Federal Emergency Management Agency

Washington, D.C. 20472

CERTIFICATION REQUIREMENTS FOR SIMPLE FLOODWAY ENCROACHMENTS

Introduction

This document is intended to provide guidance to local floodplain administrators in evaluating requests for the placement of fill at a single location, a building, or another simple encroachment within an adopted regulatory floodway. The procedure contained in this document is not intended to evaluate complex encroachments, such as extensive fills, multiple structures, bridges, or levees, where flow expansion and contraction losses may be significant. In such cases, full hydraulic analyses by computer backwater models should be employed. The minimum floodplain management requirements for communities participating in the National Flood Insurance Program (NFIP) in which a regulatory floodway has been designated prohibit any floodway development that would result in an increase in flood levels within the community during the occurrence of the base (100-year) flood discharge. This requirement is outlined in Paragraph 60.3(d)(3) of the NFIP regulations.

Because floodway development is contradictory to the tenets of sound floodplain management, such development is discouraged by the Federal Emergency Management Agency (FEMA). Therefore, these certification requirements assume that all practical alternatives to floodway development have been investigated thoroughly and have been deemed not feasible.

In accordance with the NFIP regulations, it is ultimately the responsibility of each community participating in the NFIP to prohibit floodway development that would result in increases in 100-year flood levels. Communities must make determinations of this type and maintain backup calculations and certifications in their files for review by FEMA personnel upon request.

This document also does not address the many cases and situations requiring the actual revision of the floodway via redelineation of the floodway boundary, the criteria for which are presented in Section 65.7 of the NFIP regulations. A FEMA document, entitled "Conditions and Criteria for Floodway Revisions," and dated August 27, 1984, addresses these issues.

Definition of "No-Rise"

It is important that the concept of "no rise" be clarified and understood. The actual wording of Paragraph 60.3(d)(3) of the NFIP regulations is that the community shall "prohibit ... any increase in flood levels during the occurrence of the base flood discharge." If an adopted regulatory floodway has been computed and is displayed on the effective NFIP map, all areas within the floodway are considered to be effective in conveying the 100-year flood discharge. Therefore, no obstruction, regardless of size, can be

placed within the floodway without obstructing flow and causing some increase in the base flood elevation (BFE). Such increases may be localized and may seem insignificant; if modeled, they may yield changes on the order of hundredths or thousandths of a foot.

There has been a tendency to misinterpret the "no-rise" criterion to include rounding allowances and also to conclude that an increase in computed water-surface elevation of 0.01 foot or less, as determined by a backwater computer model, is sufficient evidence to support the acceptability of development in a floodway.

Although the backwater computer model output may show little change in water-surface elevation, closer examination will, in all likelihood, reveal changes in other variables (e.g., topwidth, flow area, velocity). These changes can be translated into increases in water-surface elevation that may not be considered significant by themselves. However, the long-term cumulative effects of such increases will eventually result in significant changes. Therefore, no development in the floodway should occur without proper compensation for the lost conveyance. This is the intent of Paragraph 60.3(d)(3) of the NFIP regulations.

It is FEMA's position that this regulation is to be interpreted exactly, and strictly, as written; that is, "no" rise above the BFE will be permitted. Therefore, nothing that offers any resistance to the flow of floodwaters may be placed within a regulatory floodway unless compensatory action is taken to restore the lost conveyance.

Loss of Conveyance

In the case of a simple floodway encroachment, as discussed previously, a "no-rise" determination can usually be made based on consideration of conveyance only. In such a situation, it is the difference in the conveyance before and after encroachment, or the aforementioned loss of conveyance, that must be addressed if the effects of development are to be compared against the "no-rise" criterion. The computation of loss of conveyance is most appropriately accomplished on a micro scale by isolating a portion of a cross section, separate from the backwater computer model, and performing hand computations. Examples of typical hand computations for proposed fill and bridge pier construction are attached for reference. However, it is appropriate to incorporate one or more new cross sections at the site of the proposed construction that reflect existing conditions into the unencroached and encroached backwater computer models. This is done to establish the base flood conditions at that location, which are to be used in the hand computations. The formula used to determine conveyance (K) is

$$K = 1.49/n\ AR^{2/3}$$

where n = Manning's roughness coefficient
A = Flow area
R = Hydraulic radius

The loss of conveyance is computed using the "n" value and hydraulic radius at the site of the encroachment as applied in the computer model.

