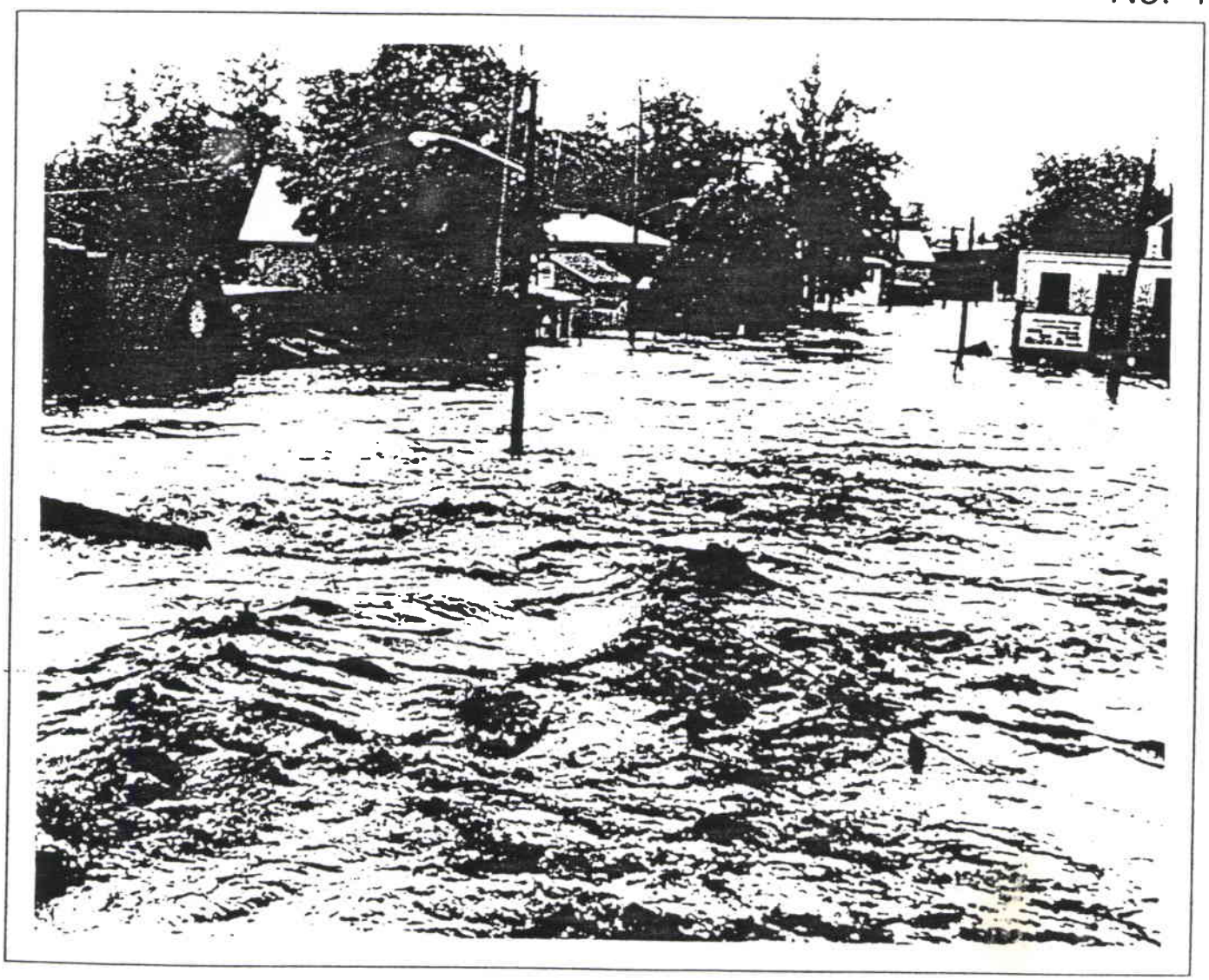
Federal Emergency Management Agency
Federal Insurance Administration

National Flood Insurance Program

The Floodway: A Guide for Community Permit Officials

Community Assistance Series

No. 4



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I. Introduction

The goal of flood plain management is to promote the wise use of areas subject to flooding. It is clear that individual decisions have not resulted in the wisest use of flood plains. Flood damages have been continually increasing and average annual damages are now estimated to be in excess of 3.8 billion dollars. Much of this loss has been borne by the Nation's taxpayers through disaster relief programs, tax deductions for flood losses, damages to public facilities that serve flood plain development, and the costs of constructing flood control projects to protect unwisely located structures. Additionally, local economic disruptions and loss of life caused by flooding are losses which are immeasurable.

The National Flood Insurance Program was created to reduce these losses by promoting a wiser use of flood plains. In return for making subsidized flood insurance available for existing structures, the participating community agrees to regulate new development in the flood plains. Structures which are built in accordance with the agreed-to regulations can also obtain very low cost flood insurance because of their reduced exposure to flood losses. The regulations are adopted by the community in a flood plain ordinance. The ordinance requires all new or substantially improved structures in the flood plain to be protected to a flood elevation determined either by the Federal Emergency Management Agency (FEMA)* or other sources. FEMA's elevations must be used if they are more restrictive.

FEMA provides flood information to a community in two stages. The initial stage is the issuance of a Flood Hazard Boundary Map which indicates which areas are likely to flood but does not show how high the flood will be. Later, FEMA conducts a Flood Insurance Study to determine the base flood elevations and, if appropriate, the floodway boundaries. The base flood, often called the 100-year flood, has a one percent chance of being equalled or exceeded in any given year. The height of that flood is called the **base flood elevation.** The land flooded by this size flood is in the base flood plain. Over a 30-year mortgage there is a 26 percent chance (about 1 in 4) that this flood or a larger one will occur.

*FEMA was created by President Carter on April 1, 1979. The National Flood Insurance Program is administered by the Federal Insurance Administration in FEMA. Formerly, the Federal Insurance Administration was in the Department of Housing and Urban Development.

II. The Purpose of the Floodway

FEMA determines the base flood elevation and the community then requires the protection of structures to this elevation. If the base flood elevation is later increased, these structures will no longer be protected from the base flood. Base flood elevations can be increased by obstructions in the flood plain. This effect can be visualized on a smaller scale by thinking of a brick placed in a gutter. The rain water will back up behind the brick and flow around it. To avoid the possibility of significantly* increased base flood elevations, FEMA asks the community to reserve a part of the flood plain. This reserved area is called the **floodway.** Appendix B explains in more detail how a floodway is determined. A community must prohibit development in the floodway if the development would cause a rise in base flood elevations. Reserving part of the flood plain for the floodway divides the flood plain into two parts:

1. the floodway, and
2. the flood fringe.

Diagram 1 shows this division of the flood plain.

Mapping a floodway eases the problem of community administration of a flood plain ordinance. In mapping a floodway it is assumed that all flood plain areas outside the floodway will eventually be filled in or otherwise obstructed. Consequently, there is no need for a case by case hydraulic analysis of each proposed development in the fringe areas. (See Section IV.C for a discussion of hydraulic analyses in the floodway.)

FEMA does not encourage filling in the fringe areas of the flood plain. This booklet does not address fringe area development, but community officials should be aware of the following potential problems caused by intensive fringe area development:

1. In some flood plains, a major loss in natural storage of flood waters will occur if encroachments are allowed in the fringe areas of the flood plain. This flood storage loss could have little effect upstream, but may have a major impact by increasing flood heights downstream. These areas are normally not included in the floodway. If the storage effect is significant in a particular flood plain, FEMA will identify the crucial areas of natural storage and work with the community to establish development standards for these areas.
2. Improper fringe area development can alter drainage patterns. This can produce increased and faster water run-off, which can increase flood heights downstream.
3. Smaller floods (e.g. the 10-year flood) could become higher or more frequent and cause increased damages to existing structures. Large amounts of fill in the fringe areas could cause a major loss to a community's environmental resources by disrupting the flood plain ecosystem.

