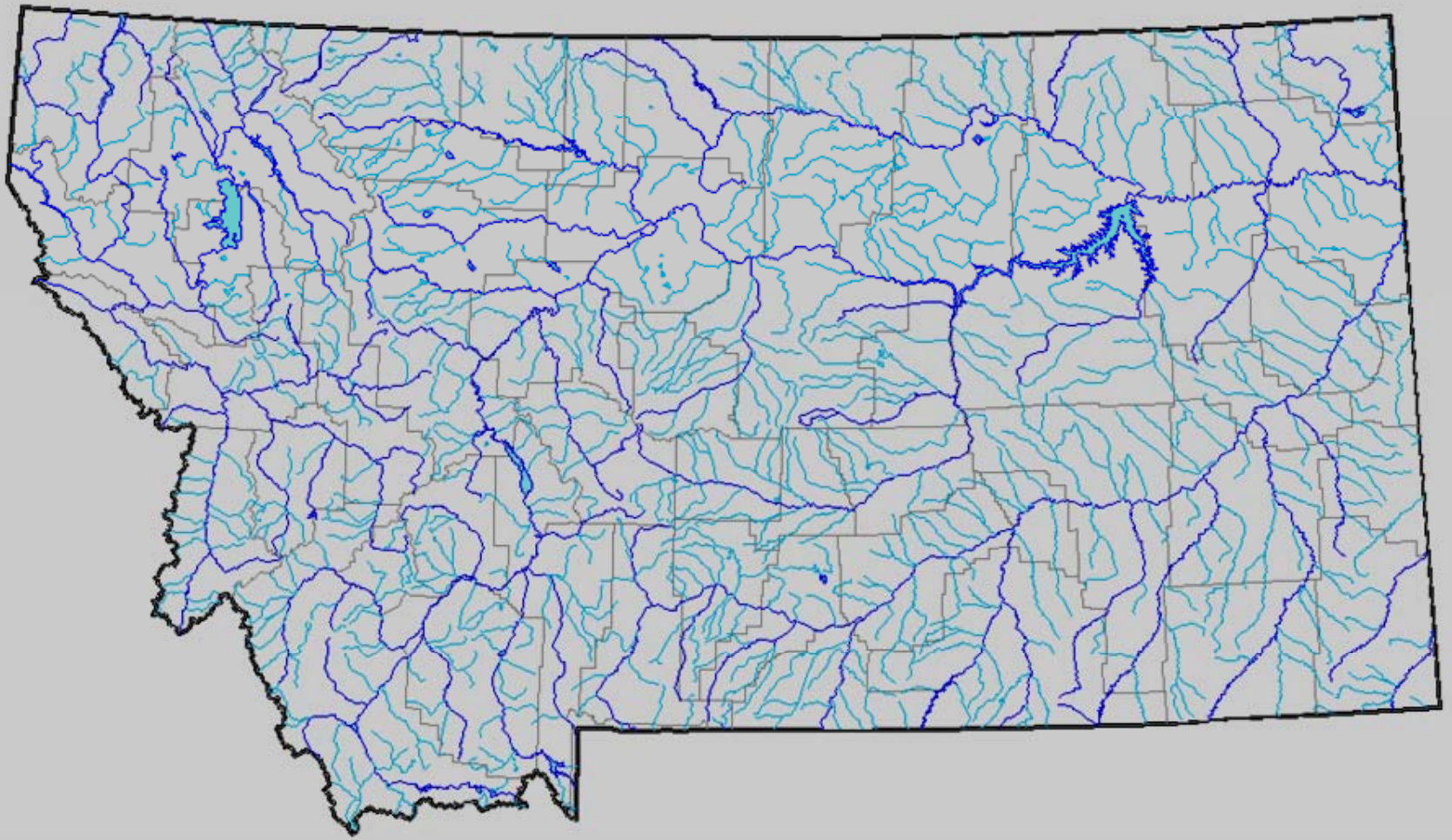
# Floodway Encroachment No-Rise Analysis & LOMR Requirements

Steve Story, PE, CFM – State Floodplain Engineer



POP QUIZ !!
(No Cheating!)

Who is considered one of the rock stars of Hydraulic Engineering & authored the definitive “Bible” of Open-Channel Flow??

Captain Nemo

Mr. Spock

The Dalai Lama

Dr. Ven Te Chow

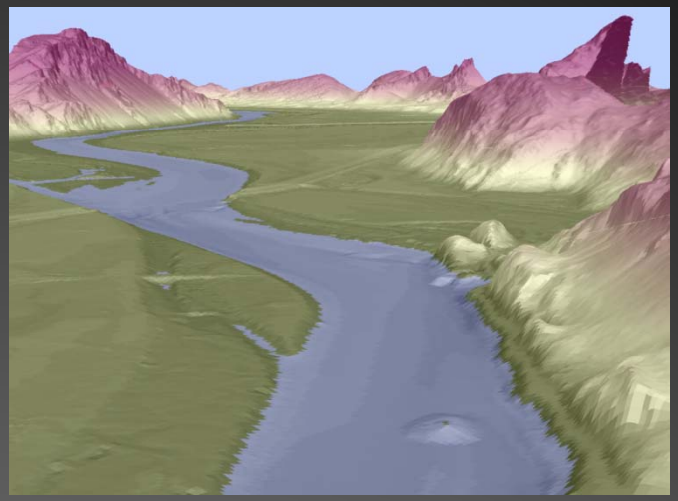
# Ven te Chow,Ph.D.(1914-1981)

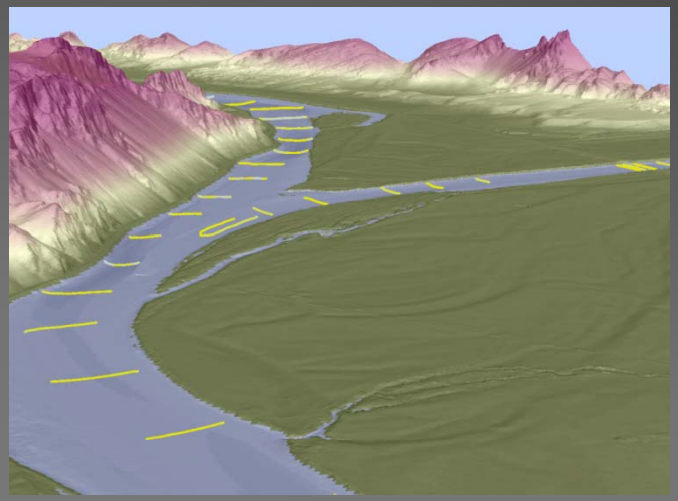
- Professor of Hydraulic Engineering, University of Illinois
- Author of the coveted “Red Book”, Open-Channel Hydraulics, 1959 (considered one of the best textbooks ever written)
- Born in China, he continued the country’s tradition of renowned Hydraulic Engineers ; beginning with Sunshu Ao (ca. 630 BC) – regarded as the first Hydraulic Engr.

# Floodway Encroachment No-Rise Analysis & LOMR Requirements

## Presentation Overview:

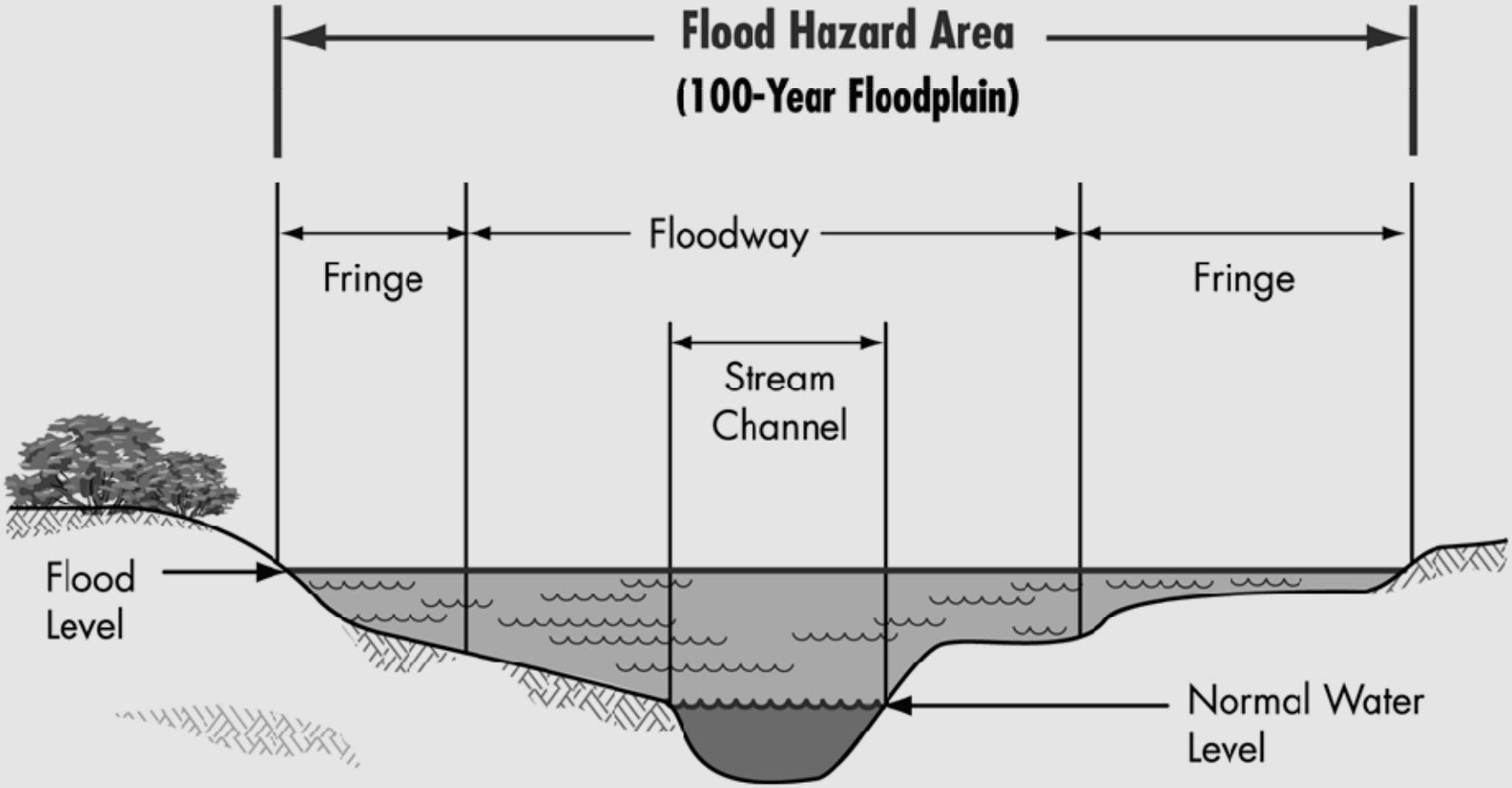
- NFIP Key Info. Review
- Study Types & Floodway
- LOMR/CLOMR Requirements
- Encroachment Review
- No-Rise Analysis Process (for Detailed study areas)
- Scoping Case Study





Images Courtesy Watershed Sciences, Inc.

