Guidance for Flood Risk Analysis and Mapping

Floodway Analysis and Mapping

November 2019
Requirements for the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) Program are specified separately by statute, regulation, or FEMA policy (primarily the Standards for Flood Risk Analysis and Mapping). This document provides guidance to support the requirements and recommends approaches for effective and efficient implementation. Alternate approaches that comply with all requirements are acceptable.

Table of Revisions

The following summary of changes details revisions to this document subsequent to its most recent version in Month Year.

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1.0 Introduction

This document provides guidance for floodway analysis, and all the components that accompany it. A floodway is a tool to assist communities in balancing development within the floodplain against the resulting increase in flood hazard. A regulatory floodway is defined as the channel of a river or other watercourse and the adjacent land area that is reserved from encroachment in order to discharge the base flood without cumulatively increasing the water-surface elevation by more than a designated height. NFIP regulations and Standard SID 69 and 70 state: “Floodway surcharge values must be between zero and 1.0 ft. If the state (or other jurisdiction) has established more stringent regulations, these regulations take precedence over the NFIP regulatory standard. Further reduction of maximum allowable surcharge limits can be used if required or requested and approved by the communities impacted.”, and “If a stream forms the boundary between two or more states and/or tribes, either the 1.0-foot maximum allowable rise criterion or existing floodway agreements between the parties shall be used.” The portions of the floodplain beyond the floodway are called the floodway fringe. The community is responsible for maintaining the floodway to mitigate flood hazards; the community must not allow any activities causing a rise in the Base Flood Elevation (BFE) in the regulatory floodway.

The baseline model for the allowable surcharge is the model used to determine the BFEs the first time a floodway was adopted for the reach. Unless it is demonstrated that the model should be revised for reasons other than encroachments into the floodplain, all subsequent revisions to the floodway are limited to the maximum allowable surcharge above the elevations determined in the base model. That way, as hydraulic models are updated to reflect encroachments into the floodway fringe, the cumulative effect of those and future encroachments is limited to the maximum allowable surcharge. If the model is revised for reasons other than encroachments into the floodplain (such as increased discharges, shift in channel, modeling software advancements), the revised model, excluding any revisions attributable to loss of conveyance areas resulting from floodplain encroachment, is the base model for future floodway analyses.

Regulatory floodways are not normally delineated in coastal high-hazard areas (i.e., Zones V1-30, VE, and V). The computation of regulatory floodways on riverine flooding sources in coastal floodplains is based on the base flood discharge and elevations of the riverine flooding source only. The regulatory floodway must be terminated at the boundary of the V1-30, VE, or V Zone, or where the mean high tide exceeds the 1-percent-annual-chance riverine flood elevation, whichever occurs further upstream.

2.0 The Floodway and Why It Is Important

Perhaps the most important function of a natural floodplain is to convey floodwaters from upstream to downstream. The portion of the floodplain that conveys most of the floodwaters is called the floodway. Obstructions placed in the floodplain block the flow of water and can cause increased flood heights upstream from the obstruction and increased velocities of floodwaters adjacent to and downstream from the obstruction. Preserving the capacity of floodplains to convey floodwaters through the designation and preservation of a floodway has been an important concept in floodplain management from the very beginning. Preserving the floodway prevents development from occurring in the floodplain that will increase flood heights and damages to upstream properties. The NFIP and nearly all state and local floodplain management programs
have incorporated the concept of a floodway to convey floodwaters in their floodplain management requirements.

2.1 The Regulatory Floodway

The NFIP defines “regulatory floodway” as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. This designated height is one foot for most NFIP communities. FEMA will develop a floodway for a community as part of a Flood Insurance Study. Floodways are usually shown on the community’s Flood Insurance Rate Map (FIRM), but for many older studies a separate Flood Boundary and Floodway Map (FBFM) was published.

An example of a FIRM with a floodway is shown in Figure 2-1. The cross hatched area in Figure 2-1 within the floodplain is the floodway. The locations of the cross sections are shown and identified by a letter and the base flood elevations are identified by numbers representing the elevation. The dark shaded area outside the floodway is the 1-percent chance floodplain or Special Flood Hazard Area and the light shaded areas (labeled Zone X) are the 0.2-percent chance floodplain.

Community’s that participate in the NFIP that have been provided with floodway data by FEMA are required to adopt a floodway that causes no more than one foot increase in the base flood elevation at any point in the community. The increase in base flood elevation from the “no floodway” to “with floodway” condition is called the surcharge. Most communities adopt the floodway provided by FEMA although they can adopt an alternative floodway provided it meets the one foot criteria. Once a community adopts a floodway, it must prohibit development in that floodway unless it has been demonstrated through engineering analyses that there will be no increase in flood stage. Some states and communities have adopted more restrictive floodway standards than those adopted by FEMA.
Definitions: “Regulatory Floodway” means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Designation of a floodway allows for part of the floodplain to be developed while at the same time preserving the ability of the floodplain to convey flood discharges. The area within the floodplain but outside the floodway is called the floodway fringe. The allowable one-foot rise in flood stage or surcharge is a compromise intended to balance the rights of the property owner to develop their property against the need to protect adjacent and upstream property owners from increased flood heights and increased flood damages. If FEMA did not allow for some increase in flood stage when designating a floodway, the floodway could comprise most of the floodplain and development in the floodplain would be severely limited.

44 CFR 60.3(d): When the Administrator has provided a notice of final base flood determinations within zones A1-30 and/or AE on the community’s FIRM …and has provided data from which the community shall designate its regulatory floodway, the community shall:
(1) …
(2) Select and adopt a regulatory floodway based on the principle that the area chosen for the regulatory floodway must carry the waters of the base flood, without increasing the water surface elevation of that flood more than one foot at any point;

CFR 60.3 was published in the NFIP regulations on October 26, 1976. However, the floodway was being used in the NFIP for floodplain management prior to 1976 because there is reference to floodways in the “The Flood Disaster Protection Act of 1973”. Figure 2-2 shows a cross section of the floodplain and distinguishes between the floodway and floodplain width.
Implications of allowing a one-foot rise: NFIP regulations allow up to a one-foot rise in flood stage when designating the floodway. If development occurs outside of the floodway in the floodway fringe and there is an increase in flood stage, there will be an increase in potential flood damages to adjoining and upstream property. In densely populated areas with existing development, even the allowable one-foot increase in depth of flooding could significantly add to flood damages to upstream property. Damages can also occur during the base flood to new buildings in the floodway fringe that are elevated or floodproofed to the base flood elevation. Additional areas may be flooded that are not shown on the FIRM as floodplain and not subject to the community’s floodplain management ordinance. In these situations, the community may wish to adopt a more restrictive floodway (surcharge less than one foot) to prevent this increase in damages.

2.2 Requirements for Development in the Floodway

Once a community has adopted a floodway, it must prohibit development in the floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed using standard engineering practice that the development will not result in any increase in flood levels during the base flood. FEMA defines “any” as meaning a zero increase (greater than 0.00 feet). This analysis is usually called a “no-rise” or “zero-rise” analysis and results in a “no-rise” or “zero-rise” certification by a qualified register professional engineer. Remember that considerable encroachment into the floodplain was already allowed when the floodway was designated by the...
community. Although some communities or states perform the hydrologic and hydraulic analyses themselves, most require the permit applicant to obtain the services of a qualified registered professional engineer to perform the analysis and provide the certification. The process for meeting this requirement is described in Section 5. Unless the engineering analysis demonstrates that there will not be an increase in the base flood elevation as a result of the development, the permit must be denied.

**44CFR 60.3(d)(3):** *Prohibit encroachments in the floodway, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during occurrence of the base flood discharge.*

### 2.3 Variances

If a permit applicant requests a variance to allow for development in the floodway that would cause an increase in flood stage, the variance request must be denied. NFIP variance criteria at 44 CFR 60.6(a)(1) specifically prohibit the issuance of variances by communities for development in a floodway that cause any increase flood levels during the base flood. Granting this type of variance could violate other NFIP variance criteria since variances also cannot result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, or cause fraud or victimization of the public.

**44 CFR 60.6(a) Variances:** *(1) Variances shall not be issued by a community within any designated regulatory floodway if any increase in flood levels during the base flood discharge would result.*

By designating a floodway, a community greatly simplifies the administration of its floodplain management regulations. Floodplain permits outside of the floodway can be issued without delays for costly hydraulic analyses. Property owners have a greater certainty as to what areas of their properties they can develop and what areas they cannot and can plan accordingly. Upstream property owners have a reasonable assurance that they will not be damaged by the actions of downstream property owners.
2.4 The Importance of Protecting the Floodway

The primary benefit to designating a floodway and regulating development within that floodway is to preserve a portion of the floodplain to convey flood waters from upstream or downstream. Without these requirements, development over time would encroach into the floodway and obstruct the flow of floodwaters thus increasing upstream flood elevations. Limiting development in floodways provides important benefits to the community.

2.4.1 Preventing Increases in Damages to Upstream Buildings

Floodway requirements are different from most other NFIP requirements which are intended to protect individual buildings from flood damages. The primary reason for designating a floodway and limiting development in that floodway is to prevent encroachments in the floodplain from blocking flood flows and increasing upstream flood stages. Without floodway requirements, encroachments into the floodplain would eventually increase flood stages to the point where upstream flood damages are significantly increased. Existing upstream buildings would be flooded to greater depths and even buildings built in accordance with the community’s floodplain management would eventually become susceptible to flood damage from the base flood. Before floodway requirements were adopted by communities it was common for floodplain encroachments such as bridges and their approaches or fill in the floodplain to cause increases of several feet in flood stage potentially increasing flood damages.

2.4.2 Limiting Development in the Most Hazardous Areas of the Floodplain

Since floodways include the stream channel and the adjacent areas of the floodplain, they tend to include the most hazardous areas of the floodplain with the greatest depths and velocities of floodwaters and amount of debris. Most of these areas are not only hazardous, but they are expensive to develop due the costs of meeting elevation requirements and designing buildings to withstand flood forces. The floodway also will generally flood more frequently than other parts of the floodplain. These areas pose a threat to public safety and are best avoided. If floodways were developed, the likely result would be buildings isolated by deep and fast flood waters that may jeopardize the safety of any building occupants as well as that of public safety employees conducting search and rescue operations.