One way of minimizing these dangers would be to elevate structures in the fringe areas on piles or columns, rather than on fill. A FEMA Regional Specialist can discuss other alternatives with interested communities.*

The community's flood plain ordinance will set different standards for uses in the fringe areas and the floodway areas. The next sections will discuss the permit official's task of regulating the adopted floodway.

*Significantly has been determined by FEMA to mean a maximum of a one foot increase in the base flood elevation. This means that in flood plain areas outside the floodway are obstructed, the base flood will not be raised by more than one foot. Any obstructions in the floodway which cause an increase will lead to more than a one foot increase when the areas outside the floodway are eventually obstructed. Appendix B explains these concepts in more detail. Many States require wider floodways than FEMA does.

*FEMA has ten regional offices around the country staffed by professional planners and engineers. One of these specialists probably distributed this booklet and marked his or her name, address and phone number on the back page. If no name is indicated in the back, and you desire further assistance after reading this booklet, call FEMA toll-free at (800) 424-8872 and ask for a Regional Specialist to return your call.

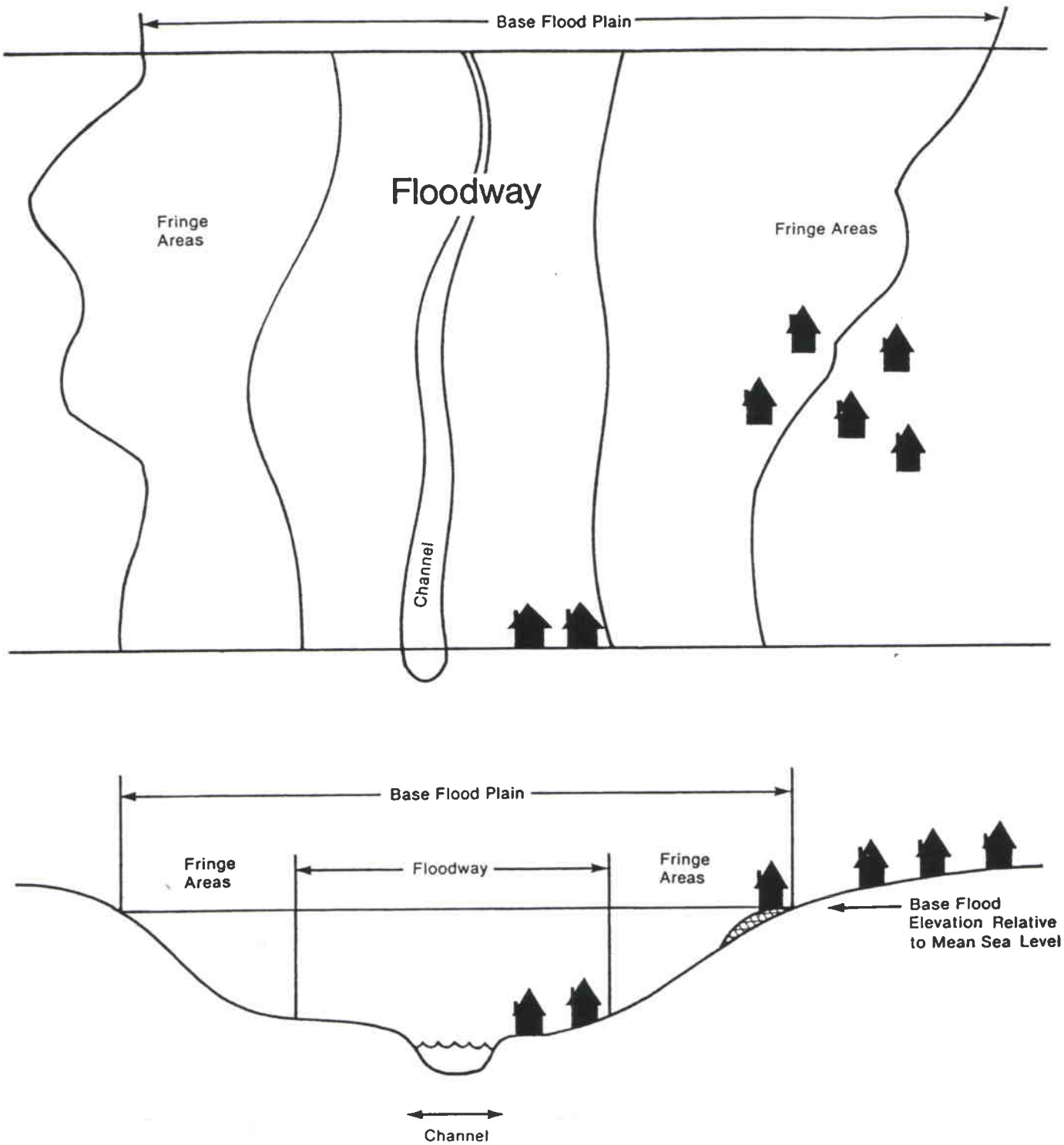


Diagram 1. Floodway and Fringe Areas.

III. Planning Considerations in the Floodway

Certain kinds of development can be safely allowed within the floodway limits. This section describes some of these situations. It is assumed that these developments can occur in such a way that they will not cause an increase in base flood elevations.

Community officials should be concerned with three potential flood hazards in a floodway –
1. the hazard to the development itself,
2. the increased hazard which the development may cause to other properties by increasing flood elevations or velocities, and
3. the risk to stranded individuals in isolated structures surrounded by flood waters, and the risk to the rescue workers.

For example, a mobile home in a floodway is likely to be totally demolished, risking the lives of its inhabitants. Aside from the danger to the mobile home and its inhabitants, experience has shown that the mobile home will float into other homes or become wedged in a bridge opening, which could increase flood heights. Also, rescue workers will be endangered trying to rescue the mobile home's occupants before the mobile home floats away.

Because of these hazards, community officials should carefully consider all of the possible dangers created by a proposed floodway development. In most cases, a review will indicate that the benefits of allowing development in the floodway are outweighed by the costs of increased future flood damage and increased hazards to life.

FEMA floodway regulations are the minimum level of regulation for participation in the National Flood Insurance Program and are most concerned with the increased damage potential to other properties caused by a development.

Section 1910.3(d) (3) states that a community must –

"Prohibit encroachments . . .within the adopted regulatory floodway that would result in any increase in flood levels within the community during the occurrence of the base flood discharge";

Section 1910.3(d) (4) additionally requires a community to –

"Prohibit the placement of any mobile homes, except in an existing mobile home park or mobile home subdivision, within the adopted regulatory floodway."

These regulations can be thought of as minimum requirements for floodway development, based upon the need to reduce flood losses to an economically acceptable level. Most communities will wish to have a higher standard for floodway development, because of their concern for the potential damage to the proposed structure and the increased hazard to life, even if flood heights are not increased. A FEMA Regional Specialist can assist a community in determining the need for additional safety standards in the flood plain ordinance.

For example, if a structure is demolished (by a flood, fire or other hazard), it is apparent that it could be rebuilt without increasing the base flood elevations originally determined in the Flood Insurance Study. This is true because the obstruction caused by the original structure was considered in calculating the floodway. Of course, the rebuilt structure would have to be protected to the base flood elevation. The structure would probably have to be on pilings or columns since fill would cause a greater obstruction than was caused by the original structure.* This type of construction in the floodway is technically permissible. However, the community may wish to prohibit it, based on possible erosion hazards to the foundation and the possible isolation of individuals in the structure during a flood. Individuals in structures surrounded by flood waters endanger rescue officials as well as themselves. There is an additional reason not to replace structures in the floodway – the absence of these structures will normally reduce the flood hazard for other structures in the flood plain. For these reasons, many States and communities exceed Program requirements and prohibit the reconstruction of damaged structures in the floodway.

Certain uses are normally acceptable within floodway areas. For example, the following uses may be ideal floodway uses, assuming they do not increase base flood elevations, and provided they can sustain flood damage without economically ruining the property owner.**
1. Agricultural uses.
2. Uses incidental to industrial-commercial structures, such as loading areas, parking areas, airport landing strips (except in flash flood areas).
3. Private and public recreational uses, such as golf courses, driving ranges, archery ranges, picnic grounds, boat launching ramps, swimming areas, wildlife and nature preserves, fish hatcheries, shooting preserves, target ranges, hunting and fishing areas, hiking and horseback riding trails.
4. Uses incidental to residential structures, such as lawns, gardens, parking areas and play areas.

