

CHAPTER 3

OVERVIEW OF THE PROCESS FOR PERFORMING A DETAILED FLOODPLAIN ANALYSIS

3.1 Purpose

A detailed analysis of floodplains is often necessary to properly plan and prepare for potential flooding conditions. FEMA has published flood insurance studies (FISs) for many areas of Indiana. Some of these are detailed FISs which means that hydraulic analyses were performed and, as a result, detailed floodplain information is available. Other FISs used approximate methods and, therefore, detailed floodplain information is not available.

A community that participates in the NFIP, which involves the majority of Indiana communities, is required to enact and enforce a local floodplain ordinance. That ordinance must meet the requirements of the Indiana Flood Control Act, the Indiana Floodplain Management Act, the Indiana Floodplain Management Rules, and FEMA regulations.

Historically, the IDNR had provided BFEs and floodway limits for proposed developments in unstudied areas, assuming the area of contributing watershed at the development is greater than one square mile. The Department now requires that these hydrologic-hydraulic assessments be performed by the requester and submitted to the IDNR for review and approval, unless the situation meets the requirements described in Chapter 2, "Obtaining a Floodplain Determination for a Minor Site Assessment."

As indicated by the preceding, various situations arise in Indiana in which the requester will be asked to perform a detailed floodplain analysis. The purpose of this chapter is to offer guidance on how to complete such analyses. See the IDNR website for a flow chart, "Overview for Performing a Detailed Floodplain Analysis," summarizing the process described in this chapter. The flow chart is also included as an appendix.

3.2 Gathering Data and Information

An early step in conducting a detailed floodplain analysis is determining if there are existing data and information that would be useful in helping to determine BFEs or floodway limits for the particular stream of interest. Examples of existing data and information are two foot contour mapping, surveyed cross-sections, and computer models previously developed for the stream reach of interest or for adjacent reaches. If a stream crossing is located downstream of or within a proposed project site, state, county, and local records should be reviewed to determine if useful bridge waterway opening or valley cross-section data are available. In some instances, IDNR may have developed computer models for the stream reach

being studied or for adjacent reaches. See Chapter 6, “Researching and Evaluating Existing Models,” for guidance.

If mapping must be developed for the project site, refer to Chapter 4, “Mapping Standards and Methods” for direction on creating a suitable map. Similarly, if cross-sections and/or bridge and culvert data must be obtained, guidance is offered in Chapter 5, “Surveying Standards and Methods.” If discharges are to be determined, refer to Chapter 7, “Guidelines for Determining Peak Discharges.” Prior to beginning the hydraulic modeling required for a detailed floodplain analysis, refer to Chapter 8, “Guidelines for Hydraulic Modeling Using HEC-RAS.” IDNR prefers use of HEC-RAS for all new hydraulic modeling. However, situations occasionally arise where other hydraulic models may be used. For guidance in these situations, see Chapter 9, “Guidelines for Alternative Hydraulic Models.”

3.3 Submitting Detailed Floodplain Analysis to the IDNR

3.3.1 *Hydraulic Modeling Checklist*

IDNR requires inclusion of a properly completed Hydraulic Modeling Checklist with all submittals of detailed floodplain analyses. The Department will not initiate a review without a completed checklist. Refer to Section 10.2 of Chapter 10, “Presentation of Modeling Results,” for discussion of the checklist. (An evaluation table is also required for permit applications, see Section 3.6).

Assuming the submittal appears to be complete, it will be assigned to the Engineering Services Center (ESC) of the IDNR Division of Water. The ESC will review the submitted BFEs, floodway, floodplain and 1% annual chance (formerly referred to as the 100-year) profile using these guidelines.

3.3.2 *Acceptable Submittal*

If the submittal is acceptable, the IDNR will issue a Floodplain Analysis Regulatory Assessment (FARA) letter. The FARA letter will include the accepted BFEs and floodway limits along with regulation requirements for development of the property in question. IDNR will copy the local floodplain management agency on all correspondence related to the detailed floodplain analysis.