2.4.3 Protecting Natural Functions of Floodplains

Floodways also protect important natural functions of the floodplain that benefit the community and its citizens. In addition to conveying floodwaters, floodways and the adjoining floodplains (floodway fringe) provide flood storage and reduce flood velocities and peak flows. When left in natural vegetation, they also protect water quality and reduce sedimentation in the river or stream. Floodways often contain wetlands and generally provide critical riparian fish and wildlife habitat including habitat for threatened or endangered species. Floodways can provide linear corridors and greenways that allow for the migration of wildlife. Floodway requirements can be combined with other regulatory programs such as those designed to protect water quality to achieve multiple objectives. Floodways that provide open space in densely populated areas are an amenity that can increase the value of adjoining property and enhance the tax base of the community.
2.4.4 Appropriate uses of floodways

There are a number of economic uses that can be conducted in floodways that do not impact flood stages. Where possible these uses should be encouraged.

- Agriculture and forestry uses that do not involve buildings or use of fill.
- Back yards, lawns, gardens, parking areas and play areas. Often subdivisions can be designed so that there are building sites on each lot that are outside of the floodplain or at least the floodway and that all floodway areas are preserved.
- Private or public open space and recreation uses such as golf courses, campgrounds, picnic grounds, boat launching ramps, wildlife and nature reserves, and similar uses. When in public ownership, floodways can provide corridors for trail systems for hiking, jogging, biking, or horse-back riding. Often these uses enhance the value of adjoining properties.
- Industrial and commercial uses such as parking lots and loading areas and airport landing strips for light airplanes that do not involve buildings or use of fill.

If these uses require fill or construction of buildings, the developer will have to demonstrate that the use will cause no rise in flood stages. Some of these uses such as campgrounds or parking lots may not be suitable for areas subject to flash floods or areas that flood frequently.

2.5 Legal Basis for Floodways

Floodway regulations have withstood numerous challenges that they are an unconstitutional taking of private property without just compensation. The challengers generally have argued that floodway requirements are so restrictive that the owner is precluded from making an economic use of their property. In nearly all cases the concept of the floodway has been upheld in the Courts as an appropriate use of the community’s floodplain management authority. The important point to remember is that floodway requirements are intended to prevent the actions of one property owner from causing increased flood damages to adjacent or upstream property owners. No property owner has a right to a use that would create a nuisance to adjacent properties.

The NFIP floodway requirements are not a prohibition on development within the floodway. They establish a performance standard (no increase in flood stages) that is intended to avoid increasing damages to adjacent and upstream property owners. If the development can be designed to meet the performance standard, it can be permitted in the floodway provided that the development meets other NFIP floodplain management requirements. Floodway requirements may increase the cost of development or limit the size of the development and the developer may decide that the development is no longer practicable and may choose to abandon the project or decide on an alternative location for the development for economic reasons. However, this is an economic decision made by the developer and does not result in a taking under the law.

There are also public policy interests in controlling development in what is generally the most hazardous part of the floodplain. There can be increased costs to the community costs in providing services to floodway development. More importantly there are significant threats to public safety for any inhabitants in the floodway and the need for search and rescue and other
emergency operations can place an additional burden on an already overwhelmed community. For these reasons as well as to provide increased protection to adjoining and upstream property owners, some states and communities adopt more restrictive (surcharge less than one foot) floodway standards. The following sections provide guidance and requirements associated with floodway determinations.

2.6 More Restrictive State and Local Floodway Standards

Several states have adopted floodplain management laws and regulations that are more restrictive than NFIP minimum requirements. Communities in these states must comply with both NFIP minimum criteria and the more restrictive state requirements. In addition, many communities have adopted more restrictive floodways or placed added restrictions on floodway development.

2.6.1 More Restrictive Encroachment Standards

The most common state requirement is an encroachment standard that is more restrictive than the NFIP one-foot rise criteria for designating floodways. Typically, these states limit the increase in flood stages caused by designating the floodway to zero or to an amount such as .1 foot or .5 foot. Provided that the state has legally enforceable laws or regulations, FEMA recognizes these state standards and maps floodways in communities in these states using the more restrictive state standard. For rivers or streams that border two states, one of which has a more restrictive floodway standard, the one-foot surcharge is used unless the states have mutually agreed on a lesser criterion.

Individual communities can also request a more restrictive floodway be placed on their FIRM. In the absence of a more restrictive state standard, FEMA’s policy has been to map a floodway for the community using the one-foot surcharge and to put that floodway on the FIRM. FEMA will then do one additional floodway analysis using the community’s more restrictive standard and provide that floodway to the community. The Mapping Partner conducting the study must consult with the appropriate FEMA Regional Office before developing a floodway for a community based on a more restrictive community standard. Information on contacting the FEMA Regional Offices can be found at http://www.fema.gov/business/nfip/nfip_regions.shtm.

2.6.2 State Floodway Regulatory Programs

Several states directly regulate all or most development in floodways. These states have engineering staffs that perform floodway analyses and review and approve permits for floodway development. Both a state permit and a permit from the community may be required for a floodway or floodplain development in these states. If your community is located in one of these states, contact the responsible state agency for information on the state requirements.

2.6.3 Floodways that Preserve Floodplain Storage

The FEMA floodway is intended to limit the impacts of encroachments into the floodplain on the hydraulics of the river or stream – the requirement prevents increases in flood elevations on upstream or adjoining properties from exceeding the one-foot standard. The FEMA floodway usually does not account for the effects of loss of storage on the hydrology of the river or stream and on downstream flood heights due to increased peak discharges. Although loss of storage usually does make much of a difference on rivers and streams with large watersheds, it could be a significant factor in increasing flood stages on smaller streams, particularly those with wide
floodplains that contain areas such as wetlands that store large amounts of floodwaters. Without these upstream storage areas, floodwaters will concentrate more quickly increasing peak discharges of floodwaters. The result will be increases in flood heights in downstream areas. Under certain conditions the increase in downstream flood heights can be much greater than the upstream hydraulic impacts of the encroachments. Some communities address storage by incorporating loss of storage into their hydrologic and hydraulic models and develop a “storage” floodway. Other communities designate wider floodways in areas of the floodplain that provide storage such as wetlands.

A community can also address this issue by limiting the amount of fill that can be placed in the floodplain, adopting wetlands ordinances, requiring large lot zoning, or requiring that compensatory storage be provided as the floodplain is developed. Compensatory storage ordinances require developers that fill in the floodplain to compensate for the loss of storage by creating new storage elsewhere on the property that is comparable to the storage that was lost.

### 2.6.4 Alternative Floodway Criteria

Some communities use other criteria to designate their floodways. Typically, these criteria include in the floodway those areas that are frequently flooded, have flood depths greater than a specified depth, or areas where floodwaters exceed a certain velocity. Their grounds for using these criteria for designating their floodways are that these areas are generally not suitable for development or are too hazardous and a threat to the safety of the public. The severity of the hazard is a function of the combination of the depth of flooding and the velocity of the floodwaters. Even very shallow flood depths of 1-2 feet can be hazardous in areas of high flood velocities. For example, floodwaters of 2 feet deep with velocities of 5 feet per second would be hazardous to even an adult. A good rule of thumb is that the depth and velocity in feet per second should not exceed 10. To meet NFIP minimum requirements these floodways must also not cause an increase in the water surface elevation of the base flood of more than one foot at any point in the community.

Another alternative is to designate a resource based floodway. Such a floodway must at a minimum include the FEMA one foot floodway but can include areas that protect other important natural floodplain functions. For example, the floodway could be expanded to include adjacent wetlands, key riparian habitat, a setback to protect water quality, and similar areas. Communities that adopt resource based floodways need to clearly explain the basis and purpose of their floodway designation in their ordinance. Resource based floodways work best when combined with restrictions on the uses allowed in floodways discussed in the next section.

### 2.6.5 Restrictions on Uses Allowed in Floodways

In addition to establishing more restrictive standards for designating floodways, some states and communities limit the types of development that can occur in floodways. Generally, these states and communities have determined that public safety issues created by locating buildings in the floodway far outweigh any economic benefits of allowing the development. For example, several states prohibit the placement of all buildings in the floodway or limit the floodway to open space uses. One state prohibits new residential buildings in the floodway with exceptions for certain farm residences. Along streams with relatively narrow floodways it may also be possible to prohibit most alterations of the floodway with an allowance for any necessary road and bridge crossings.
2.6.6 Regulating to a Base Flood Elevation that Includes the One Foot Surcharge

One of the major concerns regarding the NFIP floodway requirements is that they can result in up to a one-foot increase in flood stage for the base flood within the community. The result is that even buildings that are elevated or floodproofed to above the base flood elevation (BFE) can eventually sustain flood damage during the base flood. Several states require that any increase in flood stage that would result from the designation of a floodway be added to the BFE and the buildings be protected to the increased elevation. In some instances, states or communities add freeboard on top of the base flood elevation to account for uncertainties in the base flood elevation, provide an increased level protection, or compensate for the increase in flood stages that result from floodway encroachments.

2.6.7 Community Rating System (CRS)

Communities that adopt regulatory floodways that are more restrictive than NFIP minimum requirements or apply more restrictive requirements within their floodways can receive credits under the NFIP’s Community Rating System (CRS). The CRS provides discounts on flood insurance premiums in those NFIP communities that implement floodplain management programs that go beyond the minimum requirements of the NFIP. Contact your State or FEMA Regional Office regarding the CRS or refer to the CRS page on the FEMA website at http://www.fema.gov/business/nfip/crs.shtm for additional information.

3.0 How Floodways are Delineated in FEMA Flood Insurance Studies

Flood Insurance Studies (FISs) are conducted on behalf of FEMA by a Mapping Partner that could be a private consultant, a federal agency, a state agency, a special district such as a flood control or watershed district, or a community. States, communities, or special districts that cooperate with FEMA during the FIS process can become a Cooperating Technical Partner (CTP) to FEMA. FISs are conducted in accordance with FEMA’s Guidelines and Standards for Flood Risk Analysis and Mapping using standard engineering models. Most detailed studies along rivers and streams have been prepared using HEC-RAS or, its predecessor, HEC-2 developed by the U.S. Army Corps of Engineer’s Hydrologic Engineering Center in Davis, California. Other FEMA approved hydrologic and hydraulic models that can be used can be found on the Flood Hazard Mapping pages on FEMA’s web site https://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping.

There are two main components to a FIS that take place prior to the mapping of the floodplain and delineating the floodway, and these involve defining the hydrology and hydraulics of the stream being studied.