Other uses may be acceptable provided the permit official can determine that no increase in flood heights will result (See Section IV. C). This task of local administration of the floodway requirement will be discussed in the next section.

*This is true because the sides of the fill must be sloped to be fully stable.

**Many of the uses can be damaged by flooding. However the damages will be less than if the area had been fully developed.

IV. Procedures for Regulating the Floodway

Certain uses must be located in floodways. Marinas and bridges are examples of these types of uses. Yet these can be hazardous if improperly constructed. A marina can be destroyed by flood waters and the debris could damage other structures. A narrow bridge opening could become blocked with debris, raising flood levels upstream. Normally, these uses can be designed in a way which satisfies FEMA's floodway regulations. However, there will be cases where the community feels that a needed structure cannot be built in compliance with the regulations. In this case, the community should contact a FEMA Regional Specialist to discuss the unique circumstances of the proposed development and mutually determine possible alternatives.

A. Using FIA's Flood Boundary – Floodway Map

When a community needs to regulate a floodway, the Flood Insurance Study will be accompanied by a Flood Boundary-Floodway Map. Diagram 2A, 2B, and 2C shows one of these maps with the related Floodway Data Table and flood profiles from the Study. The Flood Boundary-Floodway Map should not be confused with the Flood Insurance Rate Map (FIRM). A FIRM is primarily used for insurance purposes. It indicates risk zones, flood plain boundaries, and rounded base flood elevations. A Flood Boundary-Floodway Map is primarily used for regulatory purposes by the community. It shows the floodway and flood plain boundaries, and, in conjunction with the flood profiles and Floodway Data Table in the Flood Insurance Study, indicates the base flood elevations along different flood plain cross sections. This booklet is only concerned with the use of the Flood Boundary-Floodway Map and the related data in the Flood Insurance Study.*

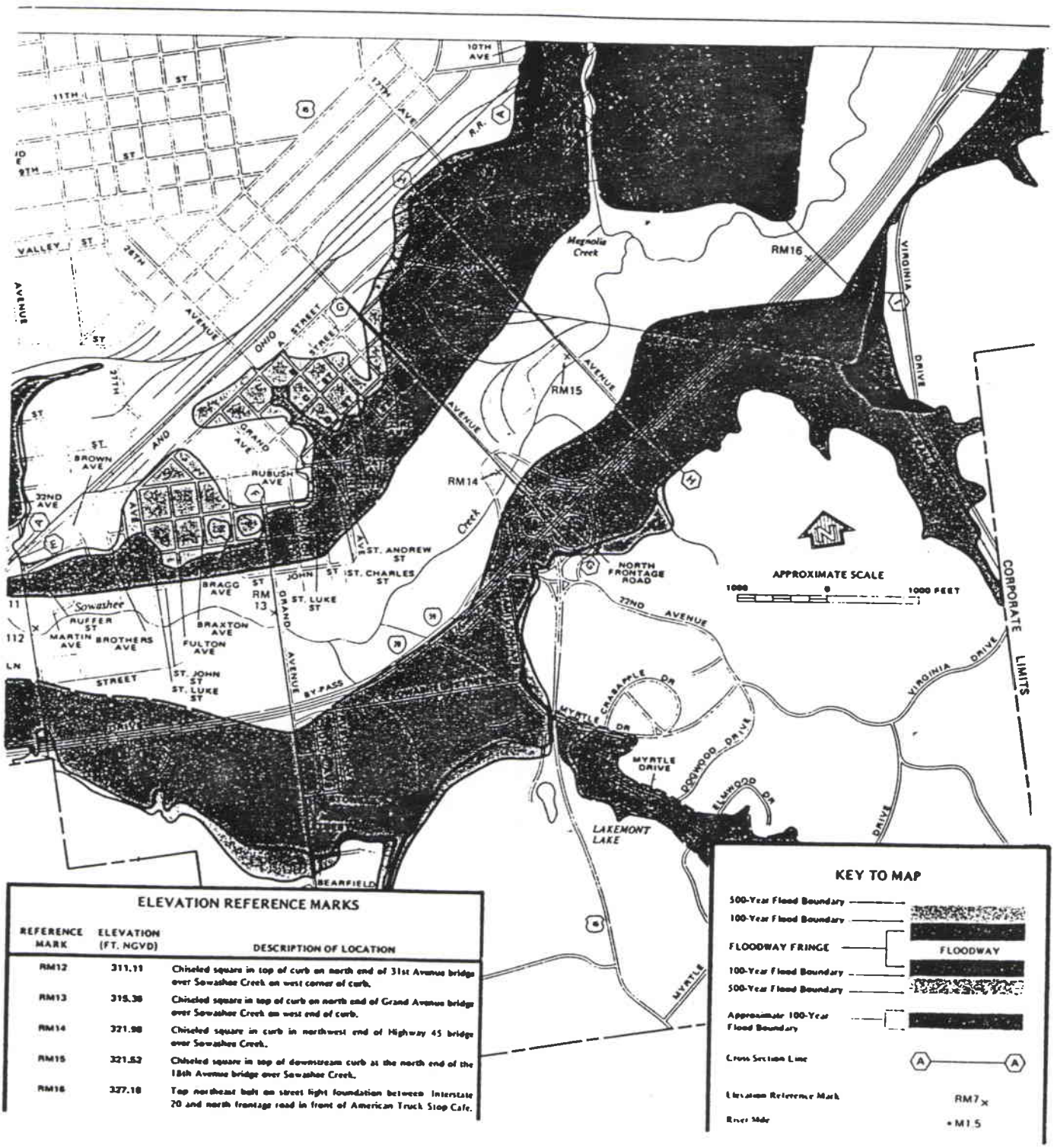
As indicated in Diagram 2A, the Flood Boundary-Floodway Map shows lightly shaded areas, darker shaded areas, and white areas in the middle of the shaded areas. The white areas are the floodway areas. The darker shaded areas just outside the floodway are the fringe areas of the base flood plain. The floodway and the fringe areas together are the base flood plain (the 100-year flood plain). The lighter shaded areas outside the base flood plain show the 500-year flood plain areas which are not already included in the 100-year, base flood plain. *A community is not required to regulate this lighter shaded area.* These lighter shaded areas are also shown on the Flood Insurance Rate Map, marked as Zone B.

Cutting across the flood plain are a series of lines, tagged with letters, called cross sections. Flood elevations and other hydraulic data are developed for each of the cross sections and the data are summarized in the Floodway Data Table (Diagram 2B) in the Flood Insurance Study.

In the sample Floodway Data Table (Diagram 2B), each cross section is listed according to its letter tag. For example, cross section I is 8.84 miles above where this creek meets the larger Okatibbee Creek. The width of the floodway is 979 feet along this cross section. The Section Area shows the area of the floodway you would see if the flood plain were sliced along the cross section, and you looked at the wall of water from the surface to the bottom of the river. The Mean Velocity is the average velocity of the water along that cross section as it crosses the floodway. Here the average velocity is 3.1 feet per second, which can be dangerous for children even in shallow water. Remember that this is an average velocity, so the velocity along some parts of the cross section will be greater, especially in or near the channel.

The next three columns show base flood elevation information. The "With Floodway" column shows what the base flood elevation will be when the fringe area is completely obstructed. The "Without Floodway"column shows the "natural" base flood elevations, before any new obstructions are placed in the flood plain. The "Difference" column shows the difference between the "With Floodway" and "Without Floodway" Columns. This difference will always be one foot or less to meet FEMA's Floodway requirement. Appendix B explains why the difference cannot always be exactly one foot.

*In areas where a floodway is not shown, the permit official will have to refer to the Flood Insurance Rate Map to determine the flood plain boundaries and base flood elevations. FEMA plans to combine these two maps for communities in the near future.