3.3.3 *Unacceptable Submittal*

If the ESC determines that the initial submittal is unacceptable, the IDNR will provide the requester with a written description of deficiencies. Although the IDNR expects professionals to provide complete initial submittals, the Department will allow additional submittal(s) to correct errors and/or rectify deficiencies. If the ESC determines that the revised submittals acceptable, the IDNR will issue the previously described FARA

letter. If the submittal is unacceptable, the IDNR will provide the requester with another written description of the deficiencies; however, this response may also indicate a limited timeframe for additional IDNR review of the material. Therefore, the local floodplain management agency will be unable to issue a building permit. Again, the local floodplain management agency will be copied on all correspondence.

3.4 Possible Revisions to Existing Base Flood Elevations and Floodway Limits

3.4.1 Needs for Revisions

Occasionally, previously established BFEs and floodway limits (those appearing in a FIS or resulting from an IDNR approved assessment) need to be reexamined. Examples of situations in which flooding characteristics may be revisited include documented disagreement with previous determinations, changes in watershed hydrology, or influence of a flood control project. Changes to existing studies often require a critical evaluation of the existing study, additional fieldwork to enhance the original model, and remodeling and remapping of the floodplain. Chapters 4 through 10 of these guidelines describe the technical aspects of modeling, which apply to restudies as well as new studies.

3.4.2 Revisions to Unpublished Studies

A revision to an unpublished study is treated similarly to the review of a new floodplain analysis as described in Sections 3.1 and 3.2 of this chapter. IDNR requires the same types of items that a new study would have, including the checklist. Examination of the previous review material in IDNR's files can be helpful in evaluating and updating a previously approved model. IDNR's review process for these requests is the same as for new requests. A FARA letter will be the end result of the acceptance of a study of this type.

Proposed revisions to the 1% annual chance peak discharge are evaluated based on the options and procedures described in Chapter 7. Review this chapter carefully before beginning to revise existing hydrologic results because many aspects of floodplain hydrology as viewed by the IDNR differ from stormwater hydrology as reviewed by local government entities.

Revisions to the floodway should be done in accordance with the hydraulic modeling guidelines provided in Chapter 8. Two criteria are especially important. First, the floodway revision should be based on equal conveyance reduction (Method 4 in HEC-RAS modeling). Second, the floodway must be based on pre-project conditions unless an IDNR-approved flood control project would result in changes to those limits.

3.4.3 Revisions to Published Studies

The process to revise a FIS is referred to as a Letter of Map Revision (LOMR). LOMR application forms (referred to as the MT2 forms) are available on the FEMA website (<http://www.fema.gov/>). Required modeling submittals are explained in Section 3.5 of this chapter, while the process for review and approval of a LOMR is described in Section 3.7 of this chapter.

3.5 Models Required for IDNR Approval of a Permit or Map Revision Request

3.5.1 Defining the Study Reach

The total study reach, or the area of revision, is defined by an effective tie-in or transition of the reach of interest with reaches immediately upstream and downstream. For streams that require a detailed study, the study reach should begin downstream at a point where there is currently no cumulative flood surcharge effect from previously permitted or allowed floodway encroachments, or where the cumulative flood surcharge effect from previously permitted or allowed encroachments is known. The study reach should extend upstream, at a minimum, to the point where there are no remaining flood surcharge effects from the proposed floodway encroachment for the project in question.

The following equation, derived from USACE Hydrologic Engineering Center - Technical Paper No. 114, can be used to estimate the distance upstream, or downstream, the study reach should extend to adequately account for cumulative effects and to estimate a point to tie-in to an existing profile.

$$L=150 HD^{0.8} / S$$

Where,

L is the reach length in feet,

HD is the average hydraulic depth for the assumed 1% annual chance frequency flood profile through the project reach in feet (cross sectional flow area in ft² divided by top width in feet), and

S is the average reach slope in percent (e.g., feet per 100 feet).

Revisions of both the downstream and upstream extents of the study reach may be necessary if additional flood profile information becomes available during preparation of a detailed flood study. IDNR staff will consider allowing a shorter reach length if the applicant can reasonably demonstrate through analysis that the additional reach upstream and downstream would not change the approvability of the model (surcharges are consistently

decreasing upstream and that potential for unacceptable cumulative impacts upstream is unlikely in a particular situation).