4.0 Hydrology

A detailed hydrologic analysis is conducted to determine the flood discharges that will occur during the base flood and other representative floods including the 10-year (10-percent chance), 25-year (4-percent chance), 50-year (2-percent chance), and 500-year (0.2-percent chance) floods at a location. Flood discharge is the quantity of floodwaters that will pass a particular location for that frequency flood measured in cubic feet per second. Flood discharges can be found in the Summary of Discharges table in the FIS report. Flood flow frequencies are determined using data from stream gages if there is one on the stream being studied and procedures described in Bulletin 17B, Guidelines For Determining Flood Flow Frequency.
If stream gage data are not available, flood discharges are determined using regression equations developed by the U.S. Geological Survey or other agencies or approved rainfall-runoff computer models that combine rainfall or snowmelt with characteristics of the watershed to obtain the flood discharges. For more information, see General Hydrologic Considerations and Hydrology Rainfall-Runoff Analysis Guidance.

An example of a flood frequency curve for a gaging station is shown in Figure 4-1. This curve relates the magnitude of the flood discharges to the percent chance of exceedance. The data shown in Figure 4-1 include the annual peak data collected at the gaging station, the solid curve representing the computed frequency curve and the dashed lines showing confidence limits that depict the uncertainty in the computed curve. For the stream in Figure 4-1, the 1-percent annual chance or 100-year discharge is 82,000 cubic feet per second (cfs).

![Figure 4-1. Flood frequency curve for a gaging station that relates the magnitude of the flood discharges to the percent chance of exceedance.](image)

**5.0 Hydraulics**

Once the flood discharges are determined, a hydraulic analysis is conducted to provide estimates of the elevations of the various frequency floods and to designate the floodway. Often HEC-RAS
or its predecessor HEC-2 are used to conduct this analysis although there are other FEMA approved models that are appropriate. The hydraulic analysis creates a computer model of the floodplain using the flood discharges, cross sections of the river or stream, and characteristics of the channel and overbank areas such as their roughness coefficients, slope, and location and size of any obstructions such as bridges and culverts.

Cross sections of the stream channel and the adjacent overbank areas are developed at regular intervals along the channel using ground surveys, detailed topographic maps or digital elevation data. A cross section is vertical slice of the channel and overbank areas taken perpendicular to the direction of flow. See Figure 5-1 for an example of a surveyed cross section. Cross sections must be located close enough together to reflect changes in the shape and slope of the channel and overbank areas. For example, cross sections are taken to reflect changes in the width of the floodplain, bridge and road crossings (several cross sections are required to model a bridge), changes in floodplain land use, and other factors that may impact flood flows. The more changes there are in the floodplain the more cross sections that are required for the hydraulic model. See the FIRM in Figure 2-1 for examples of cross section locations.

![Figure 5-1. Surveyed cross section.](image)

Roughness coefficients (called Manning’s “n”) are determined for the channel and overbank areas of each cross section. Roughness coefficients measure the friction in the channel and overbank areas and are a significant factor in measuring the effectiveness of that portion of the channel or overbank area in conveying flood waters. For example, floodwaters will flow more smoothly and at higher velocities over a paved surface than if the area were heavily forested.
Within the model, the flood discharges are routed through the model and the result of the hydraulic analysis is a base flood elevation and a floodplain boundary at each cross section. The floodplain boundary is then interpolated between the cross sections using available topographic information. See Figure 5-2 for a flood profile from a FIS.

Figure 5-2. Flood Profile from a Flood Insurance Study. Note that in addition to the elevations of various frequency floods, the Flood Profile shows the locations of the cross sections and of bridges, culverts, and other water control structures.

5.1 Floodway Analysis

The next step in conducting the hydraulic analysis is to develop the floodway. Normally, the Mapping Partner performing the hydraulic analysis will determine the floodway using equal reduction of conveyance on opposite sides of the stream (also called equal degree of encroachment). Equal reduction of conveyance means that the conveyance on both sides of the stream is reduced by an equal percentage. The computer model in effect squeezes the floodplain by progressively eliminating the area of the cross section beginning at the edge of the floodplain until the allowable one foot surcharge is reached at one of the cross sections. Usually several computer runs are made to come as close as possible to the one foot surcharge at all of the cross sections. The purpose of using equal reduction of conveyance is to ensure that like situated properties are treated equally. This does not mean that the floodway will be an equal width on both sides of the stream. Since the stream channel meanders across the floodplain, the amount of conveyance in the overbank areas will usually vary. Reducing the amount of
conveyance by an equal percentage in both overbank areas usually is the fairest way to treat property owners. See Figure 5-3 for a standard floodway schematic from a FIS report.

It is also possible to determine a floodway by manually locating floodway boundaries at each cross section and then running the computer model to determine if the floodway meets the one foot surcharge criteria. This method is used to develop a floodway when equal reduction of conveyance does not produce the desired results or to evaluate floodways proposed by communities to determine if they meet allowable one foot surcharge.

The requirement that the increase in the base flood elevation due to the floodway not exceed one foot at any point in the community generally results in many cross sections where the surcharge is less than the allowable one foot. Usually the controlling factor is a single cross section where the stage increase is 1.0 feet. In some situations, it is possible to fill up to the bank of the stream without causing a one foot increase in flood stage. When this occurs the floodway boundary is set at the bank station of the stream channel as defined in the model even though the allowable one foot increase in flood has not been reached.

The floodway analysis will produce a floodway boundary at each cross section. Engineering judgment is then used to interpolate the floodway boundary between the cross sections adhering to hydraulic principles.

Figure 5-3. Cross section of the floodplain showing the floodway, floodway fringe and surcharge. The model assumes that the entire floodplain outside of the floodway is filled or otherwise obstructed.
The study assumes that the entire floodplain outside of the floodway has been filled or otherwise obstructed and does not convey flood waters. For this reason, once a floodway has been designated encroachment analyses are no longer required for development outside of the floodway. Having a floodway considerably reduces the administrative costs of regulating floodplain development since hydraulic studies do not have to be undertaken for individual development proposals.

5.2 Steady State Floodway Analysis

Floodways as discussed in section 5.1 are determined by modeling the floodway fringe as a non-conveyance area by encroaching the effective flow area. The technique of using artificially high roughness coefficients must not be used for floodway analyses in one-dimensional steady flow analysis. The Mapping Partner should use the most recent existing conditions model, or base model discussed in section 1.0 as the base for the floodway analysis limiting surcharges to the maximum allowable above the base conditions 1-percent-annual-chance profile. Typically, the Mapping Partner should use an equal conveyance reduction method to establish the regulatory floodway.

When flow is in the supercritical regime for man-made channels, or where velocity conditions are such that normal encroachment analyses are not possible or are inappropriate, the encroachment stations should be computed so that the allowable rise in water-surface elevation matches the target water surface without exceeding the target energy grade line.

5.2.1 Boundary of Floodway Analyses

Most floodways are determined using a step-backwater model. If a floodway exists at the downstream limit of study on the same stream as the study reach, the floodway must be configured so that the floodway data at the downstream limit of study match the floodway data at the upstream limit of the existing study. See Section 6 of the Contiguous Community Mapping Guidance for more information about study tie-ins.

In case a discrepancy is identified between the floodway data table and floodway model, the Mapping Partner must document the magnitude of and reason for the mismatch and suggest remedies to the FEMA Project Officer. Once the data match, the floodway analysis is based on a starting water-surface elevation associated with the maximum allowable surcharge, or the water surface elevation resulting from application of a more restrictive requirement imposed by a state or other jurisdiction. That way, future (allowable) revisions to the downstream floodway should not create surcharges greater than the maximum allowable in the study reach.

If the study reach begins at the mouth of the stream, the Mapping Partner must start the encroachment analysis at a width yielding the maximum allowable surcharge, or the water surface elevation resulting from application of a more restrictive requirement imposed by a state or other jurisdiction, for a normal depth calculation using the same friction slope as the unencroached profile. If a floodway does not exist immediately downstream of the study reach, the Mapping Partner should start the analysis sufficiently downstream of the downstream limit of study so that differences in the starting conditions do not create surcharges greater than the maximum allowed within the study reach. That way, future floodway designations downstream should not create surcharges greater than the maximum allowable in the study reach.
If a floodway exists at the upstream limit of study, the floodway must be configured so that the floodway data at the upstream limit of the study match the floodway data at the downstream limit of the existing study. If the relevancy of the existing study is in question issues associated with tying into the existing analysis should be investigated and the Mapping Partner must seek guidance from the FEMA Project Officer.

5.2.2 Storage Considerations

Storage considerations in hydrologic and hydraulic modeling of the unencroached condition should be revised to reflect any encroachment into storage areas indicated by the floodway configuration.

If designated storage areas behind structures are accounted for in the flood discharge computations by routing the base flood hydrograph, no encroachment is to be allowed; and the floodway encroachment stations should be equal to the base floodplain boundary of the storage area designating the storage area as part of the floodway. In this case, the Mapping Partner should use the same flood discharge for the unencroached and encroached profiles in the step-backwater analysis to determine the surcharge values. However, if the storage capacity exists but is not accounted for in the routing base flood hydrograph, it can be encroached; the Mapping Partner should determine the flood discharges for the encroached profile downstream of the structure by routing the 1-percent-annual-chance flood hydrograph through the reduced storage area. In this case, the flood discharge for the encroached profile may be greater than the flood discharge for the unencroached profile in the step-backwater analysis.

5.2.3 Tributary, Split and Diverted Flows

The regulatory floodway on a tributary stream is based on the base (1-percent-annual-chance) flood discharge and elevation of that stream only and normally should not include consideration of any backwater flooding from the main stream. Therefore, the floodway elevations in the lower reach of a tributary subject to backwater flooding may be lower than those used to plot the Flood Profiles. See section 7 of the FIS Report Technical Reference to see how this is portrayed in the FIS.

The Mapping Partner should re-compute flood flow values along each flow path associated with reaches with split and/or diverted flow situations, as described in Split Flow under Section 2.1.7, in the Hydraulics One-Dimensional Analysis Guidance, under encroached (floodway) conditions. If the primary flow path (originating reach) can safely carry the entire base flood flow without increasing flood heights more than the maximum allowable surcharge, only the primary flow path requires a floodway. If not, other flow paths require floodways.