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM12	311.11	Chiseled square in top of curb on north end of 31st Avenue bridge over Sowashee Creek on west corner of curb.
RM13	315.38	Chiseled square in top of curb on north end of Grand Avenue bridge over Sowashee Creek on west end of curb.
RM14	321.98	Chiseled square in curb in northwest end of Highway 45 bridge over Sowashee Creek.
RM15	321.52	Chiseled square in top of downstream curb at the north end of the 18th Avenue bridge over Sowashee Creek.
RM16	327.18	Top northeast bolt on street light foundation between Interstate 20 and north frontage road in front of American Truck Stop Cafe.

KEY TO MAP

- 500-Year Flood Boundary
- 100-Year Flood Boundary
- FLOODWAY FRINGE
- FLOODWAY
- 100-Year Flood Boundary
- 500-Year Flood Boundary
- Approximate 100-Year Flood Boundary
- Cross Section Line (A — A)
- Elevation Reference Mark RM7 ×
- River Mile • M15

Diagram 2A. Flood Boundary and Floodway Map

Diagram 2B **Floodway Data** **Shears Branch – Sowashee Creek**

Flooding Source		Floodway			Base Flood Water Surface Elevation		
Cross Section	Distance*	Width (Feet)	Section Area (Square Feet)	Mean Velocity (Feet Per Second)	With Floodway	Without Floodway (Feet NGVD)	Difference
F	7.13	1,814	13,275	1.7	319.5	318.6	0.9
G	7.78	1,160	8,385	2.6	322.4	321.5	0.9
H	8.06	1,560	10,956	2.0	324.8	324.1	0.7
I	8.84	979	6,449	3.1	329.4	328.7	0.7

*Miles above confluence with Okatibbee Creek

The "With Floodway" and "Without Floodway" columns do not reflect the water backup effect, if any, from a larger river downstream.* If there is a water backup effect, the required base flood elevation will be higher than the elevation shown in these columns. For this reason, FEMA has begun adding a "Regulatory" column in recent Studies to clearly specify the required base flood elevation. The easiest way for the permit official to determine the required base flood elevation is to use the Flood Profile Chart (Diagram 2C). The cross sections appear along the bottom of the Flood Profile Chart. At cross section I, the base flood elevation is 329 feet (Diagram 2C). This includes the water backup effect, if any, so it may be safely used by the permit official to enforce the Program's elevation or floodproofing requirements.

The local permit official uses the Floodway Data Table primarily to check the average water velocities in the floodway. The "Mean Velocity" column gives a general indication of the hazard to personal safety due to water velocities. The other columns in the Floodway Data Table are not frequently referenced. The permit official can determine the required base flood elevation by using the Flood Profile Chart. The floodway boundary is normally located by scaling on the Flood Boundary – Floodway Map (See Appendix A), so the "Floodway Width" column is not frequently used by the permit official.

One item of information on the Flood Boundary – Floodway Map is particularly useful to the permit official. The Flood Boundary – Floodway Map shows small crosses with RM (Reference Mark) numbers. There is a Reference Mark Table in the older Flood Insurance Studies, which lists the location of each Reference Mark. In more recent Studies, RM locations are described on the map itself. Each Reference Mark is an elevation point in the community which has been accurately measured relative to mean sea level (using National Geodetic Vertical Datum). A surveyor can tell how high a structure should be elevated to reach the base flood elevation by using these Reference Marks.

Many communities prefer to transfer the floodway map to a larger map. If this is done, the cross sections should also be transferred, so the Floodway Data Table and Flood Profiles can be easily referenced.

A permit official cannot use the Flood Boundary-Floodway Map or Floodway Data Table to determine if a proposed floodway development will increase base flood elevations. The next two sections discuss the procedures by which the permit official can make this determination.

*Water backup effects sometime occur on smaller rivers near their meeting point with larger rivers. If the larger river is also flooding, the smaller river cannot empty into it as easily, due to the turbulence created when the two rivers meet. This water backup effect begins downstream from a community and is disregarded in the floodway calculations. However any water backup effect is included in the Flood Profile Chart and in the "Regulatory Column" of the Floodway Data Table for recent Studies. Ask a FEMA Regional Specialist about the water backup effect if you are uncertain of its existence in your community.

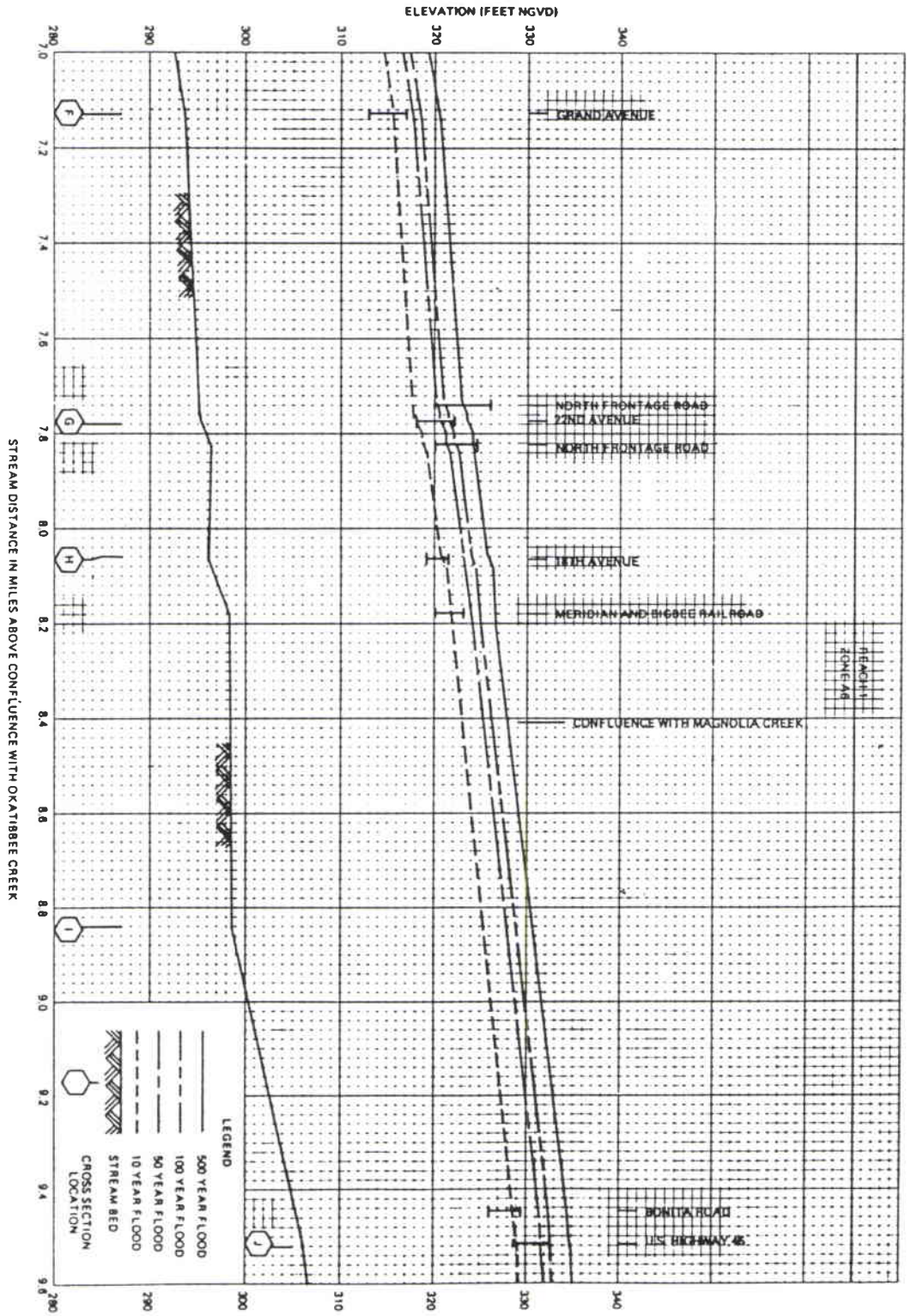


Diagram 2C. Flood Profiles – Sowashee Creek.