If a floodway revision is proposed, the effective encroachment stations and floodway top widths should tie-in at both the upstream and downstream limits of the project reach. As indicated by the preceding, the total reach requiring study will always be longer than the reach containing the project.

3.5.2 Duplicate Effective Model

When a detailed FIS or LOMR model exists, copies of the hydraulic analysis used in the effective FIS, referred to as the Effective FIS Models (10%, 2%, 1%, and 0.2% annual chance multi-profile runs and the floodway run), must be obtained from the IDNR or FEMA and then reproduced on the applicant's equipment to produce the Duplicate Effective Model. This duplication process ensures that the Effective FIS Model input data have been correctly transferred to the applicant's equipment and that revisions to the data will be integrated into the model to provide a continuous FIS model upstream and downstream of the reach being revised.

The IDNR maintains digital copies of most detailed FIS hydraulic models either developed by IDNR or submitted for their review. The Department maintains an index of all models in its files available to download through the Indiana Hydrology and Hydraulics Model Library.

Sometimes the published BFEs and floodway limits cannot be duplicated by current modeling software. If the Effective FIS Models are an unsupported modeling software (for example: E431, WSP2, HEC-2, etc.) and do not match to within 0.1 ft. with the corresponding FIS mapping and the Floodway Data Table, the requester must contact IDNR Division of Water for further guidance.

IDNR also maintains a number of IDNR-approved detailed hydraulic studies that may have not yet been published by FEMA as a detailed study or used by FEMA to update the published information. While IDNR views these as Regulatory Models, they may or may not be viewed by FEMA as Effective Models.

3.5.3 Corrected Effective Model

The Corrected Effective Model is the model that corrects any errors that occur in the Effective FIS Model, adds any additional cross-sections to the Effective FIS Model to properly analyze the impact of the proposed construction, or incorporates more detailed topographic information than that used in the effective model. An error could be a technical error in the

modeling procedures or any construction in the floodplain that occurred prior to the date of the Effective FIS Model but not incorporated into the model. Before adding the effects of any construction, the IDNR staff should be consulted to ensure that such construction meets the Floodplain Management Rules.

For the purpose of an IDNR Construction in a Floodway Permit, the Corrected Effective Model will be considered to represent the base conditions. Except for incorporating the effects of IDNR-approved Flood Control Projects, the Corrected Effective Model must not reflect any man-made physical changes since the date of the effective regulatory model. The date of the model is listed on the available model descriptions found on the Indiana Hydrology and Hydraulics Model Library. If no corrections or additions to the Effective FIS Model are needed, then the Effective FIS Model would be considered the Corrected Effective Model.

Modeling developed for the derivation of FEMA Zone A determinations may not be used for Corrected Effective models. An approved Preliminary FIS model developed for the derivation of FEMA Zone AE studies is considered as a Corrected Effective model if it replaces an unstudied or Zone A area. It is then considered best available data. Otherwise, the Preliminary model is not used until the FIS is designated as final.

When a published detailed FIS/LOMR model or an unpublished IDNR Regulatory Model does not exist, a base condition hydraulic model meeting the IDNR requirements must be produced and submitted. Base conditions are defined by the Floodplain Management Rules as the physical situation (including stream crossings) existing on January 1, 1973. The model of base conditions is used to define the regulatory floodway. If the topography that existed on January 1, 1973 cannot be reasonably determined, then the best available mapping should be used to develop the base model. Chapters 4 and 5 explain the process to be used for getting the best available data. The base condition includes all flood control projects approved under IC 14-28-1-29 in the Indiana Flood Control Act or otherwise formally recognized as flood control projects by the IDNR.

When a bridge has been replaced in compliance with state statute and IDNR rules since January 1, 1973, the more efficient bridge configuration should be used in the base model. The more efficient bridge is defined as the one that causes the smaller surcharge across the bridge. If a bridge replacement has not been in compliance with state statute and IDNR rules since January 1, 1973, the bridge that existed on the stream on January 1, 1973 should be included in the baseline model.