The Mapping Partner should ensure that the overland flow segment on the mainstream remains open by determining a separate regulatory floodway for the overflow path, or by a note on the FIRM stating that the overflow area should remain unencroached until a detailed hydraulic analysis is performed to establish a regulatory floodway. The Mapping Partner must inform the FEMA Project Officer when overland flow paths lead into another jurisdiction where a regulatory floodway has not been computed, thus necessitating that the overflow area remains unencroached.
The FEMA Project Officer may approve, as an alternative, that the Mapping Partner determine the regulatory floodway on the main channel downstream of the overflow area by determining the floodway profile with the total flow (including the flow lost as overflow). The Mapping Partner should compare the water-surface elevations from the floodway profile to the water-surface elevations of the 1-percent-annual-chance Flood Profile reflecting existing conditions (whose discharges in the main channel have been reduced because of flow lost as overflow) to determine surcharges. If the calculated surcharge is less than or equal to the allowable surcharge, the regulatory floodway is depicted on the main channel only.

Otherwise, a separate regulatory floodway is defined for the overflow path. The Mapping Partner should add a note to the Floodway Data Table or the FIRM to identify the segment of floodway where the surcharge was computed using the reduced flow. The floodway should be revised when the diverted flow does not occur anymore, and the flow is fully carried by the main stream.

5.2.4 Negative Surcharge Values

Surcharge values must be between zero and the maximum allowable value in the respective community. Negative values in output data generally indicate excessive changes in velocity, conveyance capacity, or floodway width at or downstream of the cross section with the negative surcharge. Floodway configurations should be revised until all surcharge values are between zero and the maximum allowable value. Reasons for deviating from this practice should be coordinated with the FEMA Project Officer.

5.3 Unsteady State Floodway Analysis

The equal conveyance reduction approach is most applicable to a steady state, one-dimensional model. In certain situations, equal conveyance reduction cannot be practically achieved in defining the floodway configuration. The Mapping Partner may use one of the alternative methods discussed below to determine the regulatory floodway configuration. Use of an alternative method must be approved by the FEMA Project Officer and agreed to by the communities involved.

Steady state models do not consider lost storage in both effective and ineffective flow areas and its impacts on flow rates and timing. However, for unsteady state models, encroachment into the floodway fringe would impact flow rates; the degree depends on the amount of storage lost. Encroachments result in storage decreases in both off-channel storage modeled with an elevation-storage curve, and in non-conveyance areas modeled with artificially high roughness coefficients. Input data for the elevation-storage curve or the values of roughness coefficients should be revised to reflect the lost storage.

5.3.1 One-Dimensional Unsteady Floodway Analysis

The loss of storage in the floodway fringe of an unsteady model makes it likely that the peak discharge in the floodway model will be larger than that in the unencroached analyses. The flow rate increases are likely to cause elevation increases downstream even if the base flood is fully within the channel. If surcharges increase when unsteady state modeling is used for a reach with a previously determined steady-state floodway, the floodway width should be increased to meet the maximum allowable surcharge limit, or other more restrictive requirements of a state or other jurisdiction.
The equal conveyance reduction method can be performed in unsteady state modeling through an iterative process. In general, the Mapping Partner should follow procedures described in the HEC-RAS User’s Manual (HEC, 2016) to perform unsteady flow floodway analyses. The procedure uses a steady flow encroachment analysis to establish an approximate floodway and import the encroachment stations to the unsteady flow model to verify that the surcharge is within the maximum allowable limit. The Mapping Partner should incorporate peak flows from unsteady flow runs to the steady flow model to estimate the encroachment stations. When rerunning the steady flow model with encroachment stations, Mapping Partners should adjust downstream boundary conditions to reflect increases of water-surface elevation due to encroachment.

An alternative method is to perform floodway analysis using an unsteady state model directly. The Mapping Partner should use the base flood hydrograph as the inflow hydrograph and determine encroachment stations by the equal conveyance reduction method.

Equal storage reduction may be applied in the floodway determination for streams with flooding dominated by storage. In such systems, the difference between the equal conveyance reduction method and equal storage reduction method is usually not significant. The equal storage reduction method is simpler in both concept and application and could be considered as an alternative approach for floodway determination.

5.3.2 Two-Dimensional Unsteady Floodway Analysis

When a hydrograph is routed downstream and constrained within the floodway with a given surcharge, it moves water downstream at a different rate. If the floodway fringe is encroached, the water that previously inundated the floodway fringe areas is pushed downstream due to reduction of storage and may result in increased flow rate and water-surface elevation on the downstream floodplain. The storage routing floodway procedure fills the floodplain grid elements up to the maximum allowable surcharge before distributing flow to contiguous floodplain grid elements. Because the maximum allowable surcharge is defined by the user, this procedure can easily satisfy the floodway surcharge requirement. The method does not explicitly compute and compare conveyance reductions; the Mapping Partner must get pre-approval from the FEMA Project Officer to use this method and coordinate with the communities to get an approved floodway configuration.

If the floodway was previously determined by a one-dimensional model, the Mapping Partner should incorporate the encroachment stations into a two-dimensional model and run the two-dimensional model to verify that the maximum allowable surcharge is not exceeded.

5.4 Levees and Floodways

For some communities, regulatory floodways may have already been delineated for levee-impacted areas along a flooding source. The presence and hydraulic significance of a levee along a flooding source with a regulatory floodway can affect which base model is encroached to define the floodway, the placement of the floodway boundary on the map, and the stakeholders included in the floodway coordination. FEMA has developed an approach for modeling and delineating the regulatory floodway in levee-impacted area. This approach is outlined in the Levee Guidance.
5.5 Alternative Floodway Alignments

The standard methodologies for designating floodways work well for most rivers and streams. However, there are unusual situations where it may not be possible to designate a typical one foot flood rise floodway using the standard FEMA approved models or where one would make little practical sense. Typical situations where this could occur are floodplains where flood waters escape into an adjoining watershed, streams with beds that are perched above the surrounding ground level, and extremely shallow floodplains where the flow areas are not adjacent the channel of the river or stream. The FEMA Regional Offices generally address these situations on a case by case basis in consultation with the State and the local governments affected with the overall goal of maintaining sufficient flow areas to prevent increases in flood stage of one foot or greater no matter where the water goes.

5.6 Floodways and Restudies

FEMA periodically conducts restudies of floodplains in communities where the current FIRM does not adequately reflect the current flood hazard. Restudies are generally done when physical conditions change in the watershed sufficiently to impact on flood stages, to reflect new flood control structures, to incorporate better climate data, or take advantage of new mapping and study technologies. When a restudy is done for a river or stream where a floodway has been designated, the Mapping Partner conducting the study is directed to maintain the existing floodway configuration wherever possible. If conditions have changed significantly, a new floodway may have to be developed, particularly if a wider floodway is required to meet the one foot rise criteria due to increased flood discharges. To the degree possible the new floodway will reflect the effects of the encroachments that have occurred since the original floodway was designated to ensure that flood stages do not increase more than the one-foot provided for in the original FIS.

5.7 Community Adoption of a Floodway

When FEMA provides floodway data to the community, the community is required to adopt a regulatory floodway that causes no more than a one foot increase at any point in the community. There is no requirement that the community adopt the floodway on the FIRM as its regulatory floodway. However, most NFIP communities do use the floodway on the FIRM rather than do the hydraulic analyses necessary to develop their own floodway. The community, FEMA and the Mapping Partner should work collectively to develop a floodway that meets the community’s needs. If the community uses their own floodway in lieu of the FEMA floodway, it must be in all instances wider than the FEMA floodway or the community must demonstrate that the floodway meets the allowable one foot surcharge criteria. In either situation the community must consult with the FEMA Region prior to adoption of the floodway.

5.8 Floodway Development by State and Federal Agencies

State and federal agencies also undertake development that could impact on floodways. For example, State highway departments construct roads, highways, and bridges using federal or states funds. Some of these state or federal agencies may be willing to apply for and obtain local permits and most will at least coordinate with the community to make sure that their actions are consistent with the requirements of the local floodplain management ordinance. Even if the
agency maintains that it is exempt from local permits it must still comply with floodway requirements comparable to those in your floodplain management ordinance.

Federal agencies are subject to Executive Ordinance 11988, Floodplain Management which requires at a minimum that their actions be consistent with NFIP minimum requirements. All federal agencies have adopted regulations that comply with Executive Order 11988 and should be applying floodway requirements to actions that they undertake or fund. State highway departments will be subject to Federal Highway Administration requirements each time they construct a bridge or road using federal funds. States also will have floodplain management regulations that will meet NFIP minimum requirements that will apply to their actions.

If a state or federal agency is undertaking development in a floodway in your community, you should contact that agency to assure that they have undertaken the hydraulic analyses necessary to assure that the development will not cause an increase in the base flood elevation within your community. If you need assistance, please contact your NFIP State Coordinator or your FEMA Regional Office (http://www.fema.gov/business/nfip/nfip_regions.shtm).

6.0 Floodway Coordination

The Mapping Partner ought to coordinate with the community when developing floodways. FEMA typically starts with an equal conveyance methodology to determine the floodway. However, because the floodway is the community’s tool to mitigate flood losses by restricting encroachments into the floodplain, Mapping Partners must coordinate all regulatory floodway determinations with community officials, as well as the NFIP State Coordinator and FEMA, as early as possible in the study process.

Some communities may wish to propose a floodway alignment that is not based on equal degree of encroachment (i.e. sometimes this is called a planning floodway). The approach for defining the floodway should be incorporated into the communities’ ordinances to support the variance from the equal conveyance floodway. Although generally the community should treat like situated property owners equally, there can be competing community needs that can be met if the community designates a floodway based on criteria other than equal degree of encroachment:

- The floodway can be drawn to minimize the inclusion of existing development. For example, there may be a developed or partially developed subdivision that would fall within an equal degree of encroachment floodway. Since developed areas often do not effectively convey floodwaters, floodways may need to be wider when these areas are included.

- The floodway can be drawn to accommodate proposed land uses. For example, the community may have approved a subdivision in an area or extended sewer, water, streets or other infrastructure to an area. There may be a need for a new bridge crossing and there may be other anticipated needs.

- The floodway can be drawn to be compatible with the communities land use plans or zoning. For example, one side of the river or stream may be zoned for agriculture or other low density use or be in parkland.
• The floodway can be drawn to include high hazard areas including areas subject to deep flooding or high velocity floodwaters or areas that emergency vehicles could not access during a flood.

• The floodway can be drawn in a way that will prevent legal challenges by ensuring that all existing parcels in the community have a building site.

Community designated floodways can be designed to meet the planning needs of the community provided the community has a sound rationale for establishing the proposed floodway boundaries.

Evaluating a community designated floodway can require trial and error in order to meet the allowable one foot surcharge which may increase study costs. For this reason, the Mapping Partner needs to obtain prior approval from the FEMA Regional Office. Information on contacting the FEMA Regional Offices can be found at http://www.fema.gov/business/nfip/nfip_regions.shtm.