Problem: Check your ability to use the map and data by determining the following information for **cross section F** by using Diagrams 2A, 2B, and 2C.

1. What is the Floodway Width?
2. What is the Mean Velocity?
3. What Base Flood Elevation is indicated on Diagram 2C?
4. Determine the distance from the channel to the northern floodway boundary by measuring on the Flood Boundary-Floodway Map (Diagram 2A).
5. Determine the location and elevation of the nearest Reference Mark.

Solution:

1. 1814 feet (See Diagram 2B, column 3, line 1).
2. 1.7 feet per second (See Diagram 2B, column 5, line 1).
3. 318.5 feet above mean sea level (See Diagram 2C, locate cross section F along the bottom of the graph, and read up to the second profile from the top (the 100-year flood profile); the left side of the graph indicates the base flood elevation.)
4. 700 feet (On Diagram 2A, locate the channel at cross section F and measure the distance from the channel to the northern floodway boundary, which is the northern edge of the white area. The scale indicates that the measured distance is approximately 700 feet.)
5. **RM 13. Elevation 315.36 feet above mean sea level. Chiseled square in top of curb on north end of Grant Avenue Bridge, over Sowashee Creek on West end of curb** (Locate cross section F on Diagram 2A. **Look for the nearest X. The nearest one is just to the left of the cross section, just above the channel.** It is **labeled RM 13. The elevation reference mark table in the lower left part of the diagram gives the information about RM 13.**)

B. Role of the Development Permit

The key to successful local regulation of the floodway is a well enforced permit system. A community must be informed of a proposed development before it can be evaluated.

Your community probably has had a building permit system in operation for some time. As one part of the Program's permit requirement, a permit must be required for all new construction or alterations to existing structures in the base flood plain. However, the Program's permit requirement goes beyond construction. This is because non-construction activities such as filling can have a major impact on the flood plain. For this reason, the Program regulations require a "development" permit. Program regulations define development as "any man-made change to improved or unimproved real estate, including but not limited to buildings, or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations." (Section 1909.1 of the Program's regulations).

It is apparent that the definition of "development" is very comprehensive. Most communities have not traditionally had a permit system for such a wide range of activities. Yet regulation of all development in flood plains is essential since fill or other material can obstruct flood flows just as much as a building. The permit official has some discretion to exempt obviously insignificant activities from the permit requirement (e.g. planting a vegetable garden). A FEMA Regional Specialist can assist community officials in interpreting the applicability of this definition to different types of minor development, if any question arises.

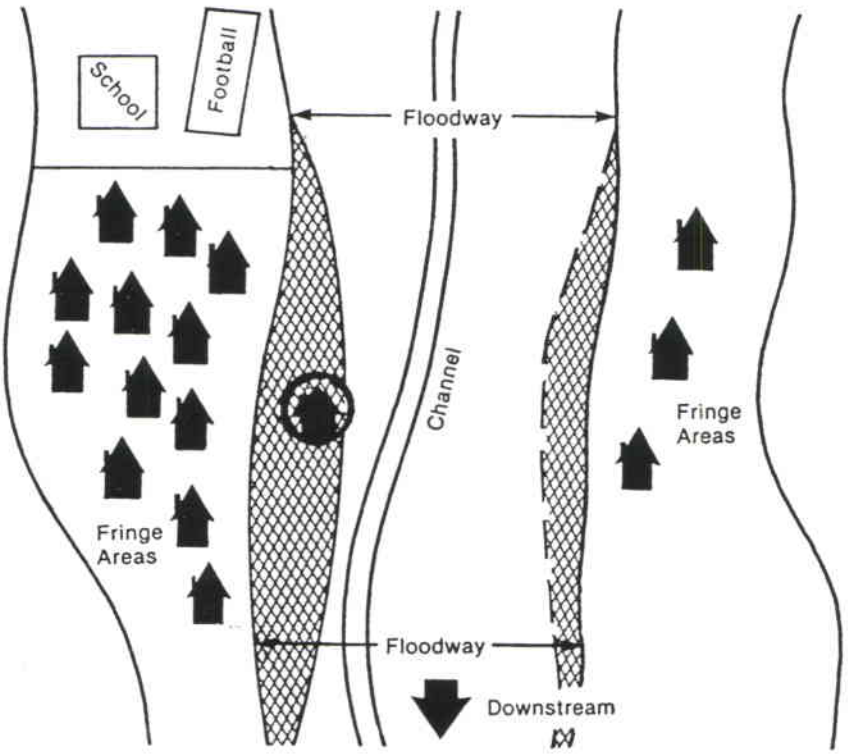
C. Evaluation of the Permit

The permit official should initially review the development plans to determine the extent of the development. In some cases, the permit official can readily determine that the proposed development will cause no change in the existing topography (for example, a play area or residential lawn area). In most cases, the permit official will not be able to determine that the development will cause no rise in base flood elevations. The permit official's first assumption will be that any new obstruction in the floodway will cause some rise in base flood elevations.

When the permit official is uncertain, the developer must prove that the proposed development, along with similar future development assumed by the equal degree of encroachment rule discussed below, will not cause any increase in base flood elevations. The developer provides this proof by hiring a registered professional engineer to analyze the development plans and certify how the base flood elevations will be affected. The developer will need to utilize an engineering firm experienced in the hydrologic and hydraulic procedures specified for a Flood Insurance Study. The FEMA Regional Office should be contacted for guidance to assure that the same or similar methodology and constants as those used in the original Study are used for the new calculations.

Normally, the professional engineer will analyze a proposal based on the equal degree of encroachment rule. For example, if one structure is proposed one hundred feet into the floodway, the engineer will assume that future structures in the area will also be allowed to encroach on the floodway to this degree. So the engineer will block out this area in making his analysis. Diagram 3 shows that the engineer assumes more obstruction than is created by the one proposed structure. This assumption is based on the legal difficulty a community would have denying similar proposals, if it allowed the first proposal. The equal degree of encroachment rule provides a uniform legal basis for granting or denying a proposed development and all similar future developments.

Deviations from the equal degree of encroachment rule can occur. For example, the rule need not be applied to both sides of the watercourse if one side is permanently reserved as open space.



Existing Structures

Proposed Structure

Area Engineer Assumes Will Be Obstructed Due to Future Development Similar to the Proposed Structure

Note 1. If the area on the right side of the floodway were reserved as open space (e.g., a city park), then the Engineer would not need to "block out" the right side of the floodway.

Note 2. In this example the area blocked out on the right side is smaller than on the left side. However the **conveyance** of floodwater that is carried within the two blocked out areas is equal. Although the right side is smaller, the flood depths or velocities must be greater on the right side. See Appendix B for a more detailed discussion.

Diagram 3. Engineer's Assumptions in Evaluating a Proposed Floodway Structure

However, deviations from the rule should be avoided, since decisions based on this rule most easily satisfy the legal requirement to treat similarly situated people in a similar manner.

A developer may propose to shift the floodway boundaries or improve flow so that the project can be allowed. Any change in floodway boundaries must have the prior approval of FEMA, and the new floodway must be formally adopted by amending the community's flood plain ordinance. A minor development in the floodway, which is documented to cause no rise in base flood elevations, does not change the floodway boundary and it is not necessary to inform FEMA in this case.

Unless it can be established that no rise in the base flood would result, the permit must be denied. Variances from this prohibition are in violation of a community's ordinance and will endanger the community's eligibility in the National Flood Insurance Program.

The community must retain on file all certifications which establish that development in the floodway has caused no rise in base flood elevations. A copy of the engineer's supporting documentation should also be kept on file. Any development allowed in the floodway must satisfy the remaining Program regulations. For example, structures must be protected to the base flood elevation. These standards are listed in detail in a community's flood plain ordinance.

Although not required by Program regulations, your community may wish to adopt stronger ordinance requirements and deny a permit even if it can be shown that the development would cause no increase in the base flood elevation. This is because your community should also be concerned with the safety hazard to the property owner in the floodway and to the community employees who may have to rescue the floodway occupants under extremely hazardous conditions.