# What makes up a Floodplain?



# National Flood Insurance Program (NFIP)

## Definitions:

- Base Flood – 1% annual-chance flood event (aka100-year flood)
- BFE – Base Flood Elevation
- FIS – Flood Insurance Study
- FIRM – Flood Insurance Rate Map
- LOMR – Letter of Map Revision
- CLOMR – Conditional Letter of Map Revision
- SFHA – Special Flood Hazard Area

NATIONAL FLOOD INSURANCE PROGRAM

# National Flood Insurance Program (NFIP)

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year = Regulatory Standard

| N (years) | 1 | 5 | 10 | 25 | 50 | 100 | 500 |
|---|---|---|---|---|---|---|---|
| 1 | 100.00 | 20.00 | 10.00 | 4.00 | 2.00 | 1.00 | 0.20 |
| 5 | 100.00 | 67.23 | 40.95 | 18.46 | 9.61 | 4.90 | 1.00 |
| 10 | 100.00 | 89.26 | 65.13 | 33.52 | 18.29 | 9.56 | 1.98 |
| 25 | 100.00 | 99.62 | 92.82 | 63.96 | 39.65 | 22.22 | 4.88 |
| 50 | 100.00 | 100.00 | 99.48 | 87.01 | 63.58 | 39.50 | 9.53 |
| 100 | 100.00 | 100.00 | 100.00 | 98.31 | 86.74 | 63.40 | 18.14 |
| 500 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 99.34 | 63.25 |

Courtesy David T. Williams, Ph.D., PE

# National Flood Insurance Program (NFIP)

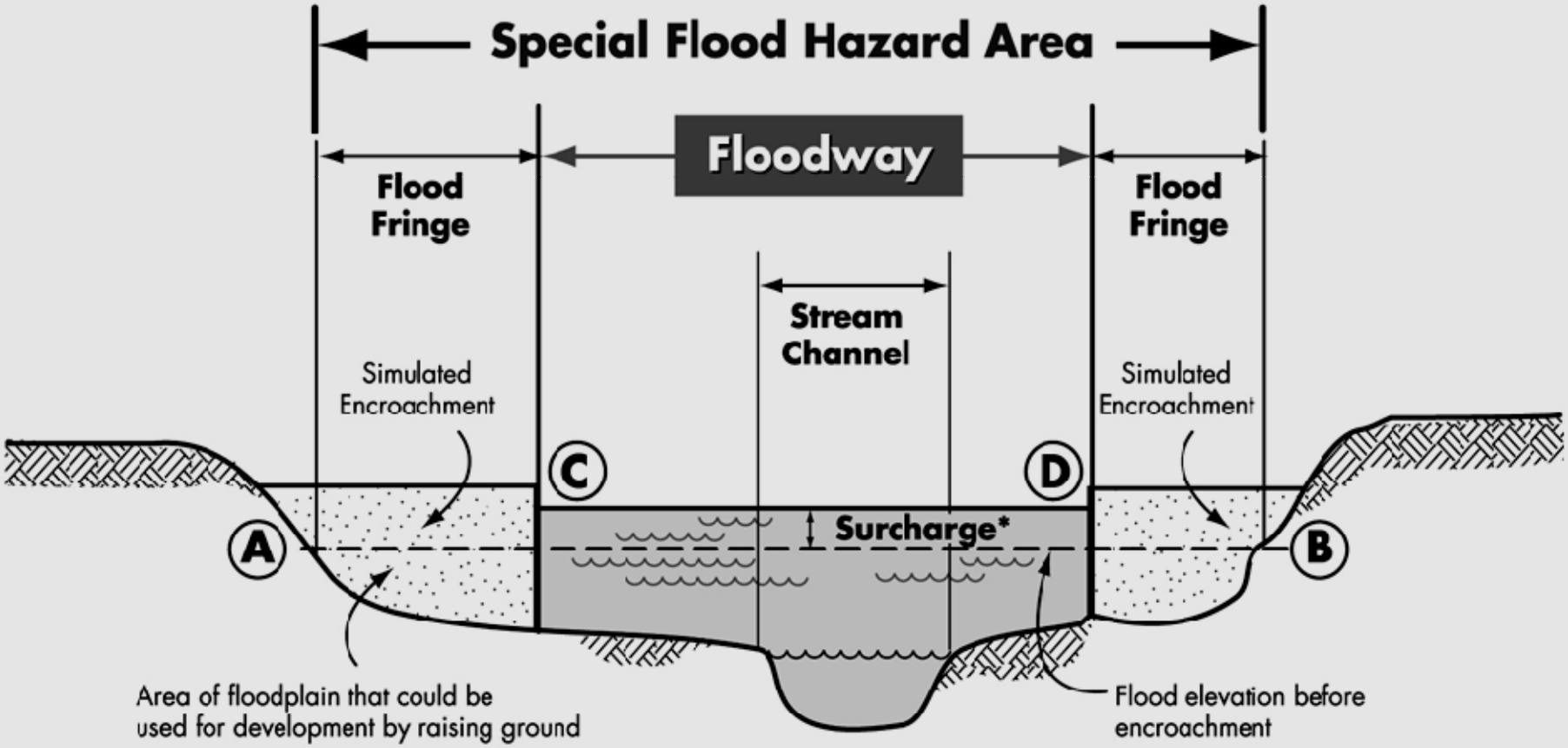
## Special Flood Hazard Area (SFHA):

The area inundated by floodwaters of the Base Flood.

This is the area where floodplain regulations must be enforced and where mandatory purchase of flood insurance applies.

| Risk Zone | Description |
|---|---|
| A | Approx. Methods, no BFEs or flood depths are shown |
| AE, A1-30 | Detailed methods, with BFEs |
| AH | Shallow Flooding (ponding), 1-3 ft depths with BFEs, detailed methods |
| AO | Shallow Flooding (sheet flow), 1-3’ depths, detailed methods, designated by 1’, 2’, or 3’ depth |

# What makes up a Special Flood Hazard Area (SFHA)




Line (A) — (B) = Flood Elevation Before Encroachment

Line (C) — (D) = Flood Elevation After Encroachment

**Simulated Encroachment**

***Surcharge not to exceed .5 foot (State of Montana requirement)***

# DFIRM Legend

## LEGEND

### SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

| | |
|---|---|
| **ZONE A** | No Base Flood Elevations determined. |
| **ZONE AE** | Base Flood Elevations determined. |
| **ZONE AH** | Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined. |
| **ZONE AO** | Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined. |
| **ZONE AR** | Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood. |
| **ZONE A99** | Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined. |
| **ZONE V** | Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined. |
| **ZONE VE** | Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined. |

### FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

### OTHER FLOOD AREAS

| | |
|---|---|
| **ZONE X** | Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. |

# DFIRM Legend

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

23 — 23 — Transect line

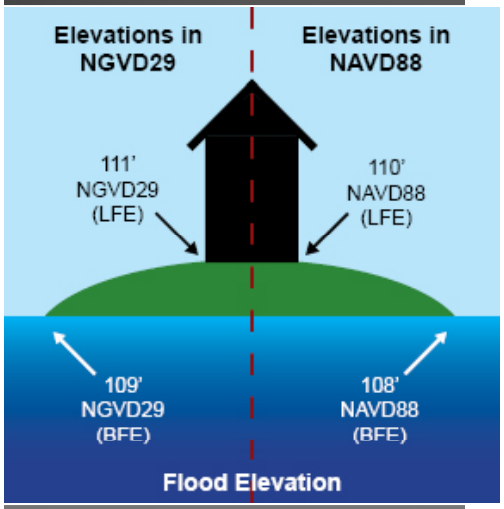
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

$^{49}89^{000m}$ N — 1000-meter Universal Transverse Mercator grid values, zone 11