Where communities have adopted a regulatory floodway, the Mapping Partner must use the configuration of the adopted floodway to the extent practical to compute floodway data along restudied streams. If the surcharge values are greater than the maximum allowable above the base condition, the Mapping Partner must inform the FEMA Project Officer and community. In such cases, the Mapping Partner must coordinate a revised configuration with the community and the FEMA Project Officer.

Where communities have not adopted a regulatory floodway or where the scope of work calls for a revised configuration, the Mapping Partner must coordinate the floodway configuration with the community and FEMA Project Officer. The Mapping Partner must discuss options for determining the floodway with community officials and the FEMA Project Officer. Those discussions should include:

• The establishment of the base condition for this floodway determination and future floodway revisions;

• The effects of high velocities on fill, and structures and preferences the community may have for restricting encroachments into high velocity areas or encroachments that may result in high velocities elsewhere;

• The restrictive nature of the regulatory floodway and means to distribute the restrictions evenly, such as determining the limits through equal conveyance reduction on both sides of the channel; and

• The use of public land such as parkland to offset restrictions in other parts of the floodplain.

The agreed upon approach must be fully documented in the hydraulics report including the reasoning leading to the encroachment methods and minutes of coordination meetings. Meeting minutes must include the date, time, and location of the meeting and a list of attendees. If the community cannot agree upon an approach, the Mapping Partner must consult the FEMA Project Officer for direction.
If more than one community is affected by the floodway, all affected communities must be included in the discussions. In the case that one of the communities sharing the same reach has a more stringent allowable maximum surcharge, the Mapping Partner must describe any differences in maximum allowable surcharge values and facilitate an agreement among the communities as to the maximum surcharge and the floodway configuration to be applied to the shared reaches. That agreement must be fully documented including the date, time, and location of the meeting, and signed by all parties in attendance. If such an agreement cannot be reached, the Mapping Partner must seek guidance from the FEMA Project Officer.

If the state or community in which the mapping project is being performed has established more stringent regulations for the maximum allowable rise in water-surface elevations, through legally enforceable statutes, these regulations take precedence over the NFIP regulatory standard. In the case of streams that form the boundary between two or more states, the 1.0-foot maximum allowable rise criterion should be used unless the states have previously agreed on a lesser rise criterion. The Mapping Partner must obtain written approval of the Regional Project Officer before computing or mapping a second regulatory floodway based on a criterion established by the community.

When the floodway has been established for either or both upstream or downstream communities, the Mapping Partner must coordinate with all involved communities to create a smooth transition of floodway surcharges and ensure the surcharges are within the maximum allowable limit.

7.0 Floodway Boundary Mapping

Floodways are delineated at the encroachment stations (limits of conveyance) at cross sections, nodes or grid elements and interpolated between. For more information, see section 5 of the Riverine Mapping and Floodplain Boundaries Guidance.

Where the floodway is mapped differently than the model results to meet state requirements, the Mapping Partner should document the state requirements and the location(s) that discrepancies occur.

8.0 Floodway Data Table

For each floodway determined under the scope of work, the Mapping Partner must create a Floodway Data Table (FDT). The FDT developed as part of this analysis must contain an entry for each cross section in the model to fully document the floodway analysis (this does not imply that all cross sections will be shown in the FDT published in the FIS report). For more information about the contents and appearance of the FDT see section 4 of the FIS Report Technical Reference.

Existence of high ground in the middle of a cross section would reduce the floodway width, computed as distance between two encroachment stations. In such a case, the width of floodway should be the width as mapped and a note should be added to the FDT to explain the difference.

When creating a FDT based on a HEC-RAS unsteady flow floodway analysis, the Mapping Partner should use floodway parameters (floodway width, section area, mean velocity of with-
floodway and without-floodway water-surface elevation) associated with the maximum discharge at each cross section from the unsteady floodway run.

Most two-dimensional models do not use cross sections. In those cases, the Mapping Partner should create a set of cross sections and an associated FDT. The cross sections should be placed at BFE contour lines and extend into the floodway fringe on both sides of the floodway. Cross sections should be placed at changes in floodway width, spaced adequately to represent stream characteristics, and with enough numbers to sufficiently represent the variation in floodway data.

9.0 Deliverable Products

The floodway analysis and mapping must be submitted as part of the hydraulics and floodplain submittal described in Section 6.6 and Section 6.9 of the Data Capture Technical Reference, and Section 9 of the FIRM Database Technical Reference. The Mapping Partner must submit files via the MIP; other media may be acceptable if coordinated with FEMA.

10.0 Floodway Analysis Review

The reviewing Mapping Partner will be responsible for performing hydraulic and floodway reviews as described below. The reviewing Mapping Partner is responsible for determining whether the proposed analyses are reasonable. Section 9 of the General Hydraulics Guidance provides requirements and criteria that should be used to determine if the hydraulic and floodway analyses are reasonable.

11.0 Evaluating Proposals for Floodway Development

Once a community has designated a floodway it must prohibit development within that floodway unless it has been demonstrated through hydrologic and hydraulic analyses that the development will not cause an increase in flood stages at any point in the community. Some communities maintain their own in-house engineering expertise and perform these analyses themselves. Most require that the permit applicant hire a qualified registered professional engineer to conduct the analysis and submit it to the community for review and approval. This analysis is usually called a “no-rise” or a “zero-rise” analysis and results in a “no-rise certification” if the analysis demonstrates that there will not be any increase in the base flood elevation due to the development. This section provides guidance on conducting and reviewing the “no-rise” analysis.

11.1 The Types of Development that Must Be Evaluated

The NFIP broadly defines development to include nearly all man-made changes to the floodplain. Permits are required for all development to determine whether the development is subject to the floodplain management requirements in the community’s ordinance. For development other than buildings the primary purpose of the permit review is to determine whether the development is in the floodway and, if it is, whether it will cause any increase in flood stage.

44 CFR 59.1 Definitions: *Development means any man-made change to improved or unimproved real Estate, including but not limited to buildings or other structures,*
It is important to note that development includes additions to buildings that are less than substantial improvements. These additions can obstruct flood flows and increase flood stages. In addition, development includes the storage of equipment and materials. Activities such as the stock-piling of sand or gravel or the storage of heavy machinery in the floodway can be as much of an obstruction of flood flows during the base flood as the permanent placement of fill or construction of a building. Unless you as a community can be absolutely sure that these equipment or materials will be removed from the floodway prior to a flood, you must determine that they will not cause any increase in flood stage before you can permit the use.

Communities can exercise some discretion and common sense in determining which development requires permits or a hydraulic analysis. For example, you can exclude on-going activities such as gardening and most forms of agriculture from your permitting requirements. These activities generally do not change the existing grade of the ground in the floodway and will not obstruct flood flows. Any related activities such as construction of levees that involve placement of fill are covered in the definition of development and will require permits.

11.1.1 Exemptions for Minor Projects

There are other developments within the floodway that will require permits but can be allowed once the community determines that they are not an obstruction to floodwaters. Small projects that do not increase the natural grade, such as the paving of a driveway or parking area at the existing grade can be permitted. There are other minor projects that probably will not increase flood stages. For example, small isolated obstructions such as a mailbox, a pitcher’s mound, or a single telephone pole can be permitted without requiring a no-rise certification. There is almost no likelihood that these minor projects by themselves or in combination could cause a measurable increase flood stage.

Common sense can also be exercised when evaluating proposals to place fences in the floodway. Most types of fences such as barbed wire or chain link fences are likely to be knocked over by floodwaters and debris long before flood heights approach the elevation of the base flood. Debris will build up on these fences and the force of the water will push or bend the fence over. More substantial fences such as solid wood privacy fences on small streams may obstruct flood flows and will need to be evaluated. If in doubt, you have two choices. You can require the fence be constructed in a manner that will assure that it will be knocked over and not obstruct flood flows during the base flood (for example by requiring shallow embedment of the fence posts) or you can require that the permit applicant obtain the services of a registered professional engineer to design the fence or conduct a no-rise analysis.

If in doubt as to whether an obstruction will increase flood stages, the community should require that the permit applicant conduct a hydraulic study to demonstrate that there will be no rise in flood stage.
11.2 Meeting the No-Rise Criteria

Once you determine that a development will take place in the floodway, the next step is to demonstrate that the development will not cause any increase in flood stage. FEMA defines “any” as meaning a zero increase. It does not mean that you can allow a .1 foot or even a .01 foot increase – it means nothing greater than 0.00 feet. If you do not limit the increase to zero, the small increases in flood heights from individual developments will cumulatively have significant impacts on flood stages and flood damages. Under NFIP minimum requirements it is assumed that there will be no cumulative increases since the permissible increase for any single encroachment is zero.

There a number of ways a permit applicant can meet the no-rise criteria contained in the community’s floodplain management regulations.

11.2.1 Redesign the Development to Avoid the Floodway

The best way to meet the no-rise criteria is to design or redesign the development so that no obstructions are placed in the floodway. For example, when planning a subdivision, the plat can be laid out so that the floodway areas are included in common open space or as backyards to buildings that will be located outside of the floodway or even better outside of the floodplain.

11.2.2 Replace an Existing Building, Bridge, or Culvert

There are also situations where you may allow the replacement of an existing building or bridge or culvert in the floodway without requiring a hydraulic study and a no-rise certification. For example, the demolition of a building and the replacement of the building with a new building can be permitted provided that the new building is contained within the footprint of the demolished building. If you go outside of the footprint of the demolished building or change the location of the building, the effect on flood flows may change and you will have to conduct a hydraulic analysis and demonstrate that there will be no increase in flood stages. The replacement building will of course have to comply with the other requirements of your ordinance. Your community may wish to limit the replacement of buildings in the floodway. Although the new building should be protected from flood damages during the base flood, it will be isolated by floodwaters and search and rescue operations may be required.

It may also be possible to replace a bridge or culvert with an identical or larger bridge or culvert and not cause an increase. However, new bridges and culverts are seldom identical to those that they replace since design standards will change. Unless the new bridge or culvert is identical to the one it replaces or the waterway opening is increased with no other change to the cross section, you will have to conduct a hydraulic analysis and demonstrate that there will be no increase in flood stage. Usually a hydraulic analysis will be required to design the bridge or culvert anyway so the no-rise certification can be provided. Remember that replacement of a bridge or culvert may provide an opportunity to solve an existing upstream or downstream flood problem.