3.5.4 Existing or Pre-Project Condition Model

If no modifications have occurred since the date of the effective model, then the Existing or Pre-Project Condition Model would be identical to the Corrected Effective Model. Additional modeling to create an Existing /Pre-Project condition model is not necessary.

If modifications have occurred since the date of the effective model, then the Existing or Pre-Project Condition Model would modify the Corrected Effective Model. The Effective FIS Model or Corrected Effective Model is modified further to produce the Existing or Pre-Project Condition Model. This model reflects modifications that occurred within the floodplain since the date of the Effective FIS Model but prior to the construction of the project for which the permit or revision is being requested.

If unauthorized modifications have occurred since the date of the Effective model, the cumulative effect of these modifications may be unknown to the IDNR. The IDNR staff should be consulted to determine how to handle the unauthorized modifications to the floodway.

State regulations and administrative rules require that cumulative effects of the action for which a permit is being sought be added to other past, present, and reasonably foreseeable future actions, regardless of what entity undertakes the other actions. Therefore, the Existing or Pre-Project Condition Model should include the above-noted actions, excluding the action for which the permit is being sought, so that cumulative effects may be properly evaluated.

The typical procedure for development of an Existing or Pre-Project Condition model is as follows:

- The Effective FIS Model or IDNR Regulatory Model is obtained from IDNR's website, if available. If no such model currently exists, the modeler must develop a Corrected Effective Model for the project site from detailed contour mapping or surveyed cross-sections.
- Necessary modifications and corrections are performed to develop the Corrected Effective Model.
- The modeler researches IDNR files for Construction in a Floodway Permits issued for any other nearby projects that may result in backwater effects within the study reach of the stream or river.
- Based on this research, the modeler then obtains available flood models developed and submitted for these projects from IDNR files or website.
- The modeler then conducts a field investigation to determine if permitted projects were indeed constructed or started prior to the permit expiring. If not, and the permit has expired, consult with the Division of Water.

- The modeler, using the procedures outlined in this chapter, would then put together the Existing or Pre-Project Condition model.
- The modeler should note in the Existing or Pre-Project Condition Model what cross-sections were incorporated from previously approved or accepted flood models.

3.5.5 Proposed or Post-Project Condition Model

This model includes the pre-project conditions plus the proposed or post-project modifications. The Existing or Pre-Project Condition model (or Effective FIS Model or Corrected Effective Model, if appropriate) is further revised to reflect post-project conditions. The Proposed or Post-Project Model must incorporate everything included in the Existing or Pre-Project Condition Model plus the proposed or post-project conditions.

Similar to the Existing or Pre-Project Condition Model, for IDNR permitting purposes, the Proposed or Post-Project Model must reflect the impact of cumulative effects as defined in IDNR regulations and administrative rules.

3.6 Applications for Proposed Construction in a Floodway

This section provides guidance on preparing an application to obtain a permit for construction in a floodway. Detailed information on this permit process is available at the IDNR website. Types of construction in floodway projects that do not require modeling are described at the noted website. Therefore, consult the website to avoid needless modeling efforts.

Modeling submitted in support of a construction in a floodway permit application is reviewed and evaluated by the ESC. The previously mentioned modeling checklist must be included with the submittal. Models submitted without a completed checklist will not be reviewed until a completed checklist is submitted. Upon the review of the submitted checklist and modeling, the ESC will draft a technical memorandum recommending either approval or denial of the project, or asking for corrections to the modeling before a conclusion can be reached. Refer back to Section 3.3; the same principles and procedures apply.

For IDNR approval, the requester must demonstrate that the project will not, either individually or in combination with other past, present, and reasonably foreseeable future actions, increase the BFE by more than 0.14 feet outside the requester's property. This is calculated by comparing the elevations from the Proposed or Post-Project Condition Model with the Existing or Pre-Project Condition Model as well as with the Corrected Effective Model, or with the Duplicate Effective Model, if no enhancements/corrections were performed. A Project Evaluation Table must be submitted to show the elevation comparisons. Figure 3-1 depicts a sample Project Evaluation Table.