4989000 FT — 5000-foot grid ticks: Montana State Plane coordinate system, (FIPS Zone 2500), Transverse Mercator

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 — River Mile

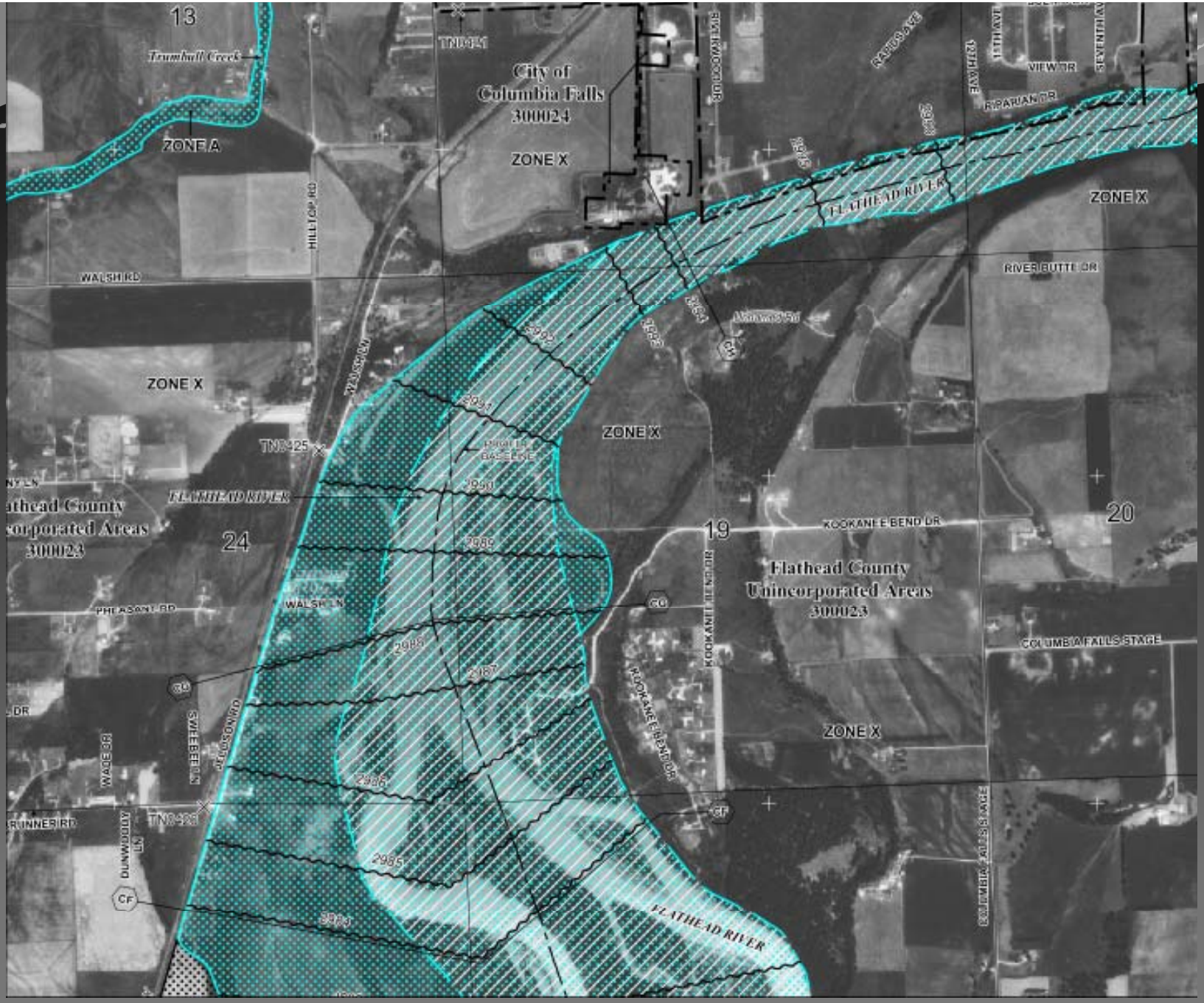



DATUM CONVERSION – NOAA"s VERTCON http://www.ngs.noaa.gov/PC_PROD/VERTCON/

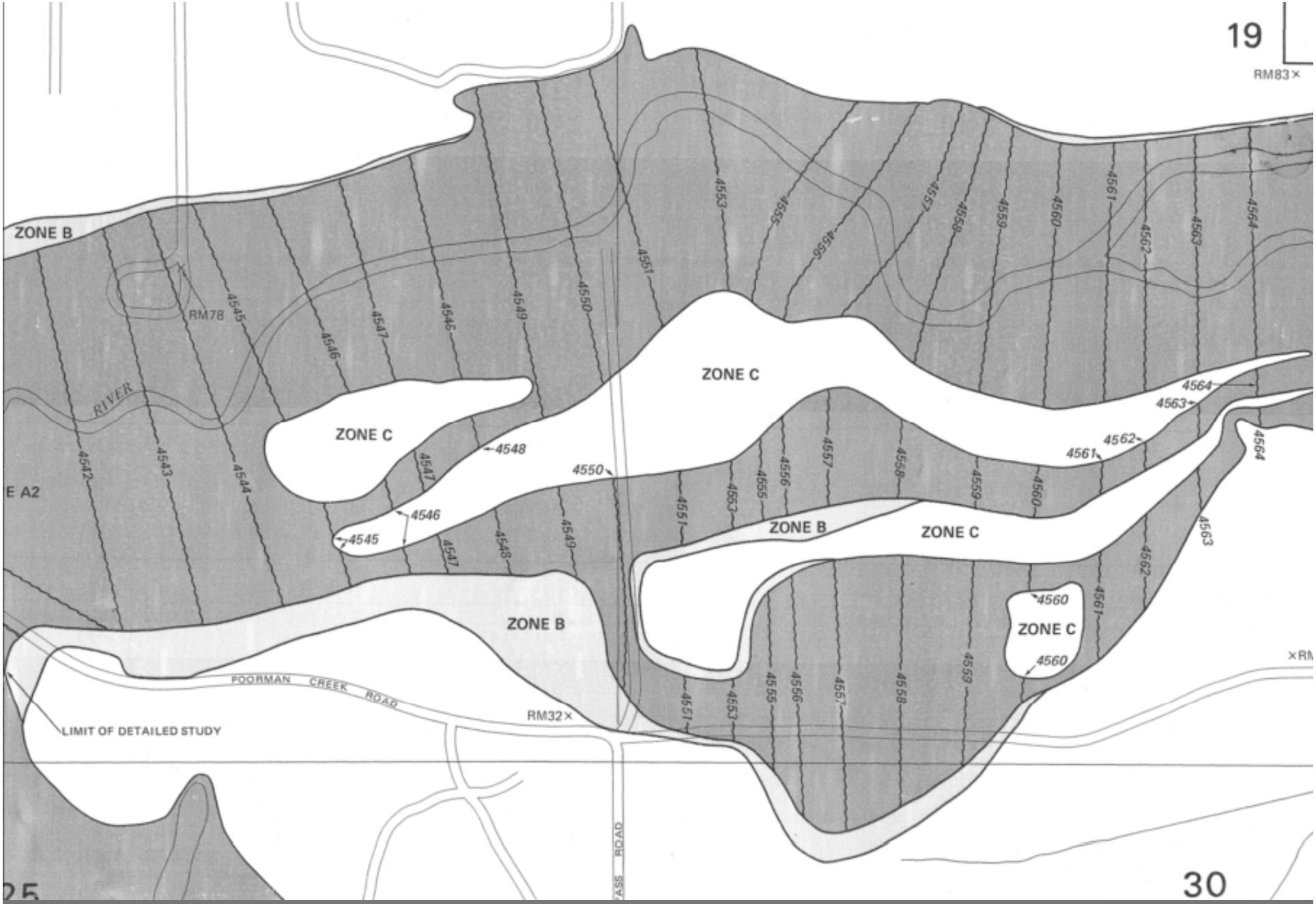
# National Flood Insurance Program (NFIP)

## Types of Floodplain Studies:

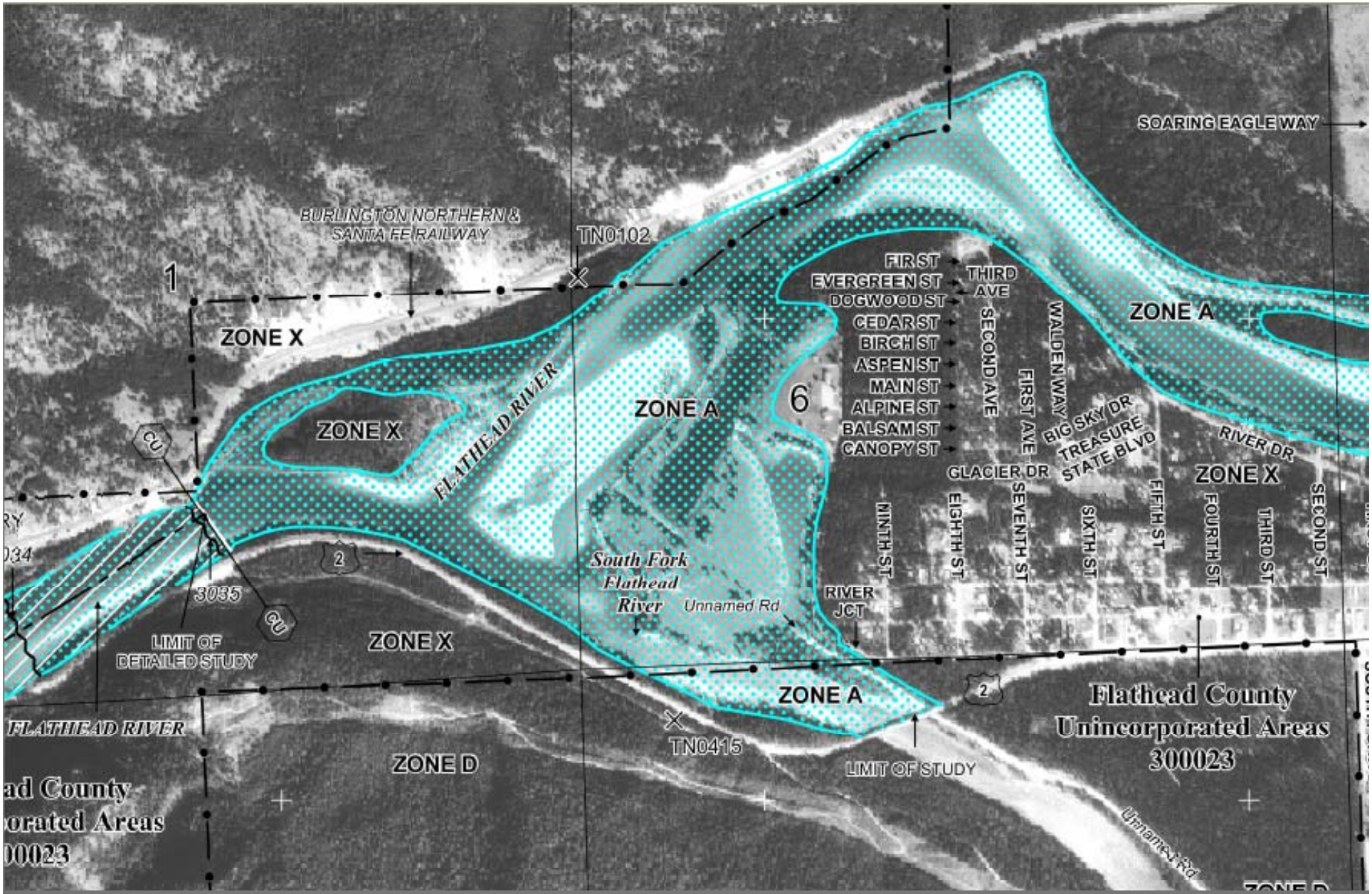
- Detailed Study (AE): the SFHA & 500-yr floodplains are defined, and BFEs are published. The 10-, 2-, 1-, & 0.2 % annual-chance flood discharges are estimated, and profiles are provided in FIS. Structure geometry from detailed field surveys. Floodway analysis typically performed.
- Limited Detailed Study (AE): SFHA defined and may include BFEs. Profiles and BFEs published in FIS. Study parameters may vary based on avail data, budget, etc.
- Approximate Study (Approx. Zone A): the SFHA is defined, but no BFEs or flood profiles.




# DFIRM – Detailed Study Section (Flathead R.)



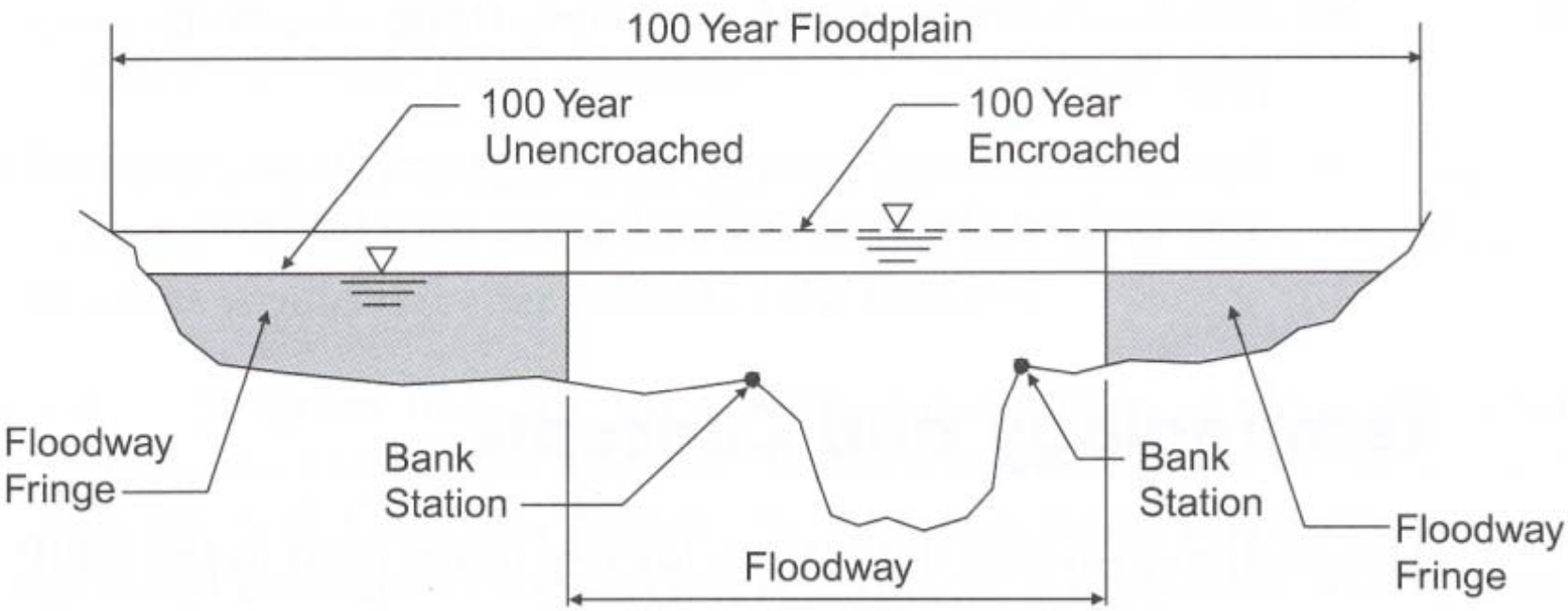

FIRM – Limited Detailed Study Area (Blackfoot R.)