11.2.3 Span the Floodway

For bridges on smaller streams it is sometimes possible to span the floodway with a waterway opening sufficient in size to pass the base flood without causing an increase. This bridge would meet the no-rise criteria. Generally, however, a hydraulic analysis would be conducted anyway as part of the bridge design and a no-rise certification can be obtained as part of that analysis.
11.2.4 Demonstrate That There Will Be No-Rise in Flood Stage through a Hydraulic Study

In some situations, it may be possible to demonstrate that a development will cause no increase in flood stage by conducting a hydraulic analysis. Guidance for conducting hydraulic analysis and making a no-rise certification can be found in Section 5.5 below. Generally, you can expect that development in the floodway will cause an increase in flood stage. If the floodway has been properly computed and displayed on the map, nearly all areas within floodway should effectively convey floodwaters. When an increase occurs, it will be necessary to modify the development proposal so that it no longer causes an increase in flood stage or to compensate for the increase. Most communities require the permit applicant to hire an engineer to do the analysis and provide a no-rise certification.

11.2.5 Limit the Development to the “Hydraulic Shadow” or “Conveyance Shadow” of Another Obstruction

There are also situations where the development can be limited to the hydraulic shadow of a building or other obstruction such as an isolated area of high ground that was in existence at the time the floodway was designated. This should be only done for small projects such as building additions or accessory buildings. The conveyance shadow includes the areas immediately upstream and downstream of an existing building or other obstruction. Flood waters are already flowing around the existing obstruction so that the new development will not affect the existing flood flows. (See Figure 11-1.)

![Figure 11-1. Limiting development to the hydraulic shadow of an existing building or other obstruction.]

Generally, the conveyance shadow is determined by drawing lines at a 1:1 ratio upstream and downstream of the obstruction. Building additions or small accessory structures built entirely within the conveyance shadow can be permitted without the engineering analysis needed for a no-rise certification. The addition or accessory building must meet all other floodplain management requirements in your ordinance.
11.2.6 Compensate for Any Rise

If a development is in the floodway and will cause an increase in flood stage, it may possible to compensate for the rise by physically modifying the floodway to replace the flood conveyance that would be lost as a result of the development. Typical ways that this is done include:

- Modifications to the channel or overbank areas of the cross section or channel improvements to compensate for the loss of conveyance. Channel improvements are frequently done as part of bridge design and construction. Modifications to the channel and overbank areas and channel improvements must be permanent changes to the floodway. The community must assume responsibility for maintaining the modification or improvement or negotiate a maintenance agreement with the permit applicant. A floodway revision as provided for in 44 CFR 64.7 will be required if floodway boundaries or base flood elevations change.

- Removal of an existing comparable obstruction such as a building or bridge. However, you must usually conduct a hydraulic analysis to demonstrate that the net result will be no increase in flood stage during the base flood.

- Permanent changes in land use such as replacement of a floodplain forest with a ball field or parking lot can also be used to compensate for loss of conveyance. However, there must permanent changes in land use. Cutting down of trees to increase conveyance is not a permanent change if the trees will grow back.

- Expanding the floodway to replace the conveyance lost due to the obstruction. It may also be possible to expand the floodway to compensate for the encroachment. This is usually done to compensate for loss of conveyance from bridge piers or pilings. Unless the area is in public ownership, expanding the floodway will generally require a floodway revision to assure that the area remains available for conveyance of floodwaters.

Each of these alternatives will require a hydraulic analysis to demonstrate the result of the compensation is that there will be no increase in flood stage during the base flood.

11.2.7 Floodway Revision

It may be possible to revise the floodway boundaries so that the development is no longer in the floodway while still meeting the allowable one foot surcharge. You can sometimes narrow the floodway at the location of the development or shift the floodway alignment so that that the development is no longer in the floodway while still meeting the one foot surcharge limitation. Usually this will require the surveying of additional cross sections to more accurately model the floodway at the location of the development. If you want to do this, you must obtain a floodway revision as provided for in 44 CFR 64.7 of NFIP regulations. Floodway revisions must be applied for by the community since it is the community’s adopted floodway that is being changed. Procedures for obtaining floodway revisions are described in Section 7. The floodway revision must be obtained prior to proceeding with the development.
11.3 How a No-Rise Certification is Developed

NFIP minimum criteria prohibit encroachments in the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the encroachment will not cause any increase in flood levels in the community during the base flood discharge. FEMA defines “any” as meaning a zero increase. It does not mean that you can allow a .1 foot or even a .01 foot increase – it means 0.00 feet. Otherwise the cumulative effects of all of the developments in the floodway could significantly increase flood stages. There should be no cumulative effects since the permissible increase for any single development is zero.

This hydrologic and hydraulic analysis is commonly called a no-rise or zero-rise analysis and results in a no-rise certification. A few states and communities perform the no-rise analysis themselves, but most require the permit applicant to hire a qualified registered profession engineer to perform the analysis and provide the no-rise certification.

Some communities require that the registered professional engineer submit the no-rise certificate on a form such as the example in Figure 11-2. Other communities allow the engineer to submit the certification in a letter. Either way is acceptable provided that all of the necessary information is included. The no-rise certification must be accompanied by documentation to support the finding that there will be no increase in flood stage including the results of the hydraulic study.

Generally, the process for conducting the hydraulic analyses is the same as that used for applying for a FIRM or floodway revision (see Section 7).

- The registered professional engineer obtains a copy of the model used to develop the effective FIS from FEMA. For information on how to obtain copies of the effective model, see FEMA’s Internet site at [http://www.fema.gov/plan/prevent/fhm/st_order.shtm](http://www.fema.gov/plan/prevent/fhm/st_order.shtm).
- The engineer duplicates the results of the effective model (called the Duplicative Effective Model).
- The engineer makes any corrections to the effective model (called the Corrected Effective Model) such as technical errors in the effective modeling or the inclusion of any floodplain changes that occurred prior to the date of the effective model.
- The engineer develops a model for existing conditions that reflects any modifications that have occurred within the floodplain since the date of the effective model but prior to the proposed development (called the Existing Conditions Model). Generally, one or more additional cross sections will be necessary to model the impacts of the proposed development and any modifications that are made to the channel or overbank areas to compensate for any loss of conveyance.
- The engineer modifies the Existing Conditions model to reflect the proposed development at the new cross sections while retaining the currently adopted floodway widths (called the Proposed Conditions Model).
• The engineer compares the results of the Proposed Conditions Model to the Effective Model or Corrected Effective Model to determine if there will be an increase in elevation of the base flood or floodway elevations at any existing or new cross section.

If there will not be an increase in either of the elevations, the engineer can prepare and submit the no-rise certification and the supporting technical documentation to the community (Figure 11-2). If there will be an increase, the development will have to be redesigned to avoid the floodway, compensation provided for the loss of conveyance, or there will need to be a floodway revision.

11.4 Evaluating “No-Rise” Analyses Submitted by Engineers

The community must prohibit development in the floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during occurrence of the base flood discharge. It is the community’s responsibility to make the determination that a development in the floodway will not cause any increase in flood stage. You cannot depend solely on registered professional engineer’s no-rise certification and must review and approve the submission.

A certification by a registered professional engineer does not constitute a warranty or guarantee of performance, expressed or implied. Certification of data is a statement that the data is accurate to the best of the certifier’s knowledge. Certification of an analysis is a statement that the analysis has been performed correctly and in accordance with sound engineering practice. However, not all engineers are equally skilled or experienced in performing technical analyses and there is room for disagreements as to what constitutes standard engineering practice. Remember the registered professional engineer works for the permit applicant and not the community. The no rise certification is a valuable piece of information that you can use to help make your determination, but you are not obligated to accept the no-rise certification if you have reason to believe that it is not done correctly.

Communities that have city or county engineering departments or that contract for these services are encouraged to develop their own in-house engineering capability to evaluate proposals for floodway development and review no-rise certifications. If your community is part of a flood control or water management district, they may be willing to provide this service for their local governments. Some states that have their own state floodplain management regulations or that maintain engineering staffs that conduct Flood Insurance Studies may also be willing to perform this service for communities. If the development requires a floodway revision and you wish to approve the development, forward the revision request to FEMA and it will do the review as part of processing the request.
Figure 11-2. Example of a No-Rise Certificate.
Communities should look at the following when reviewing no-rise certifications.

- The registered professional engineer should be experienced in conducting hydrologic and hydraulic studies. You do not have to accept a certification if you do not feel that the engineer is qualified to conduct the analysis.

- The analyses must be conducted using the hydraulic model that was used to develop the FIS if it is still available.

- The analyses should be consistent with basic hydraulic principles. For example, there needs to be smooth transitions in flood flows between cross sections. Abrupt changes in floodway width for example should be avoided.

- If the development is located between existing cross sections, additional cross sections must have been surveyed at the site of the development to accurately model the impacts of the development.

- The analysis should not include unrealistic land use or hydraulic assumptions. For example, if the analysis assumes that roughness coefficients used in the original FIS are changed, the new roughness coefficients must reflect what is actually on the ground.

- There should be no cumulative impacts if other property owners undertake similar developments. It is important that there really is no increase in flood stage due to the development.

- If the no-rise analysis depends on adding additional flow areas to compensate for the impacts of an encroachment, you must ensure that the flow area will be available in perpetuity and that the floodwaters can get to and use that flow area. You will want to require the applicant to apply for a floodway revision and adopt the revised floodway as part of your ordinance.

Again, if you have doubts about the submission, contact your state or FEMA Regional Office for assistance (http://www.fema.gov/business/nfip/nfip_regions.shtm).

If the analysis depends on a change in floodway boundaries to achieve “no-rise” and a floodway revision will be required see Section 7, Obtaining a Revision to Floodway Boundaries. If you approve the request and forward a request for a floodway revision to FEMA, FEMA will review the hydraulic analysis when it reviews the request.

Generally, you must maintain documentation in your files of the hydraulic analysis, the no-rise certification, and your determination indefinitely. FEMA or your state will ask to see the documentation on your next Community Assistance Visit (CAV), and you will need the documentation if your floodway is ever revised.
12.0 Encroachment Requirements for Rivers and Streams without Floodways

FEMA may also issue a FIRM that include rivers or streams where FEMA has conducted a detailed study and established base flood elevations, but not designated a floodway. Generally, these Studies are conducted in less densely populated areas where it is difficult to justify the expense of conducting an engineering study that would include a floodway. These areas are subject to the requirements at 44 CFR 60.3(c)(10) which requires a hydraulic analysis to ensure that each development in the floodplain does not increase base flood levels by more than one foot at any point in the community. The requirement at 44 CFR 60.3(c)(10) essentially applies the same standard to these areas as would apply if a floodway were designated (the maximum one foot rise in flood stage). The main difference is that the hydraulic analyses are conducted on a case-by-case basis for each proposed development in the floodplain. Most communities pass on the cost of performing this analysis to the permit applicant. The advantage of having a floodway designated is that the community can review and permit development outside of the floodway without requiring a hydraulic analysis and without passing the costs of that analysis on to the permit applicant.