D. Mobile Homes

Mobile homes are of special concern in floodways, due to their great potential for floating off their foundations and ramming other structures or wedging in bridge openings, which will increase flood heights upstream. For this reason, FEMA prohibits the placement of mobile homes in floodways, except in mobile home parks or mobile home subdivisions which were existing before the floodway regulations were adopted by the community. (Section 1910.3(d) (4) of FEMA regulations).

An application to locate a **non-exempt mobile home*** in the floodway must be denied.** An application to locate an exempt mobile home in the floodway can be approved, if proper safety

*i e A mobile home which will not be in an existing mobile home park or mobile home subdivision

**In certain cases, a community may decide to grant a variance Section 1910 6(a) of the Program s regulations discusses variances Any variance which creates an obstruction causing a rise in the base flood elevation will endanger a community s eligibility in the Program

precautions are taken. It would be appropriate for the permit official to warn the mobile home owner of the increased hazards in a floodway.

E. Existing Structures in a Floodway

Many communities fear that the floodway regulations will affect existing structures. **As long as an existing structure remains unchanged, the flood plain regulations will not apply to the structure.**

If an **addition** is made to an existing structure, the enforcement official should ask for a hydraulic analysis before allowing the addition. The downstream side of an existing structure normally contains ineffective flow conveyance areas. So, small additions which are aligned parallel to flood flows on the downstream side of an existing structure will generally not result in an increase in flood levels. A FEMA Regional Specialist can help a community determine the need for a detailed hydraulic analysis.

If a substantial improvement* is made to an existing structure (either by reconstruction, repairs, additions, or rehabilitation), the elevation or floodproofing requirements apply. However, if the flow blockage is not increased by an addition or fill, the permit official can assume that there will be no increase in flood heights. Although FEMA discourages this type of construction in the floodway, it is technically allowable, provided no increase in base flood elevations will result. As was mentioned previously, many States and communities exceed FEMA's minimum requirements and prohibit substantial improvements in the floodway.

*Substantial improvement is defined in Section 1909.1 of FEMA regulations. It generally means any improvement costing more than 50 percent of the current market value of the structure.

V. Conclusion

A floodway can be a valuable planning tool for your community. It can help steer development away from areas of the flood plain with the most serious hazards to lives and property, where development could cause a rise in flood levels affecting many other property owners.

Floodways are normally dangerous areas due to the depths and velocities of the water. A moderate sized person begins to lose stability in three feet of water which is moving at two feet per second. A child would begin to lose stability in water of lower depths and velocities. Every effort should be made to avoid endangering lives.

FEMA will assist your community in choosing a useful floodway for the community's flood plain management program and in effectively enforcing the adopted floodway. Effective regulation of the floodway will do much to reduce the flooding hazard to individuals and their property.

Appendix A

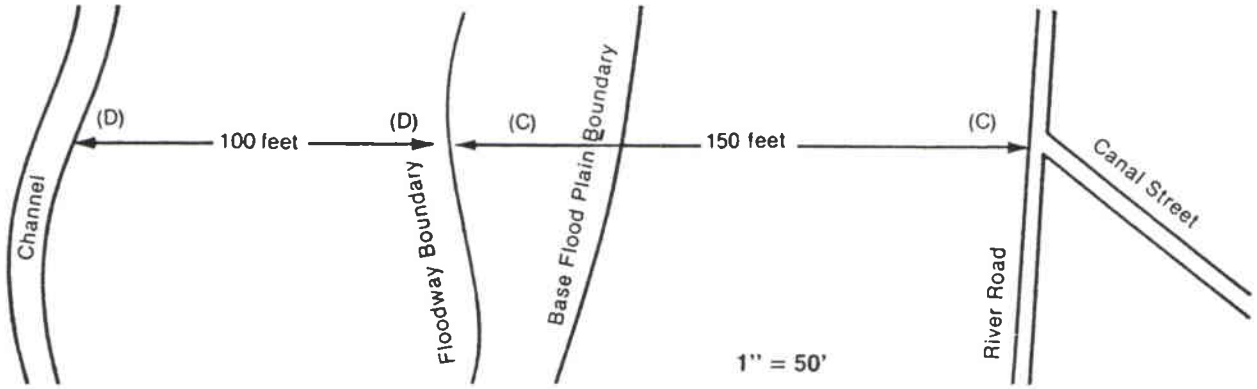


Diagram 4. Scaling Techniques.

Scaling Distances to Locate the Floodway Boundary

"Scaling" is the method which is most frequently used to locate the floodway boundary in the field. Appropriate distances are measured in inches on the Flood Boundary – Floodway Map, the map distances are converted to feet, using the "Approximate Scale" on the map, and the distance is scaled in the field.

The floodway boundary is measured relative to some identifiable physical feature, such as a road, or an elevation reference mark, which can be located both on the map and in the field. This scaling technique is necessary because *floodway boundaries are not based on ground elevations*, unlike the flood plain boundaries which intersect the ground at a specific ground elevation.

Diagram 4 shows the scaling technique. It is important to remember that the field measurements must be made on the same line as was used to measure distances on the map. For example, if the floodway boundary is measured on the map to be 150 feet **due west** of the intersection of River Road and Canal Street, then the 150 feet must also be scaled **due west** in the field. A north reference arrow appears on each map.

Note: Diagram 4 shows typical information on a community's Flood Boundary – Floodway Map.

Problem: Locate the floodway boundary in the field in the area west of the road intersection.

Solution: On the Flood Boundary – Floodway Map, measure the distance from:
1. the road intersection to the floodway boundary = 150 feet (line C); or
2. the bank of the watercourse to the floodway boundary = 100 feet (line D).

Then, measure either distance along the same line in the field.

Most watercourses have distinct banks which can be identified during periods of normal flow by a distinct break in topography and/or by a well-defined break in vegetated and non-vegetated ground cover. The floodway boundary can be scaled from either the bank of the watercourse, or some other physical feature, whichever reference point is most convenient. The physical feature should be reasonably close to the floodway to minimize scaling errors.
In cases where the floodway widths are too small to be shown on the map, the Floodway Data Table in the Flood Insurance Study must be used instead. This table has a column marked "Floodway Width." The width for the floodway at the nearest cross section is divided in half and this distance is scaled in the field from the center of the watercourse to locate the floodway boundary.

Appendix B

How the Floodway Is Determined

Program regulations require structures to be protected to the base flood elevation. If flood waters are obstructed and base flood heights are significantly increased, these structures would no longer be protected from the base flood. To avoid this possibility, FEMA will work with the community to determine what part of the flood plain must be kept free of obstructions. This crucial area is called the **floodway**. Wherever a floodway is needed, a Flood Boundary – Floodway Map accompanies the Flood Insurance Study to indicate the floodway portion of the base flood plain. The floodway boundary is determined by "squeezing in" the flood plain boundary on the computer until the base flood is raised one foot* (see Diagram 5A). This simulates the effect of building a "wall" from both sides of the flood plain toward the center of the river. (The "wall" could be fill, structures, a levee or any physical obstruction.) When the imaginary obstruction has blocked the flood flow enough to raise the base flood elevation a maximum of one foot, the limits of the obstruction define the boundary between the floodway and the fringe areas of the flood plain (see Diagram 5B).

The floodway is the part of the flood plain which carries and discharges the largest part of the flood flow. **Fringe areas** outside the floodway serve primarily as storage areas for floodwaters, and can be filled in or otherwise obstructed without causing more than a one-foot rise in the base flood elevation upstream. However, any obstruction in the **floodway** which causes **any** rise is prohibited (Section 1910.3(d)(3) of the Program's regulations). This is because any obstruction in the floodway, which causes a rise in the base flood elevation, will increase base flood elevations by more than one foot when the fringe areas are obstructed (see Diagram 6).

The one-foot rise caused by the obstructions in the fringe area is the **maximum** allowable rise. The fringe areas cannot always be obstructed to this degree. The following conditions indicate when the full one-foot rise would be inappropriate at a particular cross section.