DFIRM – Approximate Study Section (Flathead R.)

# National Flood Insurance Program (NFIP)

## What is a FLOODWAY?



# National Flood Insurance Program (NFIP)

## What is a FLOODWAY?

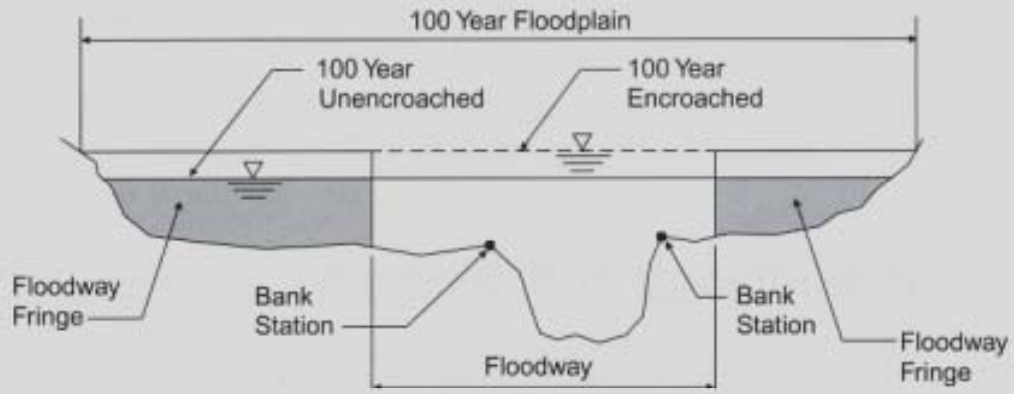
code of federal regulations

44 CFR 59.1 Definitions: “Regulatory Floodway” means the channel of a river or 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 ( = 0.5 ft in MT).

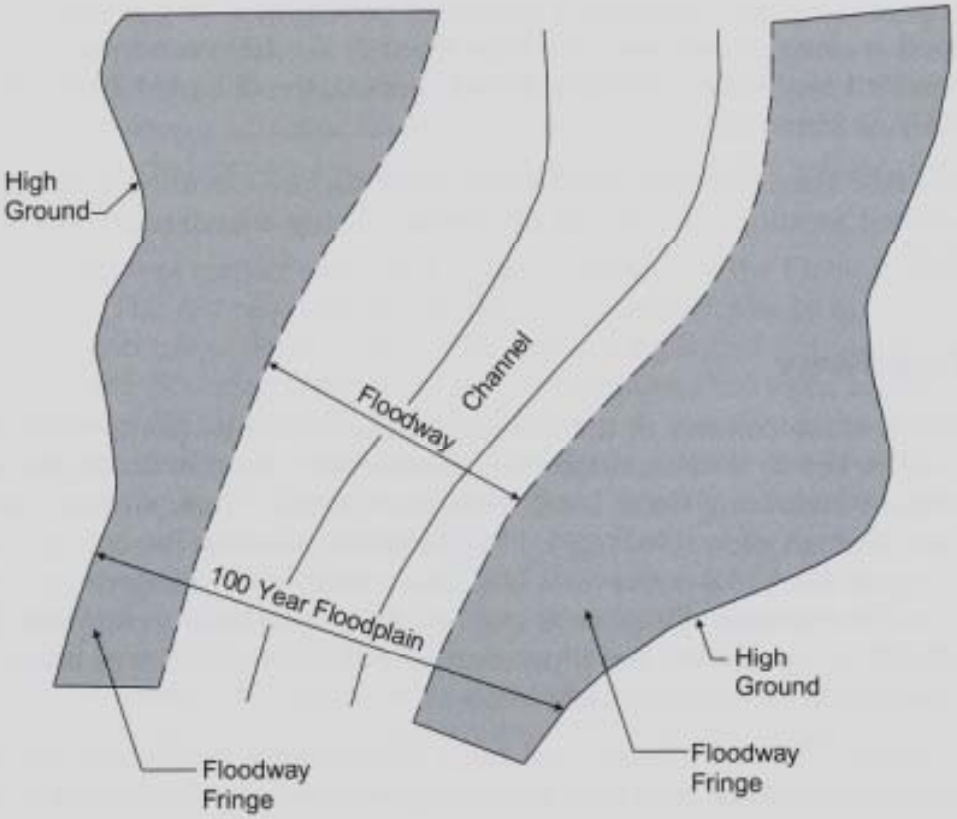
The floodway is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. The floodway is a regulatory measure to assist communities with protecting the river corridor where flows are most sensitive to encroachment.

Detailed Study Areas include delineated Floodways

Communities adopt Floodways and must regulate development there to ensure flood hazards are not increased on other properties




(a) Cross Section



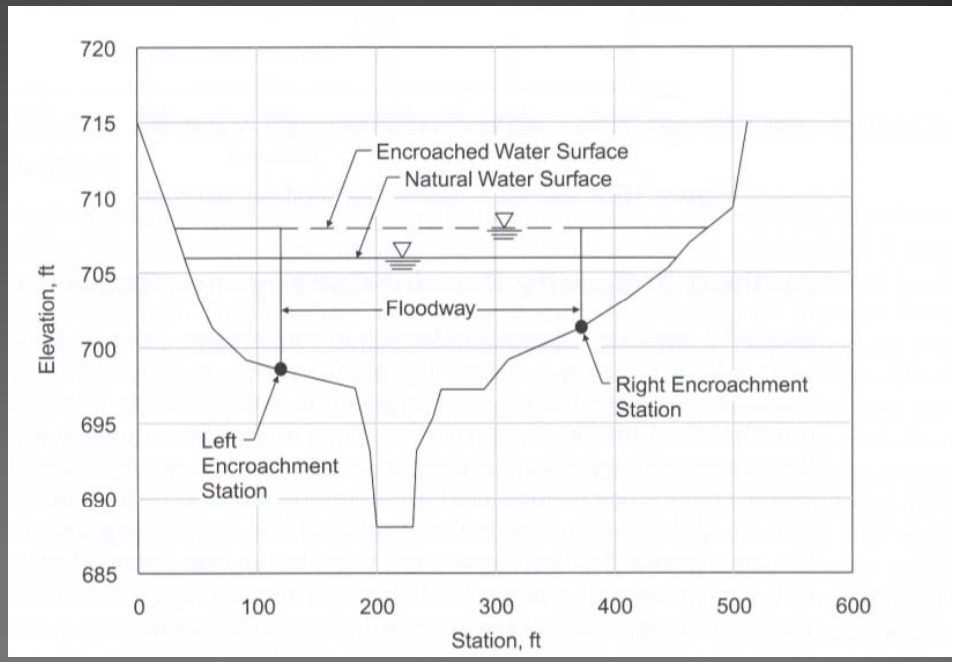

(b) Plan View

# National Flood Insurance Program (NFIP)

## How is a Floodway determined?

Perform "Floodway/Encroachment Analysis"

- Hydraulic Modeling
- Equal Conveyance Reduction
- Establish encroachment Stations
- Surcharge: ≤ 0.5 ft in MT
- Results in FIS – Floodway Data Table



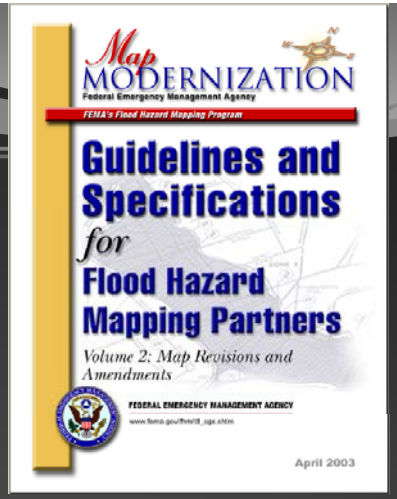
# NFIP

## Letter of Map Change (LOMC):

- FIS (report) and FIRMs (maps) define the regulatory SFHA, designate flood risk zones, and establish BFEs.
- Report and maps serve the basis for rating flood insurance and regulating development.
- Changes are sometimes necessary for:
  - Improved techniques
  - Physical Changes
  - New Data
  - Limitations of Scale
- LOMC processes provide mechanism to revise FIRM/FIS.

# NFIP

## Letter of Map Change (LOMC):




- LOMA (Amendment):
  - Structures or legally defined parcels
  - No changes to BFE
  - Not for properties in Alluvial Fans

<u>MT-1 Form</u>

- LOMA / LOMR-F
- CLOMA / CLOMR-F

(http://www.fema.gov/plan/prevent/fhm/dl_mt-1.shtm)

- LOMR (Revision):
  - More complex map changes
  - Not usually lot/structure specific
  - Typically involves H&H analysis

<u>MT-2 Form</u>

- LOMR / CLOMR
- PMR

(http://www.fema.gov/plan/prevent/fhm/dl_mt-2.shtm)

# NFIP

## Letter of Map Change (LOMC):

- LOMR (Letter of Map Revision):
  - Revises the Effective FIRM to show changes in BFEs, Floodplains, and Floodways.
  - Post-project, as-built conditions.
  - FIRM & FIS are not republished, but annotated maps, profiles, and tables are attached to Letter.
- CLOMR (Conditional Letter of Map Revision):
  - For Proposed Projects – FEMA's comment on the proposed projects compliance with the program.
  - Does not revise Map; must be followed by LOMR request when project is completed.

# NFIP

## FEMA LOMR/CLOMR FEES:

| REQUESTS FOR MAP CHANGES REQUIRING SPECIAL TECHNICAL REVIEW | FEE | COMMENT |
|---|---|---|
| CLOMR Based on New Hydrology, Bridge, Culvert, Channel, or Combination Thereof | $4,400 | Flat Fee |
| CLOMR Based on Levee, Berm, or Other Structural Measures | $6,050 | Flat Fee |
| LOMR/PMR Based on Bridge, Culvert, Channel, or Combination Thereof | $5,300 | Flat Fee |
| LOMR/PMR Based on Levee, Berm, or Other Structural Measures | $7,150 | Flat Fee |
| LOMR Based on As-Built Information (CLOMR previously issued by FEMA) | $5,000 | Flat Fee |
| LOMR/PMR Based Solely on Submission of More Detailed Data | Free | N/A |
| LOMR/CLOMR Based on Structural Measures on Alluvial Fans | $5,600 | Initial fee plus $60 per hour. Requester will be invoiced for remaining balance |

** CHECK http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm
For the most current LOMC FEE SCHEDULE

# NFIP

## FEMA LOMR/CLOMR Processing:

- Notification
  - Applicant notified regarding adequacy of submittal within 90 days
- Completion
  - Applicant either issued a LOMR/CLOMR or written comments within 90 days of receipt of all data

Technical Review performed for FEMA by their contractor Michael Baker Jr., Inc.:

- Revisions Manager: Jaclyn Bloor 720.479.3160
- Amendments Manager: Tom Birney 720.514.1110

# Engineering Revisions

## Basis for Revisions:

- New or more detailed analysis:
  - Updated hydrology
  - Additional hydraulic information (more cross sections, etc.)
  - New topographic information
  - No previous study (Zone A)
- Physical Changes:
  - Projects (bridge/culvert, channelization, levee, etc.)
  - Natural Changes (erosion, migration, structure removal)
- Error Corrections

# LOMR Requirements

## When is a LOMR Required?

- Any change (increase or decrease) in BFE resulting from physical changes (44 CFR 65.3)

code of federal regulations

- Requests involving:
  - Floodway Changes
  - Changes in properties of alluvial fan areas
  - Changes in Coastal High Hazard areas

# CLOMR Requirements

## When is a CLOMR Required? (2 Situations)

- DETAILED STUDY Reach: Proposed projects that encroach upon the floodway and cause BFE increase > 0.00 ft (exceed No-Rise condition)
  - 44 CFR 60.3 (d)(3) and (d)(4)
- LIMITED DETAIL Reach (BFEs w/out FW): Encroach upon a floodplain and cause BFE increase > 0.50 ft (MT Std)
  - 44 CFR 60.3 (c)(10) and (c)(13)
- How determine Increase?