Compensation

Once a determination has been made as to the amount of conveyance lost as a result of the proposed development, the designer or engineer is required to adequately compensate for this loss. This compensation is accomplished by including some means or measures within the proposed floodway development for providing an increase in effective conveyance, at some point on the cross section, equal to or greater than that lost. Equal area exchanges are only valid if the "n" value and hydraulic radius remain unchanged between the encroachment site and the compensation site. It is also important that the flow area provided be truly effective; that is, open to inflow and outflow and not just an isolated low spot or depression. This increased effective conveyance could be computed by hand in a manner similar to that used to compute the loss of conveyance.

The means or measures used to provide this effective conveyance (e.g., excavation, roughness coefficient reduction) would be at the discretion of the designer or engineer but must be approved by the community. Where these means and measures require some form of maintenance, the community must assume ultimate responsibility for their maintenance.

Data Requirements

The items identified below are necessary to document and demonstrate compliance with the "no-rise" criterion for simple floodway encroachments.

1. Hydraulic backwater models of the 100-year flood and floodway water-surface profiles for the following:

   a. Duplicate of the effective Flood Insurance Study (FIS) model.

   b. Existing-conditions (effective FIS) model modified to include cross sections through the project site. Cross sections must reflect conditions prior to construction of the project.

   c. Post-project conditions model. This model must include cross sections through the project site reflecting floodplain conditions after construction of the project. The 100-year flood (without floodway) and floodway elevations for this model must not be greater than those in the existing-conditions model described at letter "b" above. This hydraulic backwater model is necessary to ensure that any changes in transition losses, which are based on velocity heads rather than conveyance, do not cause increases in water-surface elevations. Also, a hydraulic backwater model provides a means of evaluating effective flow areas upstream and downstream of the encroachment and compensation sites.

2. A copy of the appropriate NFIP map showing the existing floodway and indicating the project area

3. Topographic mapping of the entire project area indicating the locations of all cross sections used in the modified hydraulic model and a plan view of all project elements

4. Construction plans, certified by a registered professional engineer, for all project elements, including those measures employed to provide additional effective conveyance

5. The following information, to be obtained by hand computation using the cross section and 100-year encroached hydraulic data in the modified existing-conditions computer model output provided under Item 1b:

   a. Calculation of the reduction in conveyance (K) caused by the proposed obstruction, assuming no change in floodway water-surface elevation, and using the "n" value appropriate for the site of the proposed obstruction

   b. Calculation of the increase in conveyance (K) obtained by the proposed offsetting measure, using the "n" value appropriate for the site of this measure

   c. Comparison showing that the conveyance increase computed in 5b equals or exceeds the loss computed in 5a

6. Evidence that the increase in effective conveyance provided for in Item 5b will be maintained perpetually. This should be in the form of a self-maintaining measure or certified maintenance plans for the measure provided.

7. An executed copy of the attached certification statement signed and sealed by a registered professional engineer

A copy of the hydraulic computer model for the effective FIS for the specified stream and community may be obtained by written request to the following address:

Federal Emergency Management Agency
Federal Insurance Administration
Risk Studies Division
500 C Street, SW
Washington, D.C. 20472

Federal Emergency Management Agency

Washington, D.C. 20472

CERTIFICATION OF A "NO-RISE" DETERMINATION

FOR A PROPOSED FLOODWAY DEVELOPMENT

Community Name

Development Name

Lot/Property Designation

Property Owner

I hereby certify that the proposed remedial measures, in combination with the property development designated above, will result in no loss of flow conveyance during the occurrence of the 1 percent annual chance of exceedence (100-year flood) discharge.

I further certify that the data submitted herewith in support of this request are accurate to the best of my knowledge, that the analyses have been performed correctly and in accordance with sound engineering practice, and that the proposed structural works are designed in accordance with sound engineering practice.