In some cases, the Existing or Pre-Project Condition model will show base flood elevations that exceed the 0.14-foot threshold as compared to the Corrected Effective Model. In these circumstances, IDNR staff should be consulted prior to submitting an application. The IDNR may still grant a permit to the applicant if it can be shown that the project for which the permit is being requested, as modeled in the Proposed or Post-Project Condition Model, would cause no increase over the Existing or Pre-Project Condition Model.

Figure 3-1. A project evaluation table like this should be included with an application for a construction in a floodway permit.

**PROJECT EVALUATION TABLE
HYDRAULIC MODELING RESULTS**

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LOCATION DESCRIPTION		PUBLISHED OR EFFECTIVE DATA (Ft., NGVD) <small>(Based on FIS Table or Profile)</small>	MODELING RESULTS				COMPARISONS			NOTES
Model Cross Section Station	Location Description		Duplicate Effective Model (Ft., NGVD)	Corrected Effective Model (Ft., NGVD) <small>(model name)</small>	Existing-Conditions Model (Ft., NGVD) <small>(model name)</small>	Proposed-Conditions Model (Ft., NGVD) <small>(model name)</small>	Cumulative Impacts w/o Project (ft) <small>(6) - (5)</small>	Cumulative Impacts with Project (ft) <small>(7) - (5)</small>	Project Impacts (ft) <small>(7) - (6)</small>	
	D/S end of study reach						-	-	-	
							-	-	-	
							-	-	-	
							-	-	-	
	property limit						-	-	-	
							-	-	-	
							-	-	-	
	example bridge						-	-	-	
							-	-	-	
							-	-	-	
							-	-	-	
	property limit						-	-	-	
							-	-	-	
							-	-	-	
							-	-	-	
							-	-	-	
							-	-	-	
	U/S end of study reach						-	-	-	

NOTES:

- * Project increases water surface 0.14-ft above Corrected Effective Model; project may be permissible only if there is zero rise over the Existing Condition Model.
- X Project increases water surface 0.14-ft above Corrected Effective Model AND does not have zero rise over the Existing Condition Model; project is not permissible.

Project surcharges greater than 0.14 feet are acceptable if the extent of the excessive surcharge remains on the requester's property. Proof of property

ownership is required in these cases. Flood easements might be obtained for off project land that would be inundated by an excessive increase in regulatory flood stages. However, the project for which an easement is permitted must be a dam, a flood control project as defined under IC 14-28-1-29, or a public works project. See the Appendix for further discussion of flood control projects. If base flood elevations (as published by FEMA) are being exceeded in these instances, then a Letter of Map Revision (LOMR) is required at the completion of the project. See the Appendix for more information on the LOMR application process.

Also, for projects involving the relocation of streams in published FEMA floodways, a LOMR is required after completion of the project.

If the project requires a compensatory measure to make its impact negligible (thus permissible), it needs to also meet the provisions of IC 14-28-1-29 because in accordance to IC 14-28-1-29 (b)(2), it may be deemed to have a potential to “adversely affect and interfere with flood control in Indiana” (should the project fail). For this type of project to be approved, the following conditions apply:

- Any engineering analyses or design documents submitted for consideration of approval are to be certified by a Professional Engineer or Land Surveyor licensed in the State of Indiana.
- As-built plans must be certified by a Professional Engineer or Land Surveyor licensed in the State of Indiana.
- The project must be properly operated and maintained by a government entity.
- A letter of perpetual maintenance from a governmental entity with an attached O&M Manual is required. The O&M Manual must include the following information:
 - 1) Responsibility statement - Who insures that the project will function as designed in perpetuity
 - 2) Financial Assurance – How will maintenance work be funded, how will major repairs be funded. Funds may be raised/committed to through taxing authority
 - 3) Schedule of events
 - 4) Procedures / Actions to be performed and by when
 - a) Preventive Maintenance
 - b) Repair Maintenance
 - i) Immediate
 - ii) Required at earliest date
 - 5) Reporting (Inspection / Monitoring) procedures –Who does inspection and monitoring, how records are kept, and who are reports filed with
 - 6) Permanent Maintenance and Access Easement – Establish proof through copy of recorded maintenance and access easement.