  Comparison between pre-project (existing ) conditions and post-project (proposed) conditions model

# LOMR/CLOMR Requirements

Key points:

- How do you know if your project is going to require a LOMR or CLOMR without a hydraulic analysis?

  *Is professional judgment adequate?*

- To avoid these requirements, must design project accordingly – may be an iterative process…
- Project Scoping is extremely important –
  - Scheduling – Hydraulic model acquisition; Floodplain permitting; CLOMR Review; etc.
  - Project Costs – LOMR/CLOMR fees; surveying; design iterations; permit & FEMA form preparation; etc.

GOT FREEBOARD??
Glacier NP, McDonald Creek - 2006

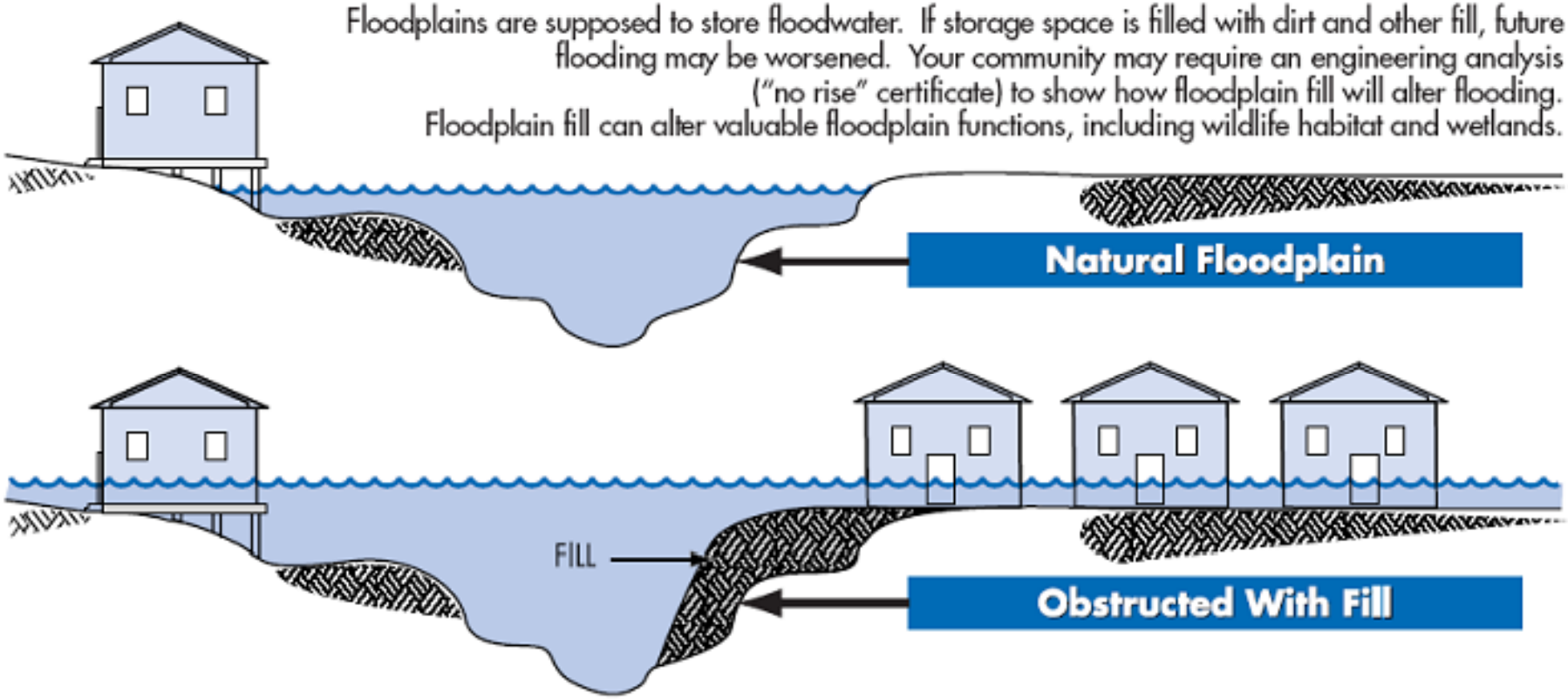
# Encroachment Review

Basic Rule – Development must not increase the flood hazard on other properties (either upstream or downstream)

- Refer to “Encroachment” Handout
- All projects within the regulatory FLOODWAY must undergo an Encroachment Review to determine their effect on flood flows. Process to Evaluate encroachment effects!
- Development projects in the flood FRINGE by definition do not increase flood heights above the allowable level, so encroachment reviews typically are not necessary.

# Allowing Fill in the Floodplain Today May Worsen Impacts of Future Flooding…

Floodplains are supposed to store floodwater. If storage space is filled with dirt and other fill, future flooding may be worsened. Your community may require an engineering analysis ("no rise" certificate) to show how floodplain fill will alter flooding. Floodplain fill can alter valuable floodplain functions, including wildlife habitat and wetlands.



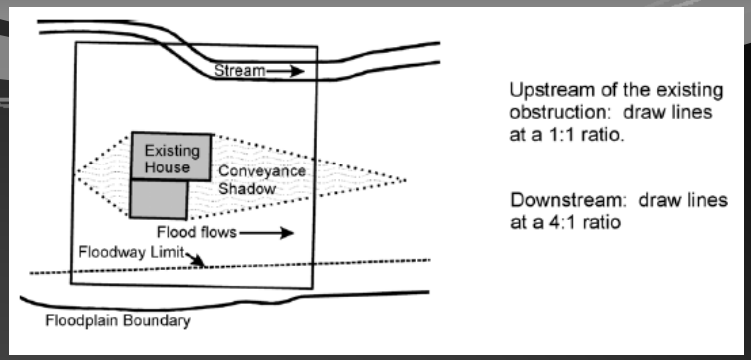
# Encroachment Review

code of federal regulations

44 CFR 60.3(d)(3):

- [In the regulatory floodway, communities must] Prohibit encroachments, 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 <u>any</u> increase in flood levels within the community during the occurrence of the base flood discharge.
- This is the "<u>No-Rise</u>" requirement = Zero Increase (0.00)

# Encroachment Review




## The Key Questions:

Detailed Study Reach (BFEs with delineated Floodway)

- Is the Floodway encroached? Yes = No-Rise Analysis
  (Possible exceptions - minor projects, conveyance shadow)
- Based on the results of the No-Rise analysis, is a CLOMR/LOMR required for the Project?

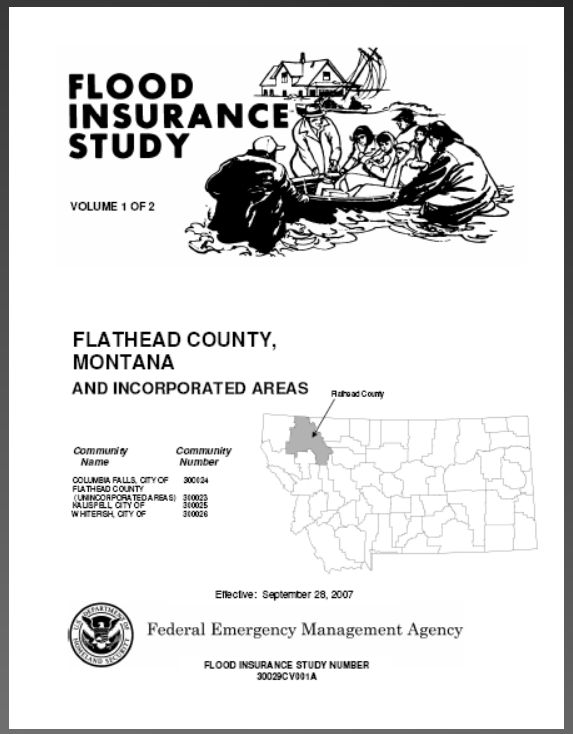
Limited Detail / Approximate Reaches (no floodway)

- Is the Floodplain encroached? Yes = “No”-Rise Analysis
- If > 0.5’ rise, then CLOMR required.

# Encroachment Review

## How to determine if your project encroaches on Floodway?

- Flood Insurance Rate Map (FIRM/DFIRM)
- Flood Insurance Study (FIS) – Floodway Data Tables



FLOOD INSURANCE STUDY

VOLUME 1 OF 2

FLATHEAD COUNTY, MONTANA

AND INCORPORATED AREAS

Flathead County

| Community Name | Community Number |
|---|---|
| COLUMBIA FALLS, CITY OF | 300024 |
| FLATHEAD COUNTY (UNINCORPORATED AREAS) | 300023 |
| KALISPELL, CITY OF | 300025 |
| WHITEFISH, CITY OF | 300026 |