Date

Registered Professional Engineer

Seal

EXAMPLE NO. 1

RIGHT OVERBANK CONVEYANCE (EXISTING CONDITION)

Assumptions:

1. Portion of Fill in Floodway Fringe is Allowable and is Accounted for in Floodway Surcharge

2. Existing Condition Conveyance Should Assume Existence of Wetted Perimeter Along Floodway Boundary

3. Maximum Conveyance Loss Will Occur in Conjunction with Floodway Depth, Therefore, Use Floodway Water Surface Elevation in Computation

4. Conveyance Losses Computed with Floodway Water Surface Elevation and Properly Compensated for Will Not Increase 100-year (Base Flood) Elevation

Therefore:

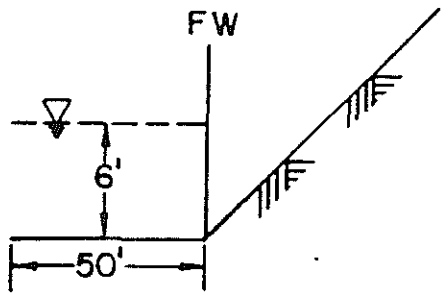
$K_{Exist} = {}^{1.49}/_{n}\, A\, R^{2/3}$

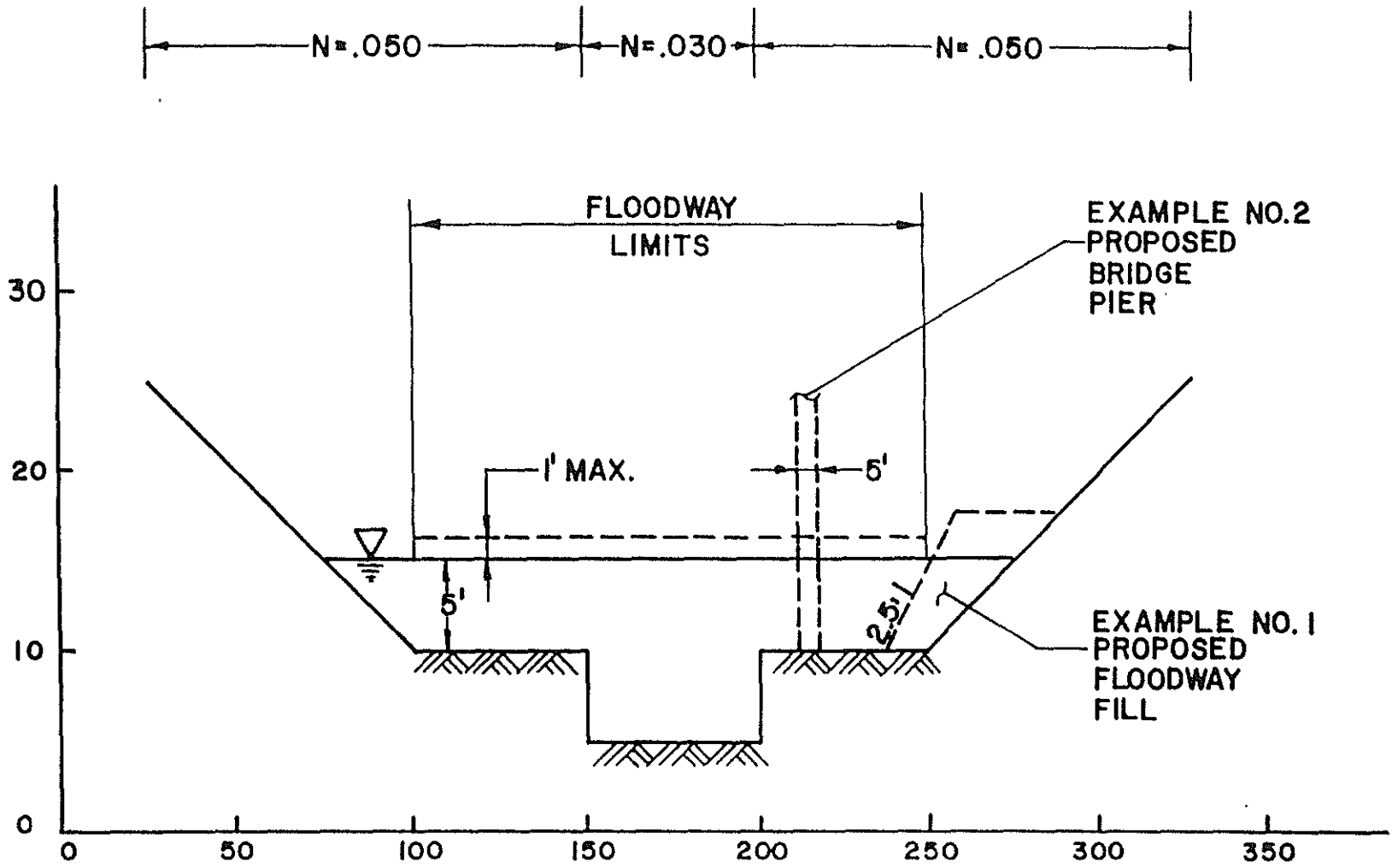
$A = 50 \times 6 = 300\ FT^2$

$WP = 50 + 6 = 56\ FT$

$R = 300/56 = 5.36 \qquad R^{2/3} = 3.06$