The requirement in 63.3(c)(10) only applies along rivers, streams, and other watercourses where FEMA has provided base flood elevations. The requirement does not apply along lakes, bays and estuaries, and the ocean coast. Generally, this type of data is provided as interim data and the intent is to eventually re-map these areas to add floodways when funding becomes available and the amount of development warrants the added cost to develop floodways.

Sometimes a decision is made not to designate a floodway on a stream because hydraulic conditions on the river or stream do not lend themselves to modeling a floodway using standard methodologies. Generally, FEMA, the state, and the community agree to an alternative management scheme for the stream that achieves the same purpose as designating a floodway or performing an encroachment analyses under 60.3(c)(10).

44 CFR 60.3(c)(10): Require until a regulatory floodway is designated, that no new construction, substantial improvements, or other development (including fill) shall be permitted within zones A1-30 and AE on the community’s FIRM, unless it is demonstrated that the cumulative effect of the proposed development when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.

12.1 Ways to Meet the 60.3(c)(10) Requirement

Section 60.3(c)(10) of NFIP regulations requires a hydraulic analysis to ensure that each development in the floodplain does not increase base flood levels by more than one foot at any
point in the community. One of the concerns that have been expressed about implementing the requirement has been the cost of performing a hydraulic analysis for a small development such as a single home. The costs of this analysis must be considered as part of the cost of developing in the floodplain. The potential adverse impacts of development in the floodplain on upstream and adjacent property owners can be significant and must be evaluated before the development is allowed to occur. However, there are several ways a community can avoid or minimize these costs:

- **Stay out of the floodplain entirely.** Usually limited detail studies without floodways are provided in rural areas or less densely populated areas where parcels are large and there is a choice of building sites. In these cases, it is often in everyone’s best interest to design the development so that the building sites are located outside of the floodplain. The floodplain is preserved, and the permit applicant avoids the added costs of performing the hydraulic analysis and of developing in the floodplain.

- **Limit development to backwater areas.** It may also be possible to limit the development to backwater areas that are not effective flow areas. Most floodplains have irregular boundaries and include backwater areas that provide storage of floodwaters but play little or no role in the conveyance of floodwaters. The velocity of floodwaters in these areas may be zero or close to zero. There may also be floodplain areas that are separated from the river or stream by a railroad or road embankment or a substantial levee that is at or near the base flood elevation that parallels the river or stream. Areas behind these obstructions also may not convey flood flows. These areas are not taken into account as flow areas when the hydraulic model is developed of the floodplain. Development of these areas will not increase flood stages. A qualified engineer can apply basic hydraulic principles to identify these areas. The remainder of the floodplain is sometimes referred to as a natural floodway.

- **Establish setbacks:** Finally, it may be possible to develop a standard setback or an algorithm for establishing setbacks along smaller streams in your community that would serve the same purpose as 44 CFR 60.3(c)(10). You may already have adopted a setback to preserve a natural stream buffer to protect water quality. Back-up your setback or algorithm with engineering calculations to show that development will cause no more than a one foot rise in flood stage. Be conservative. Test the setback or algorithm on a reasonable number of cross-sections given the variety of stream conditions in your community. If you choose this alternative, check with your state or FEMA Regional Office first.

If you adopt either the second or third alternative and feel that permit applicants may challenge your setbacks or other requirements, you can always allow the applicant the option of hiring an engineer and submitting a (c)(10) analysis if they disagree. Most permit applicants are likely to comply with your requirement as long as it is reasonable rather than to go to the expense of paying for a hydraulic analysis.

### 12.2 Performing a 60.3(c)(10) Analysis

In those floodplains where FEMA has provided the community with base flood elevations, but no floodway, the community must prohibit development unless it is demonstrated that the cumulative
effect of the proposed development when combined with all other existing and anticipated
development, will not increase the water surface elevation of the base flood more than one foot
at any point within the community.

When evaluating the proposed development, you must assume that other like situated property
owners will want to develop their properties in the same manner as the permit applicant and that
eventually their properties will be developed. You must take their rights to develop into account
when evaluating a development to determine if it will cause no more than a one foot increase in
flood stage for the base flood. For example, if the permit applicant wants to build a house on fill
that extends 100 feet into the floodplain, you must assume that the property owners across the
stream encroach into the floodplain an equal amount. You must also make the same assumption
for upstream and downstream property owners on both sides of the river or stream. You are in
effect developing a floodway for that reach of stream. You need to extend your hydraulic analysis
far enough upstream and downstream to capture the cumulative impacts of all of this
development.

13.0 Obtaining a Revision to Floodway Boundaries

Generally, you must apply for and obtain a floodway revision from FEMA any time you want to
make a change in the FEMA-designated floodway boundaries even if the change is so small that
it would not be visible on your FIRM. Applicants for floodway revisions usually want to narrow the
width of the floodway or shift the location or alignment of the floodway to allow for a development.
Procedures for obtaining a floodway revision can be found in NFIP regulations at 44 CFR 65.7
Floodway Revisions.

Requests for floodway revisions must come from the community. It is your floodway that you
have legally adopted as part of your floodplain management ordinance. You probably held a
public hearing and met other due process requirements when you designated your floodway and
usually will have to meet the same requirements to adopt a floodway revision. You are not
obligated to revise your floodway merely because a permit applicant can demonstrate that it is
possible to narrow the floodway or change the floodway alignment. Remember that when you
revise a floodway boundary, you may impact on other property owners in your community. They
usually will have an interest in maintaining the current floodway alignment and must be notified
before you propose a Floodway Revision to FEMA.

13.1 Procedures for Applying for a Floodway Revision

Applications for floodway revisions are submitted using FEMA’s MT-2 Forms. The MT-2 Forms
and the accompanying instructions can be downloaded from FEMA’s web site
44 CFR 65.7 Floodway Revisions. (a) General:

Floodway data is developed as part of FEMA Flood Insurance Studies and is utilized by communities to select and adopt floodways as part of the floodplain management program required by Sec. 60.3 of this subchapter. When it has been determined by the community that no practicable alternatives exist to revising the boundaries of its previously adopted floodway, the procedures below shall be followed.

You are under no obligation to request a floodway revision under 44 CFR 65.7 just because a developer wants one. It is your floodway that you have adopted in accordance with your due process requirements and you as a community must approve the proposal and submit it to FEMA. Remember you are required to evaluate alternatives to the development that would meet the requirements of your floodplain management ordinance and demonstrate that these alternatives are not feasible before a LOMR will be issued by FEMA. In most situations there will be alternatives that do not require encroachments into your floodway or floodplain that would not require a floodway revision.

You will be required to submit evidence that all affected property owners and communities have been notified of your intent to revise the floodway to assure that they are aware of potential adverse impacts of the revision. Your community will also have to find that the revision and the proposed project meet or are designed to meet all community floodplain management requirements and that all necessary federal, state, and local permits have been or will be obtained. The most commonly required federal permits are wetlands permits under Section 404 of the Clean Water Act of 1972 and incidental take permits under Section 10 of the Endangered Species Act of 1972. If the floodway revision is approved by FEMA, you will be required to adopt the revised floodway as part of your floodplain management ordinance and use the revised floodway to regulate future development.

The procedure for applying for a floodway revision requires a hydraulic analysis similar to that required to demonstrate that a development would cause no-rise in the elevation of the base flood. The main difference is that instead of evaluating the impacts of a development in the floodway on the base flood elevation, the hydraulic analysis is instead demonstrating that the proposed revised floodway including any modifications that have been made to the channel and overbank areas within the revised floodway will carry the base flood without increasing the water surface elevation of that flood more than one foot at any point in the community. This is the same standard used to designate the floodway that is being revised.

13.2 Development Proposals that Exceed the One Foot Standard

There are limited situations where it may be necessary to allow development in the floodway or the floodplain that would result in increases in the base flood elevation greater than that generally allowed by NFIP minimum criteria. This could include:

- A proposal for development in the floodway that would cause an increase in the base flood elevation.
• A request for a revision to floodway boundaries that would result in a floodway that would result in greater than the allowable one foot surcharge.

• A proposal for development in a floodplain where no floodway has been designated that would cause greater than a one foot increase in flood stage.

Generally, this type of development is discouraged. Designation of the floodway can already cause up to a one foot increase in flood stage and even this one foot increase can substantially increase upstream flood damages.

There are situations where it may be in the public interest to allow this development if no existing buildings are impacted and future buildings are elevated or floodproofed to the new base flood elevations. The procedure for obtaining a FIRM and floodway revision to allow this type of development has been established at 44 CFR 65.12 of NFIP regulations. Section 65.12 was developed to provide a mechanism to address several situations where it was thought to be in the public interest to allow development in the floodplain that would otherwise violate the provisions of the community’s floodplain management ordinance. These situations include:

• Construction or increase in height of a dam or other water control structure particularly when it would reduce overall flood damages. Without the procedure at Section 65.12 this type of development would not be permitted under the community’s floodplain management ordinance.

• Construction or replacement of roads or bridges that cross the floodplain. In situations where no existing development is impacted by the increase in flood stage there may be considerable cost savings in building a bridge with a smaller waterway opening.

• Other developments that have a net public benefit where there are no practicable alternative actions that would comply with the community’s floodplain management requirements.

The procedure can only be used in situations where no existing structures will be impacted by the increase in the base flood elevation and only if all affected property owners are notified of the proposed revision. If FEMA approves the revised floodway, the community must adopt the revised floodway and higher base flood elevations and use them to regulate all future development. Often agencies proposing to construct such facilities are willing to purchase and relocate impacted buildings and purchase flowage easements to mitigate the impacts of the increased base flood elevations.
44 CFR 60.3(c)(13): Notwithstanding any other provisions of Sec. 60.3, a community may approve certain development in Zones A1-30, AE, and AH, on the community’s FIRM which increase the water surface elevation of the base flood by more than one foot, provided that the community applies for a conditional FIRM revision, fulfills the requirements for such a revision as established under the provisions of Sec. 65.12, and receives the approval of the Administrator.