Effective: September 28, 2007

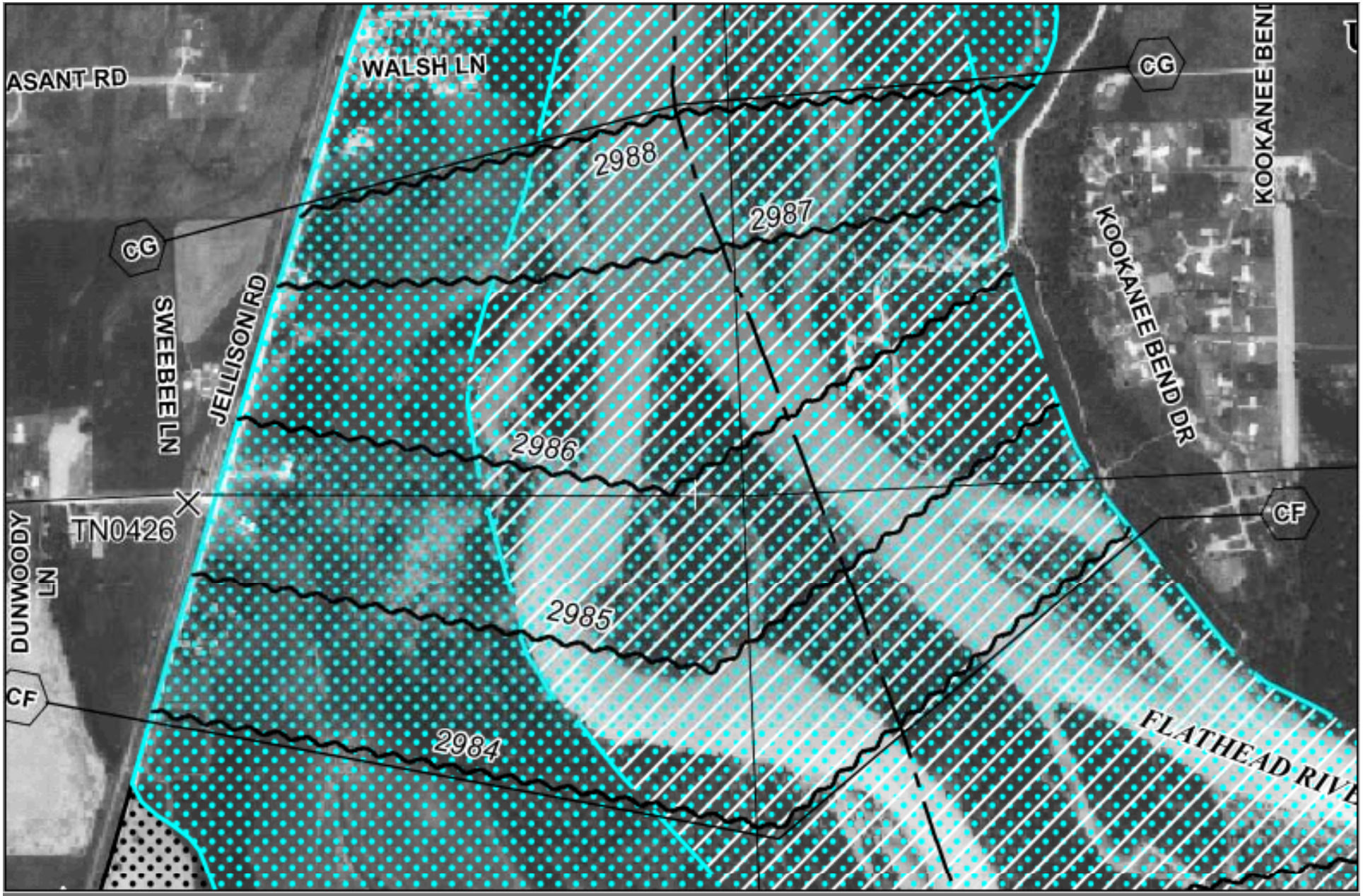
Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER 30029CV001A

## Use Effective FIS/FIRMs –

- Available at FEMA Map Service Center

  http://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1




Example – DFIRM

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| FLATHEAD RIVER (cont.) | | | | | | | | |
| BO | 145,150 | 3,251 | 18,754 | 4.5 | 2,933.7 | 2,933.7 | 2,934.0 | 0.3 |
| BP | 147,050 | 2,925 | 15,369 | 5.4 | 2,935.5 | 2,935.5 | 2,935.8 | 0.3 |
| BQ | 148,550 | 3,657 | 20,632 | 4.0 | 2,937.2 | 2,937.2 | 2,937.6 | 0.4 |
| BR | 151,050 | 3,931 | 9,143 | 9.1 | 2,940.7 | 2,940.7 | 2,940.7 | 0.0 |
| BS | 153,950 | 3,194 | 12,346 | 6.8 | 2,945.1 | 2,945.1 | 2,945.1 | 0.0 |
| BT | 156,550 | 2,604 | 18,187 | 4.6 | 2,947.3 | 2,947.3 | 2,947.3 | 0.0 |
| BU | 158,650 | 2,002 | 7,356 | 11.4 | 2,949.5 | 2,949.5 | 2,949.5 | 0.0 |
| BV | 160,350 | 1,252 | 10,087 | 8.3 | 2,953.2 | 2,953.2 | 2,953.2 | 0.0 |
| BW | 162,150 | 971 | 7,894 | 10.6 | 2,956.3 | 2,956.3 | 2,956.3 | 0.0 |
| BX | 163,700 | 1,750 | 14,184 | 5.9 | 2,957.9 | 2,957.9 | 2,957.9 | 0.0 |
| BY | 165,550 | 1,850 | 7,621 | 11.0 | 2,960.2 | 2,960.2 | 2,960.2 | 0.0 |
| BZ | 167,300 | 1,608 | 12,297 | 6.8 | 2,962.7 | 2,962.7 | 2,962.7 | 0.0 |
| CA | 170,100 | 2,013 | 12,744 | 6.5 | 2,966.7 | 2,966.7 | 2,966.7 | 0.0 |
| CB | 172,400 | 1,280 | 12,883 | 6.5 | 2,969.8 | 2,969.8 | 2,970.3 | 0.5 |
| CC | 174,500 | 1,377 | 12,545 | 6.6 | 2,972.7 | 2,972.7 | 2,973.2 | 0.5 |
| CD | 178,000 | 2,506 | 20,757 | 4.0 | 2,977.6 | 2,977.6 | 2,978.1 | 0.5 |
| CE | 180,700 | 2,416 | 17,097 | 4.9 | 2,980.9 | 2,980.9 | 2,981.4 | 0.5 |
| CF | 183,600 | 2,775 | 19,317 | 4.4 | 2,984.0 | 2,984.0 | 2,984.3 | 0.3 |
| CG | 186,700 | 2,125 | 15,714 | 5.4 | 2,988.0 | 2,988.0 | 2,988.5 | 0.5 |
| CH | 191,400 | 730 | 9,788 | 8.6 | 2,993.7 | 2,993.7 | 2,994.2 | 0.5 |
| CI | 197,900 | 469 | 8,694 | 9.7 | 2,997.8 | 2,997.8 | 2,998.3 | 0.5 |
| CJ | 200,070 | 1,181 | 12,310 | 7.7 | 3,004.1 | 3,004.1 | 3,004.3 | 0.2 |

[1]Feet above confluence with Flathead Lake

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

**FLATHEAD COUNTY, MT**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**FLATHEAD RIVER**

# Example – Floodway Data Table

# Encroachment Review

Typical projects that usually require Encroachment Review & No-Rise analysis:

- Includes new construction, replacement or removal of existing structures:
  - Stream crossing structures:  bridges, culverts
  - Flood control structures: dams, levees, flood walls, etc.
- Fill
- Channel modifications – natural or other (armoring & stream stabilization projects)

# Encroachment Review

## Floodplain Development Permit Application

- Applicant must demonstrate that 44 CFR 60.3(d)(3) has been satisfied – i.e. complete a No-Rise Hydraulic Analysis OR provide explanation of why a hydraulic analysis is not necessary OR Submit CLOMR.

  (Possible exceptions - minor projects, conveyance shadow)

- Encroachment Analysis Certification: such analyses must be performed and certified/sealed by a Licensed MT Professional Engineer.

  (Engineer/PE must be competent & experienced in the field of hydraulic engineering, ARM 24.183.2203)

- Communities are required to review and approve the No-Rise submittals. (DNRC will complete technical review at the request of the community)

# Encroachment Review

## Floodplain Development Permit Application

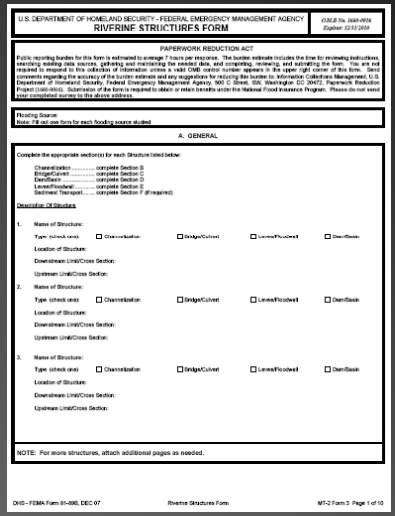
- The analysis must be supported by technical data, and be based on the Effective hydraulic model utilized to develop the Effective FIRM floodway and BFEs.
  - Must submit electronic model files with application (i.e. HEC-RAS, etc.)
- BFE increase or decrease, and/or Floodway changes require LOMR per 44 CFR 65.3 (LOMRs must be submitted within 6 months of construction and are based on as-built conditions)
- BFE increase > 0.00 requires CLOMR per 44 CFR 60.3(d)(4). (CLOMRs must be submitted prior to construction and are based on proposed conditions)

# No-Rise Hydraulic Analysis Process

## Guidelines & Specifications

- FEMA Instructions for completing MT-2 Forms (LOMR/CLOMR application forms)

  http://www.fema.gov/plan/prevent/fhm/dl_mt-2.shtm



U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. No. 1660-0016
Expires: 12/31/2010

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number is displayed in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington, DC 20472. Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. Please do not send your completed survey to the above address.

Flooding Source:
Note: Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization ..... complete Section B
Bridge/Culvert ..... complete Section C
Dam/Basin ..... complete Section D
Levee/Floodwall ..... complete Section E
Sediment Transport ..... complete Section F (if required)

Description Of Structure

1. Name of Structure:
   Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin
   Location of Structure:
   Downstream Limit/Cross Section:
   Upstream Limit/Cross Section:
2. Name of Structure:
   Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin
   Location of Structure:
   Downstream Limit/Cross Section:
   Upstream Limit/Cross Section:
3. Name of Structure:
   Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin
   Location of Structure:
   Downstream Limit/Cross Section:
   Upstream Limit/Cross Section:

NOTE: For more structures, attach additional pages as needed.

DHS - FEMA Form 81-086, DEC 07 Riverine Structures Form MT-2 Form 3 Page 1 of 10

- Summary of MT-2 Forms:
  - Form 1 – Overview & Concurrence Form (Community must Sign)
  - Form 2 – Riverine Hydrology & Hydraulics Form **(REVIEW THESE INSTRUCTIONS)**
  - Form 3 – Riverine Structures Form
  - Form 4 & 5 – Coastal Analysis/Structures Forms
  - Form 6 – Alluvial Fan Flooding Form

# No-Rise Hydraulic Analysis Process

## Step 1 – Contact/Discuss Project with Floodplain Administrator, DNRC, and other permitting authorities.

- Site visit may be beneficial
- Determine if any new studies are in process that include the project area.
- Any LOMCs for the project area?
- The State, community, or others may have copies of effective hydraulic model for project site.

# No-Rise Hydraulic Analysis Process

## Step 2 – Acquire Effective Hydraulic Model

- This takes time – so plan accordingly!