$K_{Exist} = {}^{1.49}/_{.050}\,(300)\,(3.06) = \underline{27356.40}$




N=.050
N=.030
N=.050
FLOODWAY
LIMITS
EXAMPLE NO.2
PROPOSED
BRIDGE
PIER
1' MAX.
5'
5'
2.5'
1
EXAMPLE NO. 1
PROPOSED
FLOODWAY
FILL
30
20
10
0
0
50
100
150
200
250
300
350

RIGHT OVERBANK CONVEYANCE (PROPOSED CONDITION)

Assumptions: 1. All Previous

2. Proposed Fill Slopes Above Floodway Water Surface Elevation and Outside Floodway Limit Do Not Contribute to Wetted Perimeter

Therefore:

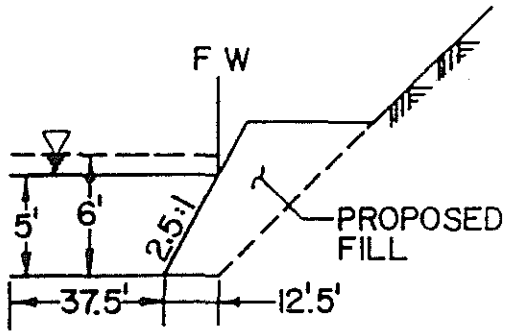
$K_{Proposed} = {}^{1.49}/_{n} A R^{2/3}$

$A = (1)(50) + 1/2(5)(50 + 37.5) = 268.75\ FT^2$

$WP = 37.5 + (12.5^2 + 5^2)^{1/2} + 0 = 50.96$

$R = {}^{268.75}/_{50.96} = 5.27 \qquad R^{2/3} = 3.03$

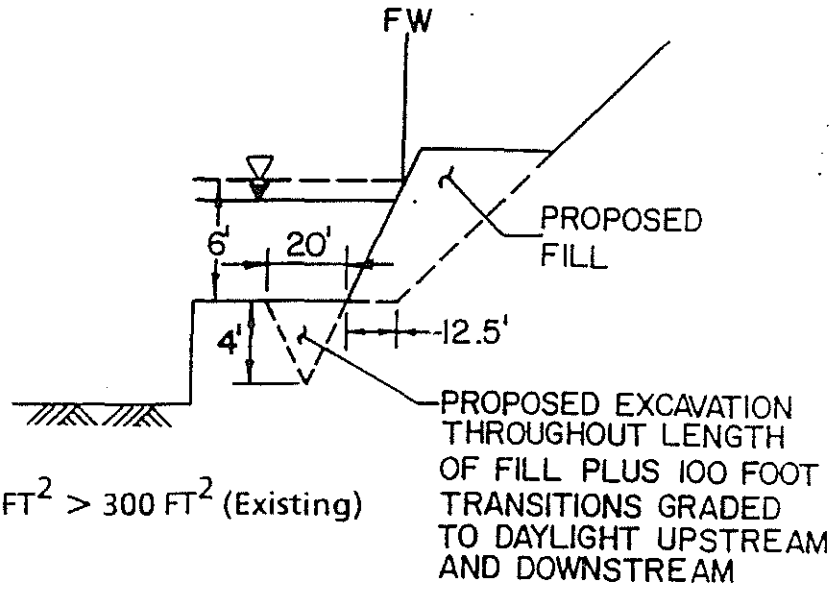
$K_{Proposed} = {}^{1.49}/_{.050}(268.75)(3.03) = 24266.51$