44 CFR 60.3(d)(4): Notwithstanding any other provisions of Sec. 60.3, a community may permit encroachments within the adopted regulatory floodway that would increase in base flood elevations, provided that the community applies for a conditional FIRM and floodway revision, fulfills the requirements for such a revision as established under the provisions of Sec. 65.12, and receives the approval of the Administrator.

Guidance for meeting the requirements of Section 65.12 can be found in the MT-2 Forms and Instructions and in Appendix C. A community may allow this type of development only if applies for and obtains a conditional FIRM and floodway revision and meets specific requirements in Section 65.12. A FIRM revision will be required to reflect any increase in base flood elevations due to the development. A floodway revision is required if there is a change in floodway boundaries. Once the community obtains approval of the FIRM and floodway revision, it must adopt the higher base flood elevations and revised floodway prior to permitting the development.

13.3 Meeting the Requirements of 44 CFR 65.12

Prior to permitting a proposed development in the floodway that would cause an increase in the base flood elevation, a request for a revision to floodway boundaries that would result in greater than the allowable one foot surcharge, or proposed development in a floodplain where no floodway has been designated that would cause greater than a one foot increase in flood stage the community must apply for and obtain approval from FEMA of a conditional FIRM and floodway revision.
44 CFR 65.12 Revision of flood insurance rate maps to reflect base flood elevations caused by proposed encroachments.

(a) When a community proposes to permit encroachments on the floodplain when a regulatory floodway has not been adopted or to permit encroachments upon an adopted regulatory floodway which will cause base flood elevations increases in excess of that permitted under paragraphs (c)(10) or (d)(3) of s.60.3 of this subchapter, the community shall apply to the Administrator for conditional approval of such action prior to permitting the encroachments to occur and shall submit the following as part of the application:

The requirements for obtaining conditional approval are found in 44 CFR 65.12. The community must:

- Evaluate alternatives to the development that would meet the requirements of 60.3(c)(10) or (d)(3) and demonstrate that these alternatives are not feasible.

- Provide individual notice to each property owner explaining the impact of the proposed action on their property.

- Obtain concurrence of the Chief Executive Officer of any other community impacted by the proposed action.

- Certify that no structures would be impacted by the increased base flood elevations.

Once the conditional map change has been approved by FEMA the community must adopt the increased base flood elevations and revised floodway prior to permitting the proposed action. The increased base flood elevations and revised floodway become part of the ordinance and apply to all future development in the community.

You are under no obligation to request a floodway revision under 44 CFR 65.12 just because a developer wants one. It is your floodway that you have adopted in accordance with your due process requirements and you as a community must approve the proposal and submit it to FEMA. Remember you will be required to evaluate alternatives to the development that would meet the requirements of your floodplain management and demonstrate that these alternatives are not feasible before a CLOMR will be issued by FEMA. In most situations there will be alternatives that do not require encroachments into your floodway or floodplain that would exceed those permitted in your floodplain management ordinance.
14.0 Alterations and Relocations of Watercourses

Communities that participate in the NFIP are also required to assure that flood carrying capacity of an altered or relocated watercourse in a floodplain is maintained. This requirement applies in Zone A where FEMA has not provided base flood elevations as well as in Zones AE, A1-30, AO and AH which have been studied in detail. In order to meet this requirement, communities must assure that:

- Any altered or relocated watercourse has the same or greater flood carrying capacity as it did before the alteration occurred, and
- Once the watercourse has been altered or relocated, the community has an affirmative responsibility to assure that it is properly maintained.

The community is also responsible for notifying adjacent communities and the state coordinating office prior to altering or relocating a watercourse and providing FEMA with a copy of this notification.

44 CFR 60.3(b):

(6) Notify, in riverine situations, adjacent communities and the State Coordinating Office prior to any alteration or relocation of a watercourse, and submit copies of such notifications to the Administrator;

(7) Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained;

14.1 Definition of Watercourse

Watercourse is not defined in NFIP regulations, but generally means the channel of a river, stream or drainage way and not the adjacent overbank areas. Placement of fill in the overbank areas only and outside of the channel is not an alteration or relocation of a watercourse. The overbank areas are addressed under the NFIP floodway requirements. Watercourses include not only rivers or streams that are the source of flooding used to determine the base flood and the floodplain boundaries, but also smaller streams, drainage ways and ditches within the floodplain that could flood during smaller more frequent events.

14.2 Application

The requirement to maintain the carrying capacity of altered or relocated watercourses applies to watercourses in all mapped floodplains. In a Zone A where no base flood elevations have been provided by FEMA, the requirements are particularly important because there are no floodways designated and no other requirements that would preserve the capacity of the floodplain to convey floodwaters. Preserving the capacity of the watercourse to convey floodwaters will help prevent flooding from becoming worse as the area develops. Historically, the failure to maintain the carrying capacity of altered relocated channels has created numerous flood problems. For example, it was common practice to force a natural stream into a pipe or culvert when developing
an industrial area or a subdivision. Frequently these pipes or culverts did not have the capacity to pass the 1% chance flood or even much more frequent floods. The result was chronic flooding, repetitive flood losses, and eventually costly corrective measures.

Once FEMA provides a community with base flood elevations and a floodway is designated the requirements continue to apply to the channel of the river or stream. The floodway designation will prevent encroachments in the floodplain that cause more than a one foot increase in flood stage while the (b)(6) and (b)(7) requirements will protect the capacity of the channel of river or stream to convey floodwaters. The (b)(6) and (b)(7) requirements also will continue to apply to watercourses such as smaller tributary streams and drainage ways within the floodplain even though they are not the flooding source that produces the base flood elevation.

Communities are not required to maintain natural streams or channels and watercourses that were altered or relocated before the community joined the NFIP. Natural streams and watercourses that were altered or relocated before the community joined the NFIP are treated as existing conditions that are taken into account when the floodplain is mapped by FEMA. FEMA recognizes that maintaining natural streams can be costly to the community and often raises environmental issues. Watercourses that were altered or relocated prior to the community’s participation in the NFIP can also be costly to maintain and the community may not have the legal authority to undertake or require their maintenance. However, if these watercourses do silt in or become clogged with debris or other obstructions, FEMA will eventually have to re-map these areas to reflect the increased flood hazard. The floodplain will likely become larger and the base flood elevation will increase. It is usually in the best interests of communities to maintain these pre-existing altered or relocated channels even though it is not required by FEMA to ensure that flooding does not increase and to avoid the need for this remapping.

14.3 Maintaining the Carrying Capacity of the Watercourse

Communities must assure that the carrying capacity of the altered or relocate watercourse is maintained. This means that the carrying capacity of the altered or relocated channel must be the same or greater than the original watercourse. The community will have to undertake some kind of analysis to assure that this occurs.

In undeveloped areas designated as Zone A where FEMA has not conducted a detailed engineering study and not developed base flood elevations, this analysis can be as simple as the community engineer reviewing the proposal and determining that:

- The channel size and cross section are as big, and the channel is as straight as the original watercourse and that there are smooth hydraulic transitions into and out of the altered or relocated portion of the watercourse.
- The channel sides and bottom are of the same or similar materials to the original watercourse and that the roughness coefficient is roughly the same.

If there are substantial differences between the altered and relocated channel and the original watercourse it may be necessary to require that the permit applicant submit a hydraulic analysis by a registered professional engineer.
In developed areas a detailed hydraulic analysis will usually be necessary to assure that the carrying capacity of the watercourse is maintained because of the potential for increasing flood damages to existing buildings. If the area has a floodway designated, this can be done as part of the hydraulic analyses necessary to meet floodway requirements.

If you choose to enlarge a watercourse you may impact on downstream peak flood discharges. The larger channel will carry more floodwaters and depending on the watershed may increase or decrease these peak discharges. You should consider requiring the permit applicant to provide an analysis assessing these impacts before you approve the development.

### 14.4 Maintaining the Altered or Relocated Portion of the Watercourse

Once a watercourse is altered or relocated an artificial condition is created. If the watercourse is not maintained, erosion of the banks and sedimentation could occur decreasing the capacity of the channel to carry flood flows. Altered and relocated rivers or streams will often meander and try to return to their old location. In addition, vegetation can grow choking the altered or relocated channel. Any benefits in reducing flood hazards from the altered or relocated channel will be lost and flood hazards could increase. Figure 14-1 shows a constructed channel that is overgrown with vegetation and for which the conveyance is significantly reduced.

![Figure 14-1. Picture of a constructed channel in Arizona that is overgrown with vegetation (from U.S. Geological Survey Scientific Investigations Report 2006-5108).](image)

As a result, it is critical that any altered or relocated channel be maintained. There are two ways that this can be done. First, the community can formally assume ownership or responsibility for the maintenance of the channel and obtain from the permit applicant any necessary easements or other permissions necessary to conduct the maintenance. Second, the community can negotiate an enforceable maintenance agreement with the owner of the watercourse to assure that the watercourse is maintained. Whichever alternative is chosen the community will have to
periodically inspect the watercourse. When maintenance is required, the community will either have to conduct the maintenance or require the owner of the watercourse to conduct the maintenance.

If a community requests that FEMA revise its FIRM based on an altered or relocated watercourse, FEMA will require you to submit a maintenance agreement prior to issuing a Letter of Map Revision (LOMR) or physical map revision. If the channel is not maintained, FEMA can rescind the LOMR, revise the FIRM to show the increased flood hazard, or initiate an enforcement action against the community.

14.5 NFIP Community Rating System (CRS) Credits for Drainage System Maintenance

The NFIP provides credit under its Community Rating System (CRS) for communities that have Drainage System Maintenance programs that meet CRS requirements. The CRS provides discounts on flood insurance premiums in communities that undertake floodplain management activities that go beyond the minimum requirements for community participation in the NFIP.

For the purposes of CRS, a community’s drainage system includes those natural and man-made drainage ways and channels, storm sewers and ditches, and detention and retention basins that must be maintained in order to prevent damages to buildings during smaller more frequent storms. Drainage System Maintenance credits are provided for communities that establish and implement programs to systematically inspect their drainage systems, including all channels and debris basins, and remove debris and correct any drainage problems they encounter. This credit applies to all natural and man-made watercourses that are part of the community’s drainage system, not just those that have been altered or relocate since the community joined the NFIP.
Related Templates associated with this Guidance

Note:

The following templates will be a tool to help practitioners comply with the guidance contained in this document and will help with overall program consistency. Once they have been reviewed and comments have been addressed, the templates will be stored individually on the fema.gov G&S web page under the “Templates and Other Resources” link (http://www.fema.gov/media-library/assets/documents/32786?id=7577). They are merely provided here to aid in the consolidation of review comments to one document.