1. The floodway boundary cannot go inside the watercourse bank; it will stop at the bank even if the one-foot rise has not been reached.
2. Obstructions can sometimes cause extremely hazardous velocities and allowing the full one-foot rise in these cases would be dangerous.
3. Obstructions at a particular cross section which allow a full one-foot rise can sometimes back the water up so much that there will be greater than a one-foot rise upstream. Since no point of the floodway can exceed a one-foot rise, **this cross section must have less than a one-foot rise.**

Normally, floodway boundaries are determined by applying the equal degree of encroachment rule.* The rule requires that the quantity of flood waters conveyed **on both sides** of the watercourse be reduced by an equal percentage when developing the encroached floodway boundary. If ten percent of the flow conveyance is imaginarily "blocked out" from one side of the river, then ten percent is also "blocked out" from the other side. The equal degree of encroachment rule is based on the legal need to treat similarly situated property owners in a similar manner. In practice, the rule is not always followed, because property owners are often not similarly situated. Many factors, including topography, existing development patterns, and comprehensive land use plans may justify modifications to the equal degree of encroachment rule. However, deviations from the rule must be carefully considered, since floodways based on this rule most easily satisfy the legal requirement to treat similarly situated people in a similar manner.

Equal degree of encroachment is measured by the loss of flood water conveyance on both sides of the river. Conveyance reflects the **quantity** of flow and the **velocity** of the flow. This means that the equal degree of encroachment rule may lead to less **surface area** being blocked out on one side than on the other. This can occur if the velocity or depth of the water on one side is greater than on the other. (See Diagram 7.)

*One foot is the maximum increased rise allowable at any point along the watercourse (Section 1910.3(d)(2) of FEMA regulations. The rise will often be less than one foot at some points in order to keep the increase from exceeding one foot at other points. The maximum one foot rise was selected as a compromise between an extremely restrictive floodway (with no rise allowed) and an extremely lenient floodway (greater than one-foot rise) which could cause extremely damaging increases in flood heights. Many States require more restrictive floodways than FEMA does.

*See also Section IV C

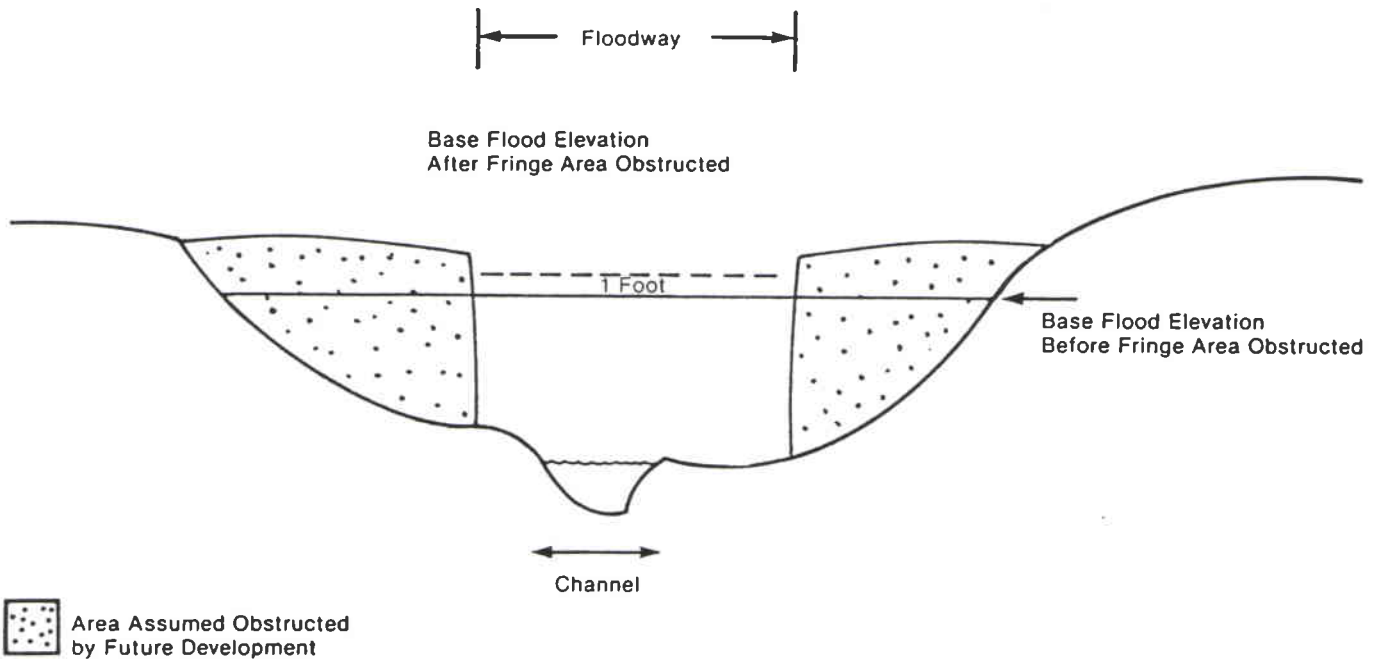


Diagram 5A. Developing the Floodway Boundaries by "Squeezing in" the Floodwaters.