TOTAL CONVEYANCE LOSS IN FLOODWAY

$K_{Exist} - K_{Proposed} = 27356.40 - 24266.51 = \underline{3089.89}$

DESIGN OF CONVEYANCE COMPENSATION MEASURE



$K_{Compensated} = {}^{1.49}/_{n}\, A\, R^{2/3}$

$A = 268.75 + 1/2\,(20)\,(4) = 308.75\ FT^2 > 300\ FT^2$ (Existing)

$WP = 50.96 - 20 + (2)\,(10^2 + 4^2)^{1/2} = 30.96 + 21.54 = 52.50$

$R = 308.75/52.50 = 5.88 \qquad R^{2/3} = 3.26$

$K_{Compensated} = {}^{1.49}/_{.050}\,(308.75)\,(3.26) = 29994.45$

TOTAL CONVEYANCE GAIN IN FLOODWAY

$K_{Compensated} - K_{Proposed} = 29994.45 - 24266.51 = \underline{5727.94}$

COMPARISON

Gain (5727.94) > Loss (3089.89)

Therefore: COMPENSATION MEASURE OKAY

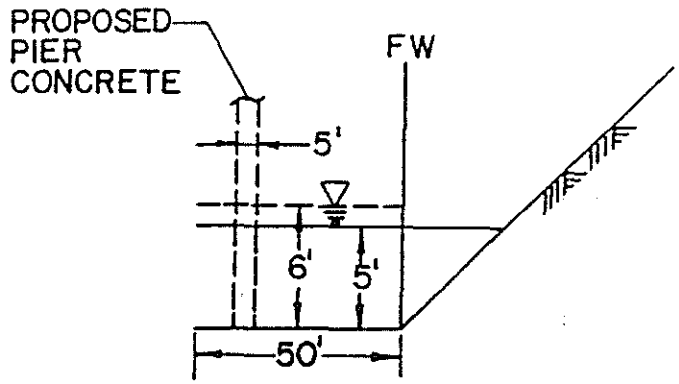
NOTE: Fill Slope Would Require Adequate Protection Against Velocities and Checks for Stability

EXAMPLE NO. 2

RIGHT OVERBANK CONVEYANCE (EXISTING CONDITION)

Same As Example No. 1 = 27356.40

RIGHT OVERBANK CONVEYANCE (PROPOSED CONDITION)



$K_{Proposed} = {}^{1.49}/_{n}\ A\ R^{2/3}$

$A = (6)(50) - (6)(5) = 300\text{-}30 = 270\ FT^2$

$WP = (50\text{-}5) + 2(6) + 6 = 63\ FT$

$R = 270/63 = 4.29 \qquad R^{2/3} = 2.64$

Weighted "n"

"n" ROB = .050 WP = (50-5) + 6 = 51 FT

"n" Concrete = .013 WP = 2(6) = 12 FT

"n" Weighted = ${}^{51}/_{63}$ (.050) + ${}^{12}/_{63}$ (.013) = .043

$K_{Proposed} = {}^{1.49}/_{.043}\ (270)\ (2.64) = 24{,}699.35$

TOTAL CONVEYANCE LOSS IN FLOODWAY

$K_{Exist} - K_{Proposed} = 27356.40 - 24699.35 = 2657.05$

DESIGN OF CONVEYANCE COMPENSATION MEASURE

Trial No. 1 — Placement of Dumped Riprap Across Entire Right Overbank* Beneath Bridge (n = .035)

* Excavated and Prepared

Weighted "n"

"n" Weighted = $^{51}/_{63}$ (.035) + $^{12}/_{63}$ (.013) = .031

$K_{Compensated}$ = $^{1.49}/_{.031}$ (270) (2.64) = 34260.39

TOTAL CONVEYANCE GAIN IN FLOODWAY

$K_{Compensated} - K_{Proposed}$ = 34260.39 - 24699.35 = 9561.04

COMPARISON

Gain (9561.04) > Loss (2657.05)

Therefore: COMPENSATION MEASURE OKAY