- Request & obtain from FEMA Engineering Library:
  - Involves Fees ($150 +)
  - Takes 2-6 weeks to receive data
  - Receive microfiche copies of input/output hydraulic model files or the model files (if available).

http://www.fema.gov/plan/prevent/fhm/st_order.shtm

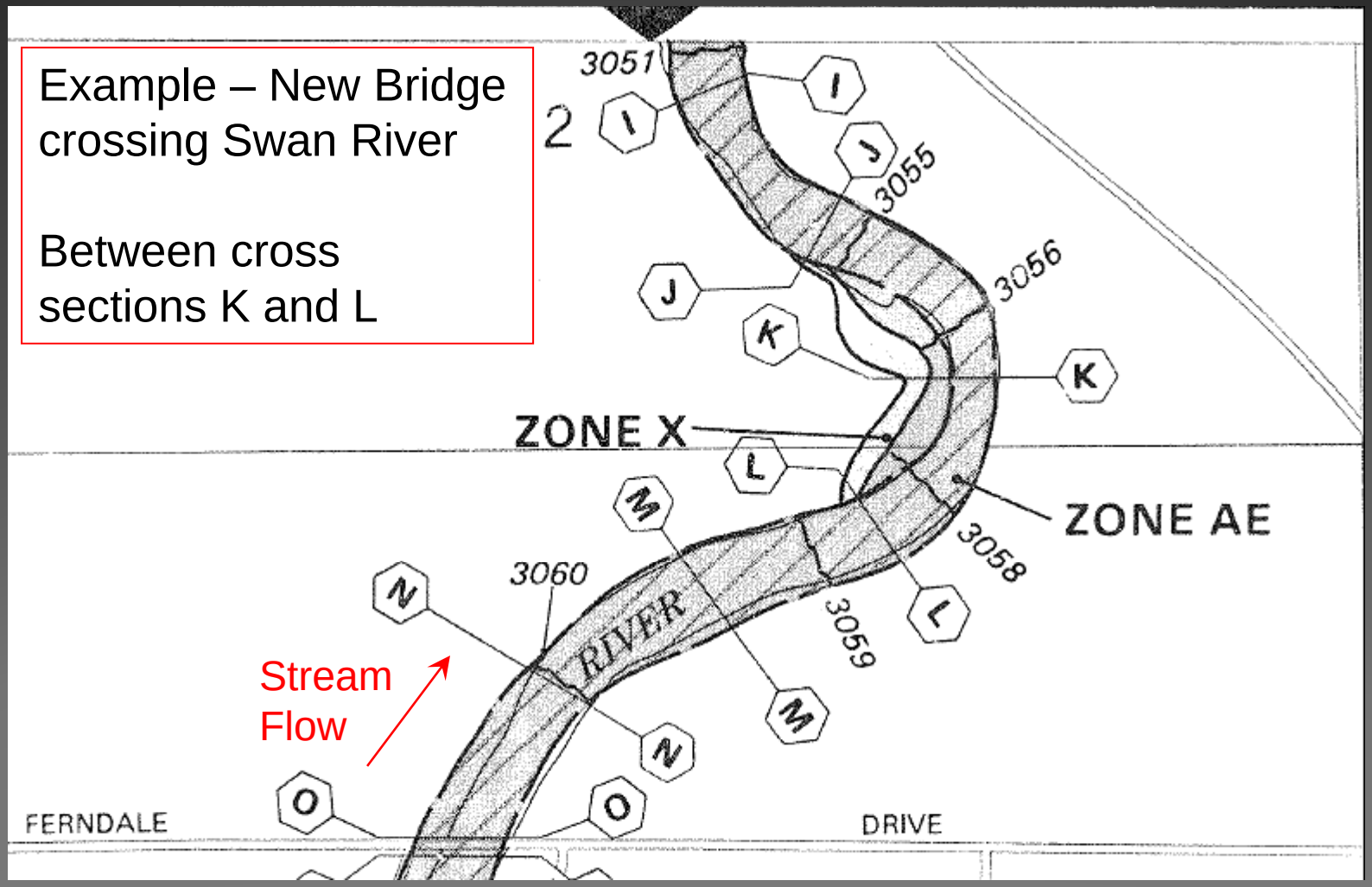
# No-Rise Hydraulic Analysis Process

## Step 3 – Develop Duplicate Effective Model

- This is a reproduction of the Effective model for the specific project area.
- Various scenarios based on date of the Effective model and the hydraulic software used (i.e. HEC-2, WSP-2, etc.)
- Duplicate the effective model results in the hydraulic model that you have selected (HEC-RAS most common)…
  - Must be FEAM approved: http://www.fema.gov/plan/prevent/fhm/en_hydra.shtm

# No-Rise Hydraulic Analysis Process

## Step 3 – Develop Duplicate Effective Model



| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| | | | | | (FEET NGVD) | | | |
| Lower Swan River | | | | | | | | |
| A | 64,410 | 173 | 1369 | 6.6 | 3033.8 | 3033.8 | 3033.9 | 0.1 |
| B | 65,025 | 180 | 1159 | 7.8 | 3034.8 | 3034.8 | 3034.9 | 0.1 |
| C | 65,630 | 255 | 1392 | 6.5 | 3036.3 | 3036.3 | 3036.4 | 0.1 |
| D | 66,230 | 150 | 718 | 12.5 | 3038.6 | 3038.6 | 3038.6 | 0.0 |
| E | 66,860 | 185 | 1067 | 8.4 | 3042.7 | 3042.7 | 3042.9 | 0.2 |
| F | 67,470 | 188 | 999 | 9.0 | 3044.7 | 3044.7 | 3044.8 | 0.1 |
| G | 68,050 | 210 | 1024 | 8.8 | 3047.0 | 3047.0 | 3047.1 | 0.1 |
| H | 68,665 | 265 | 1209 | 7.4 | 3049.6 | 3049.6 | 3049.6 | 0.0 |
| I | 69,245 | 250 | 935 | 9.6 | 3051.7 | 3051.7 | 3051.7 | 0.0 |
| J | 69,880 | 215 | 1226 | 7.3 | 3054.6 | 3054.6 | 3054.7 | 0.1 |
| K | 70,625 | 165 | 950 | 9.5 | 3056.3 | 3056.3 | 3056.5 | 0.2 |
| L | 71,295 | 255 | 1557 | 5.8 | 3058.6 | 3058.6 | 3058.8 | 0.2 |
| M | 71,915 | 300 | 1885 | 4.8 | 3059.5 | 3059.5 | 3059.6 | 0.1 |
| N | 72,520 | 260 | 1430 | 6.3 | 3060.1 | 3060.1 | 3060.2 | 0.1 |
| O | 73,120 | 280 | 1935 | 4.7 | 3061.4 | 3061.4 | 3061.4 | 0.0 |
| P | 73,165 | 280 | 1953 | 4.6 | 3061.4 | 3061.4 | 3061.4 | 0.0 |
| Q | 73,765 | 260 | 867 | 10.4 | 3063.1 | 3063.1 | 3063.1 | 0.0 |
| R | 74,370 | 260 | 1412 | 6.4 | 3066.3 | 3066.3 | 3066.3 | 0.0 |
| S | 74,960 | 275 | 1600 | 5.6 | 3067.3 | 3067.3 | 3067.4 | 0.1 |
| T | 75,570 | 185 | 1010 | 8.9 | 3067.9 | 3067.9 | 3068.1 | 0.2 |
| U | 76,185 | 285 | 1950 | 4.6 | 3069.7 | 3069.7 | 3069.9 | 0.2 |
| V | 76,795 | 265 | 1581 | 5.7 | 3070.1 | 3070.1 | 3070.3 | 0.2 |
| W | 77,395 | 260 | 1442 | 6.2 | 3070.9 | 3070.9 | 3071.2 | 0.3 |
| X | 77,925 | 210 | 1248 | 7.2 | 3071.8 | 3071.8 | 3072.0 | 0.2 |
| Y | 78,475 | 220 | 1362 | 6.6 | 3073.0 | 3073.0 | 3073.1 | 0.1 |

[1] Feet above mouth

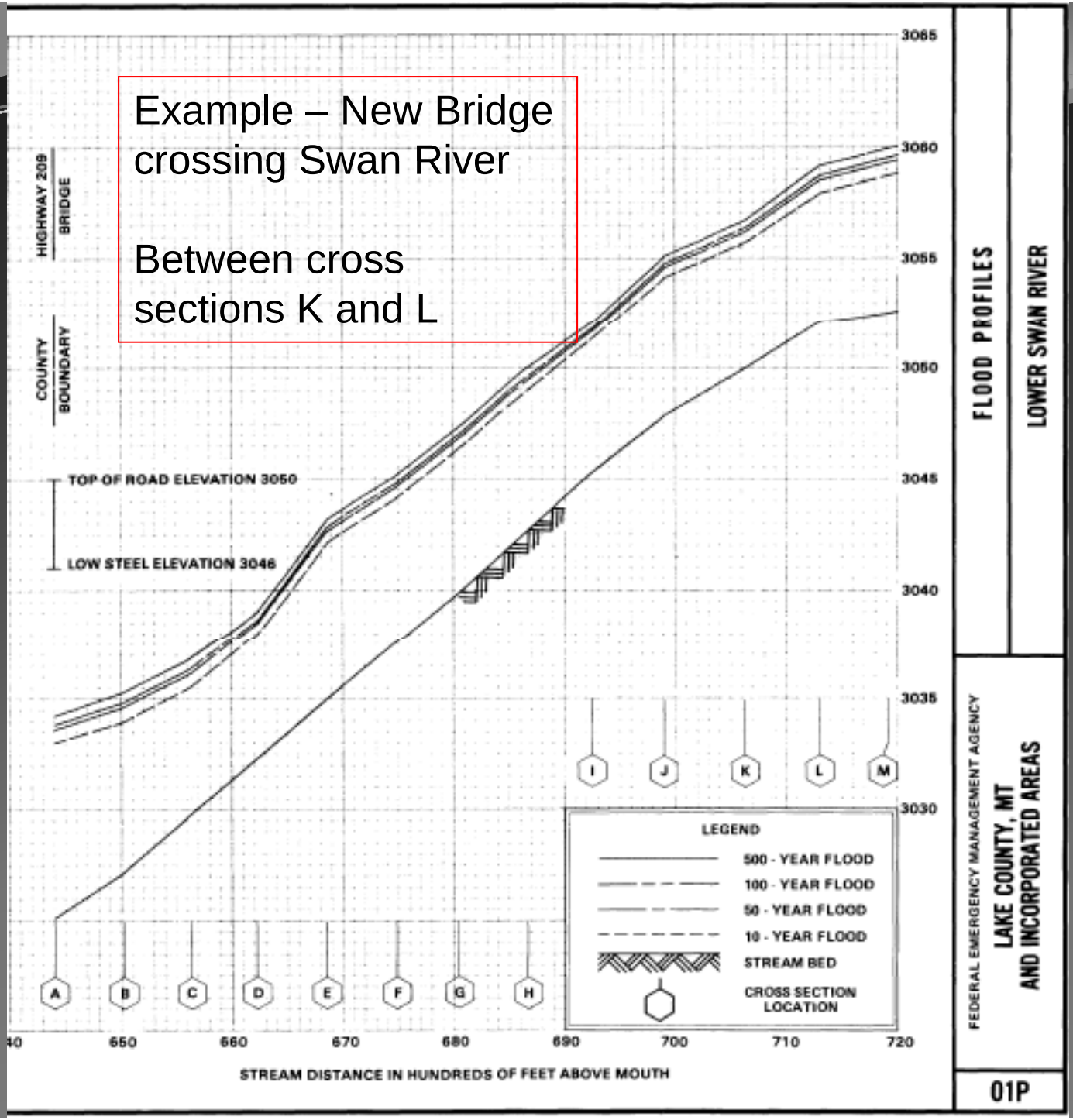
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

