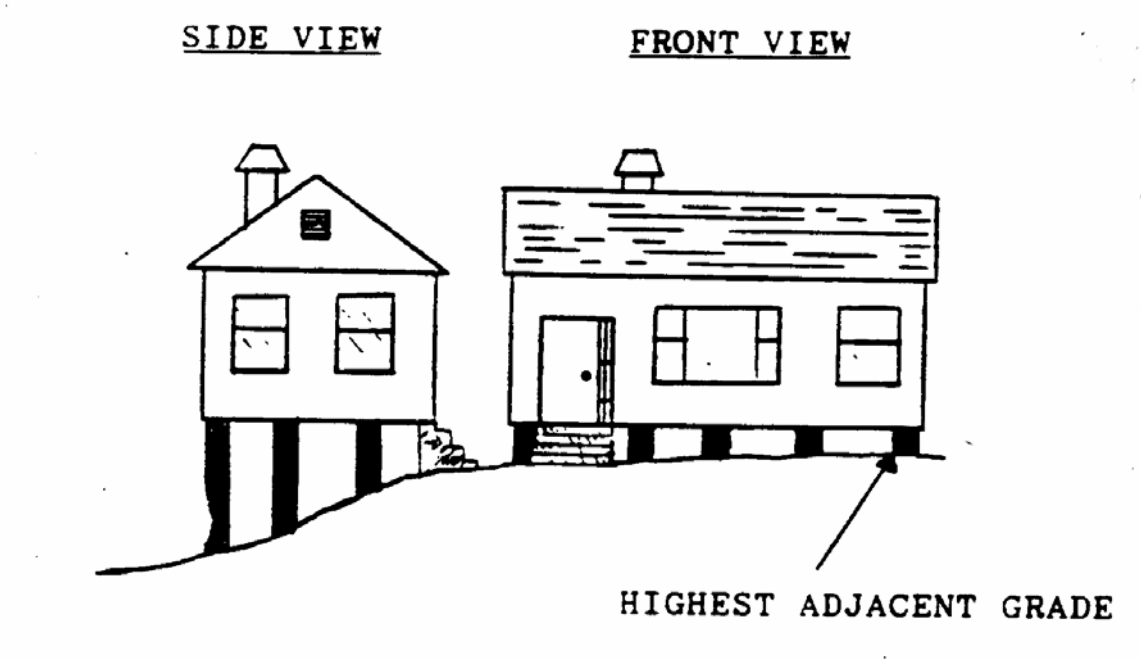
• Crest of highway or railroad

Major U.S. and Interstate highways and Main Railroad lines are usually elevated to withstand major flooding. By requiring the lowest floor to be at or above the crest of a highway or railroad, a measure of safety will be provided. It may be useful to contact the appropriate agency or company to see if they can provide the criteria or standard used in construction or rehabilitation of a highway or railroad.

• Elevation above highest adjacent grade

If no other information is available and the depth of flooding would likely be shallow, require the lowest floor to be at least 2 ft. above the highest adjacent grade.

Regardless of what method is used to determine a BFE, always require or recommend that the lowest floor is at least 2 ft. above the highest adjacent grade.



EFFECT OF ELEVATION IN APPROXIMATE ZONE A ON FLOOD INSURANCE

Insurance rates are significantly affected by the elevation of the building's lowest floor. Notice how rates drop as the lowest floor is elevated "above the highest adjacent grade." This does not require an engineer to conduct a study. If an engineer conducts a study using detailed engineering methods to determine the BFE, the flood insurance can be based on the BFE developed by the engineer.

EXAMPLE OF FLOOD INSURANCE RATES FOR UNNUMBERED ZONE A
(BASED ON MAY 1, 20007 POST-FIRM RATES)
SINGLE FAMILY RESIDENCE: $50,000 COVERAGE ON HOUSE AND $15,000 ON CONTENTS

Elevation Above or Below BFE	Annual Premium
(With BFE submitted by a registered professional engineer, surveyor or architect)	
+ 2 feet or more	$ 236.00
0 to +1 foot	$ 600.50
(Based on height of lowest floor above highest adjacent grade)	
+ 5 feet or more	$ 252.00
+2 to 4 feet	$ 645.00
+1 foot	$ 1265.00
(**No elevation certificate: no elevation information used for rating - Post-FIRM)**	
N/A	$2,203.00
(No elevation certificate: no elevation information used for rating - Pre-FIRM)	
N/A	$410.00

RECOMMENDATIONS FOR DETERMINING OR ESTIMATING BFES

It is a good idea to try to gather existing flood data and establish contacts with agencies and consulting firms before the floodplain administrator is approached regarding developing in the Approximate Zone A areas. Here are some suggestions:

- Contact the U.S. Army Corps of Engineers and the local Conservation District to find out if those agencies have flood data or studies which can provide flood elevation (and possibly "floodway" data). Keep a record of addresses, phone and fax numbers and emails of the offices and individuals which handle floodplain duties for these agencies. Obtain copies of data, maps, studies, and other information to assist in obtaining flood elevation data.

- Obtain copies of topographic or quadrangle maps from the Arkansas Geological Commission which contain contour lines and spot elevations to compare to flood maps as demonstrated with Contour Interpolation. The phone number for ordering topographic maps (at 1:24,000 scale) is 501-296-1877.

- Research past flood events and try to find high-water marks. Obtain rainfall and/or streamflow data for past floods. Compare these flood events to what would be the 100-year flood/storm. Download National Weather Service Technical Paper No. 40 to see what the 100-year rainfall is in your community for a variety of times. For small watersheds covering only a few square miles or less rainfall may be indicative of the magnitude and frequency of the flood. The Internet address of TP-40 is http://hdsc.nws.noaa.gov/hdsc/pfds/other/ar_pfds.html. Rainfall data for locations nearest your community may be found at the National Climatic Data Center website: http://www.ncdc.noaa.gov/oa/ncdc.html.

- If the contour interval is 5 ft. on the topographic map, the Contour Interpolation method may be used if the procedure outlined in the section above or in FEMA 265.

- Review all the sources/methods discussed in this document and see which ones might work.

- It is not necessary for the local floodplain administrator to determine the BFE. The developer can be held responsible for providing BFEs using the sources or methods approved by the community. The developer would most likely employ a surveyor or engineer to provide the BFE. The local floodplain administrator can accept a number of sources or methods, including a detailed engineering study employing rigorous methods used by FEMA for conducting Flood Insurance Studies.

- The Internet contains a wealth of information. Visit sites such as FEMA, U.S. Army Corps of Engineers, Natural Resources Conservation Service, National Climatic Data Center, Arkansas Natural Resources Commission, Arkansas Floodplain Management Association, Arkansas Geological Commission, U.S. Geological

Survey, and others. Just type these names in the Search and select from the sources listed by Yahoo, Google or other search engines.

- Document the source or method used to determine the BFE on permit applications or attach documentation to the permit.

- If you need additional assistance, contact the Arkansas Natural Resources Commission at 501-682-3960 and ask for floodplain management assistance