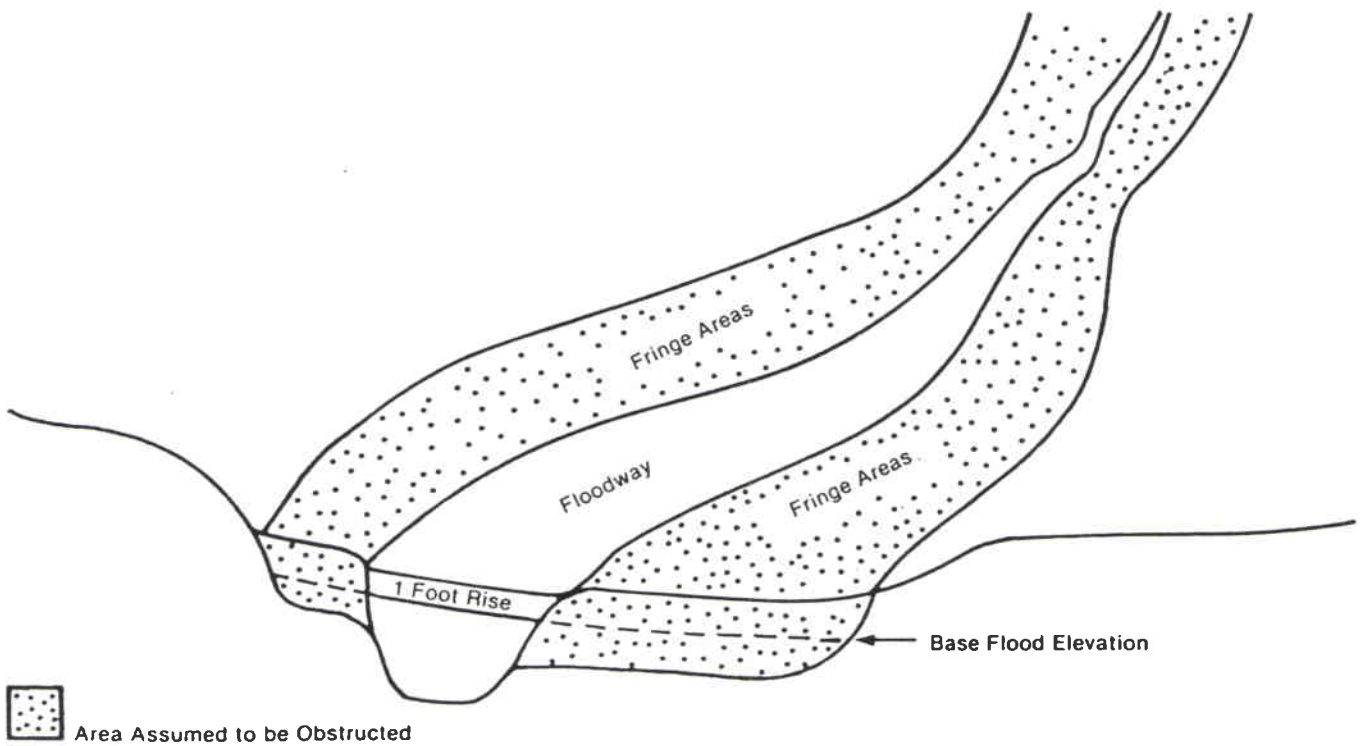
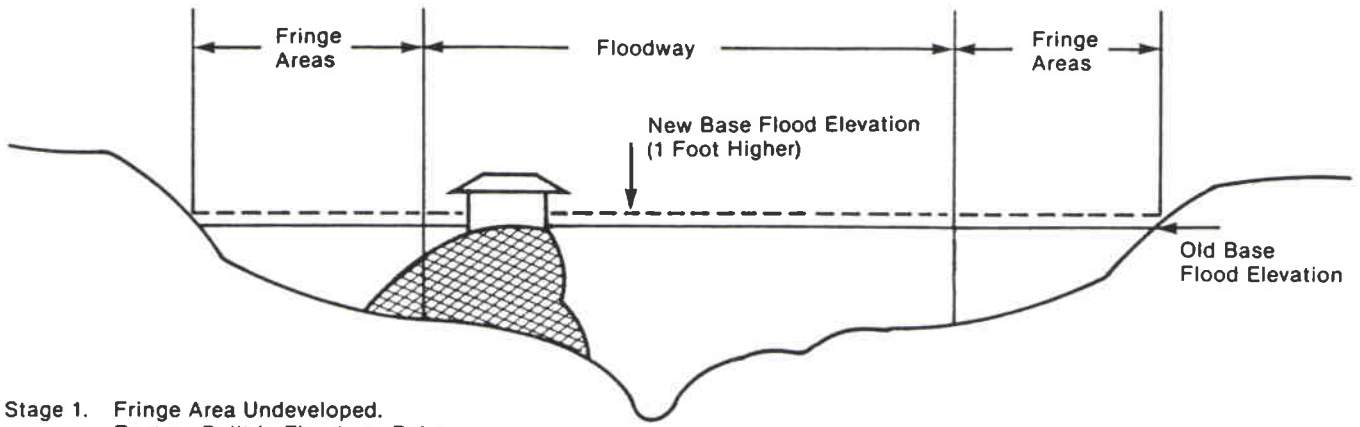
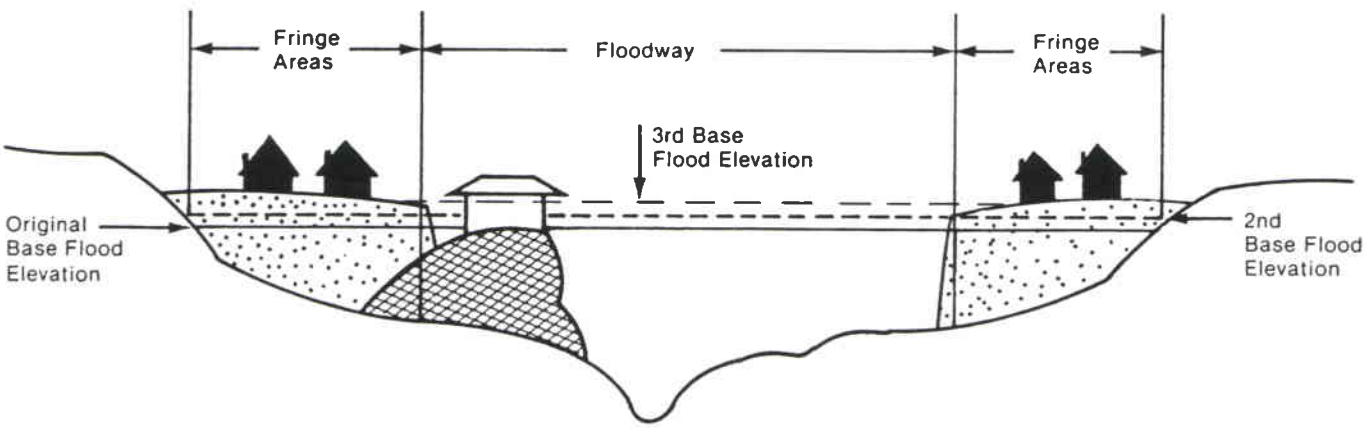


Diagram 5B. The Limits of the Imaginary Obstruction are the Floodway Boundaries.

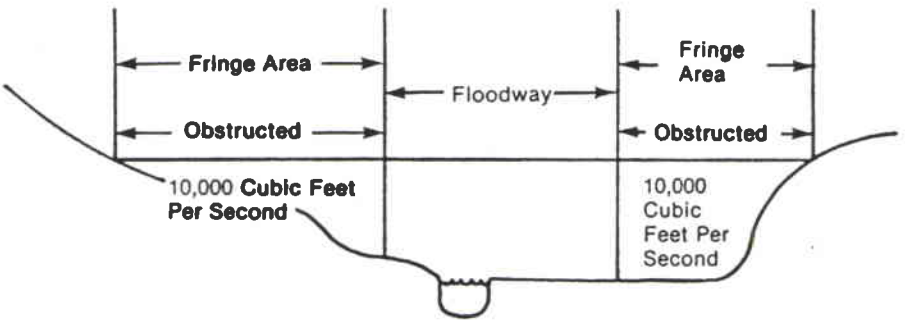


Stage 1. Fringe Area Undeveloped.
Factory Built in Floodway Raises
Base Flood Elevations by One Foot.
This Structure is in Violation of FIA Regulations.



Stage 2. Fringe Area Developed.
Base Flood Elevation Rises Another Foot.
Total Rise now **Two** Feet.

Diagram 6. Effect of Floodway Obstructions.



The right side of the flood plain is deeper so the fringe area on the right side can be narrower and still carry the same amount of water per second as the left side. When the fringe areas are obstructed, the obstruction will create an equal degree of encroachment.

Diagram 7. Example of Equal Degree of Encroachment.

Glossary

Base Flood – A flood which has a one-percent chance of being equalled or exceeded in any given year. There is a 26 percent chance that this flood or a larger one will occur during a 30-year mortgage. All Federal agencies and many States recognize this standard for regulatory purposes.

Conveyance – Refers to the carrying capacity of all or a part of the flood plain. It reflects the quantity and velocity of flood waters. Conveyance is measured in cubic feet per second (CFS). If the flow is 30,000 CFS at a cross section, this means that 30,000 cubic feet of water pass through the cross section each second.

Cross Section – At regular intervals along the water course, the flood plain is sliced from one side to the other. The computer analyzes each of these slices to determine the flood conveyance capacity of the flood plain as the flood passes through.

Encroachment – Any obstruction in the flood plain which affects flood flows. See the definition for obstruction.

Equal Degree of Encroachment – A rule which requires that conveyance be reduced by equal percentages on both sides of the watercourse. See Section IV.C and Appendix B for a detailed discussion.

Flood Fringe Areas – The part of the base flood plain outside of the floodway.

Flood Plain Management – Means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and flood plain management regulations.

Floodway – Means the watercourse channel and adjacent land areas which must be reserved to carry the base flood without cumulatively increasing the base flood elevation more than a designated height. (One foot is the maximum increase allowed by Section 1910.3(d) (2) of FIA regulations.)

Hydraulics – A branch of science that deals with practical applications of liquid in motion.

100-Year Flood – See Base Flood definition.

National Geodetic Vertical Datum (NGVD) – A measure of mean sea level. FEMA maps are always referenced to NGVD – 1929 datum.

Obstruction – Any physical object which hinders the passage of water.

Regulatory Floodway – Any floodway referenced in a flood plain ordinance for the purpose of applying floodway regulations. See Floodway definition.

Scaling – Measuring a distance on a map and using the map scale to translate the distance into feet. The distance is then measured in the field. See Appendix A.

If you desire further assistance, contact:

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(If no name is filled in, call FEMA toll free at (800) 424-8872 and ask for a Regional Specialist to return your call.)

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