LAKE COUNTY, MT
AND INCORPORATED AREAS

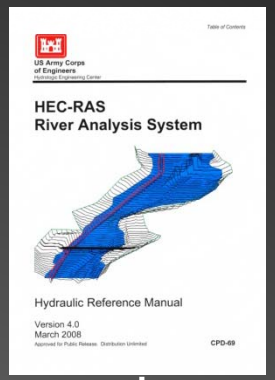
FLOODWAY DATA

LOWER SWAN RIVER


Example – New Bridge crossing Swan River
Between cross sections K and L
HIGHWAY 209 BRIDGE
COUNTY BOUNDARY
TOP OF ROAD ELEVATION 3050
LOW STEEL ELEVATION 3046
3065
3060
3055
3050
3045
3040
3035
3030
A
B
C
D
E
F
G
H
I
J
K
L
M
LEGEND
500 - YEAR FLOOD
100 - YEAR FLOOD
50 - YEAR FLOOD
10 - YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
640
650
660
670
680
690
700
710
720
STREAM DISTANCE IN HUNDREDS OF FEET ABOVE MOUTH
FLOOD PROFILES
LOWER SWAN RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
LAKE COUNTY, MT
AND INCORPORATED AREAS
01P

# No-Rise Hydraulic Analysis Process

## Step 3 – Develop Duplicate Effective Model

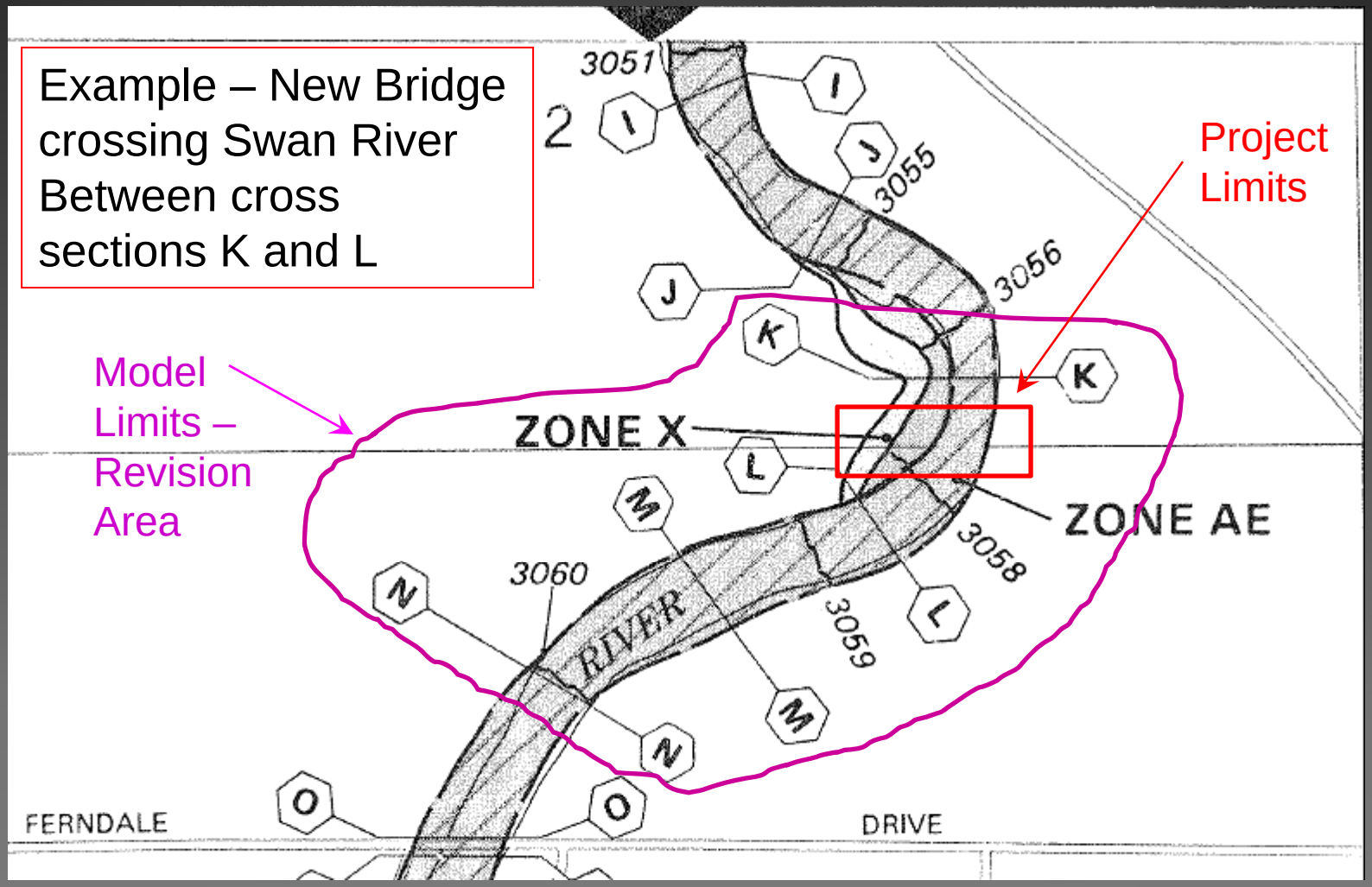



- Example – Using HEC-RAS hydraulic model
- Define Project Area
  - Go downstream from Project to first FIRM cross section and begin the model here (i.e. Cross Section K for example)
  - Upstream – recommend including 2-3 cross sections above project area (choose Cross Section N for example)

Duplicate Effective Model – has 4 cross sections (K, L, M, N) and any others not shown on FIRM maps but in eff model.

# No-Rise Hydraulic Analysis Process

## Step 3 – Develop Duplicate Effective Model



# No-Rise Hydraulic Analysis Process

## Step 3 – Develop Duplicate Effective Model

- Boundary Conditions – use Known Water Surface at downstream cross section (BFE @ K = 3056.3), not Normal Depth.
- Essentially creating a truncated version of the Effective hydraulic model for the project reach - using all the same data (geometry, friction values, etc) from the Effective model to duplicate the results.
- Since Floodway – also have encroached/unencroached conditions with matching stations accordingly.

# No-Rise Hydraulic Analysis Process

## Step 3 – Develop Duplicate Effective Model

- Using same model program, i.e., HEC-2 to HEC-2: must duplicate FIS profiles and elevations in floodway data table to within 0.1 foot.
- Effective model not available: then new model must reproduce FIS profiles to within 0.5 foot.
- Using alternate model, i.e., HEC-2 to HEC-RAS: must reproduce FIS profiles to within 0.5 foot.

# No-Rise Hydraulic Analysis Process

## Step 4 – Develop Corrected Effective Model

- This is the Duplicate Effective model with the following modifications:
  - Corrections to any errors (technical error or construction in the floodplain that occurred prior to date of eff model).
  - Addition of cross sections (i.e. new cross section locations for new bridge) reflecting conditions at time of eff model. (Usually don't have this type of historical data)
- Must NOT reflect any man-made physical changes since the date of the effective model

# No-Rise Hydraulic Analysis Process

## Step 5 – Develop Pre-Project (Existing) Conditions Model

- Update new cross sections added to model to reflect current existing topographic conditions.
- Modifications apply to new cross sections as well as those in the original Effective model
- However – FIRM cross sections upstream (N) and downstream (K) of the revised reach (at effective tie-in) should be identical to those in the Effective model.

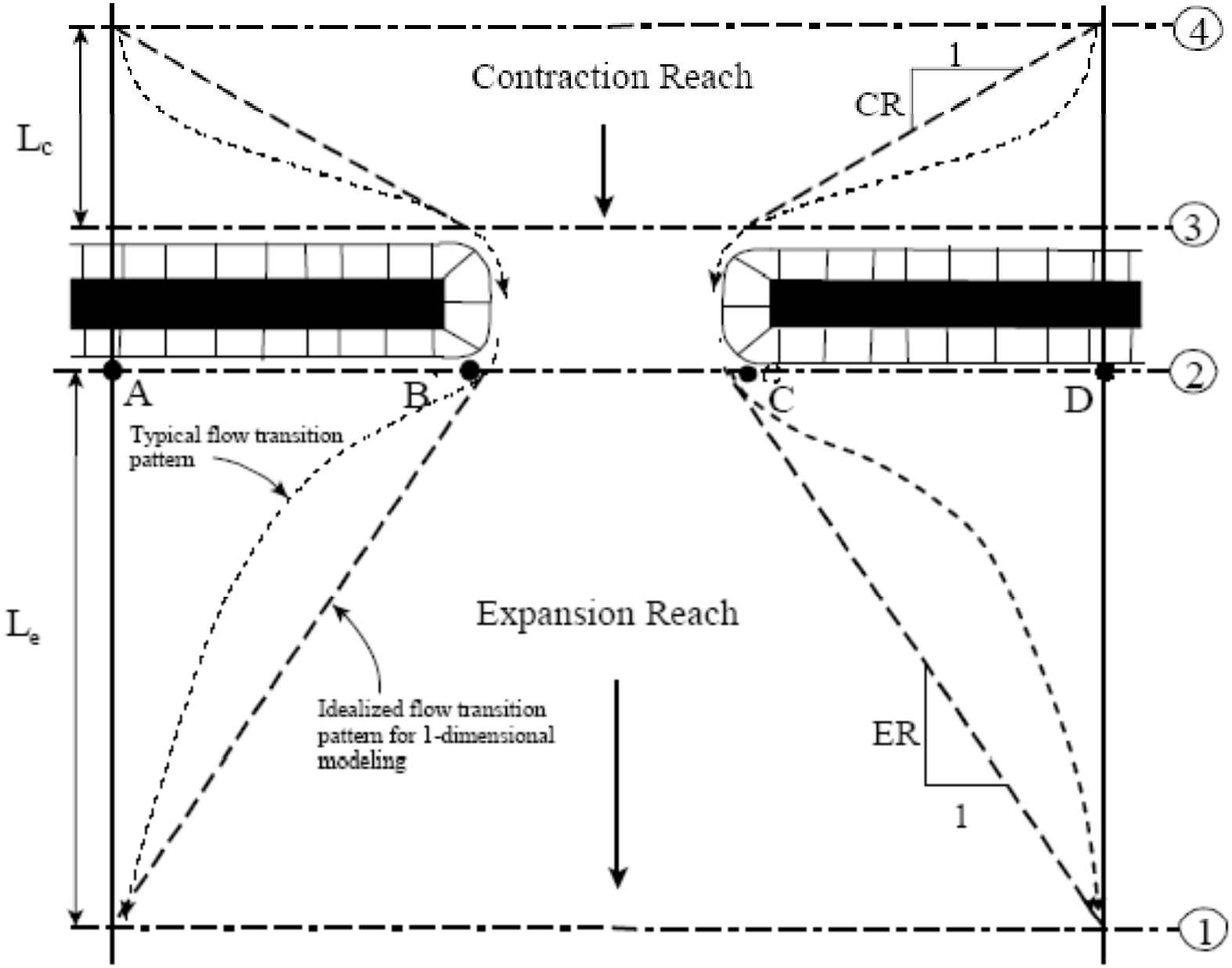



*Figure 6-11 Cross Section Locations at a Bridge or Culvert*

# No-Rise Hydraulic Analysis Process

## Step 6 – Develop Post-Project (Revised) Conditions Model

- Modify Existing Conditions Model to reflect the revised conditions – i.e. addition of the Bridge in this example.

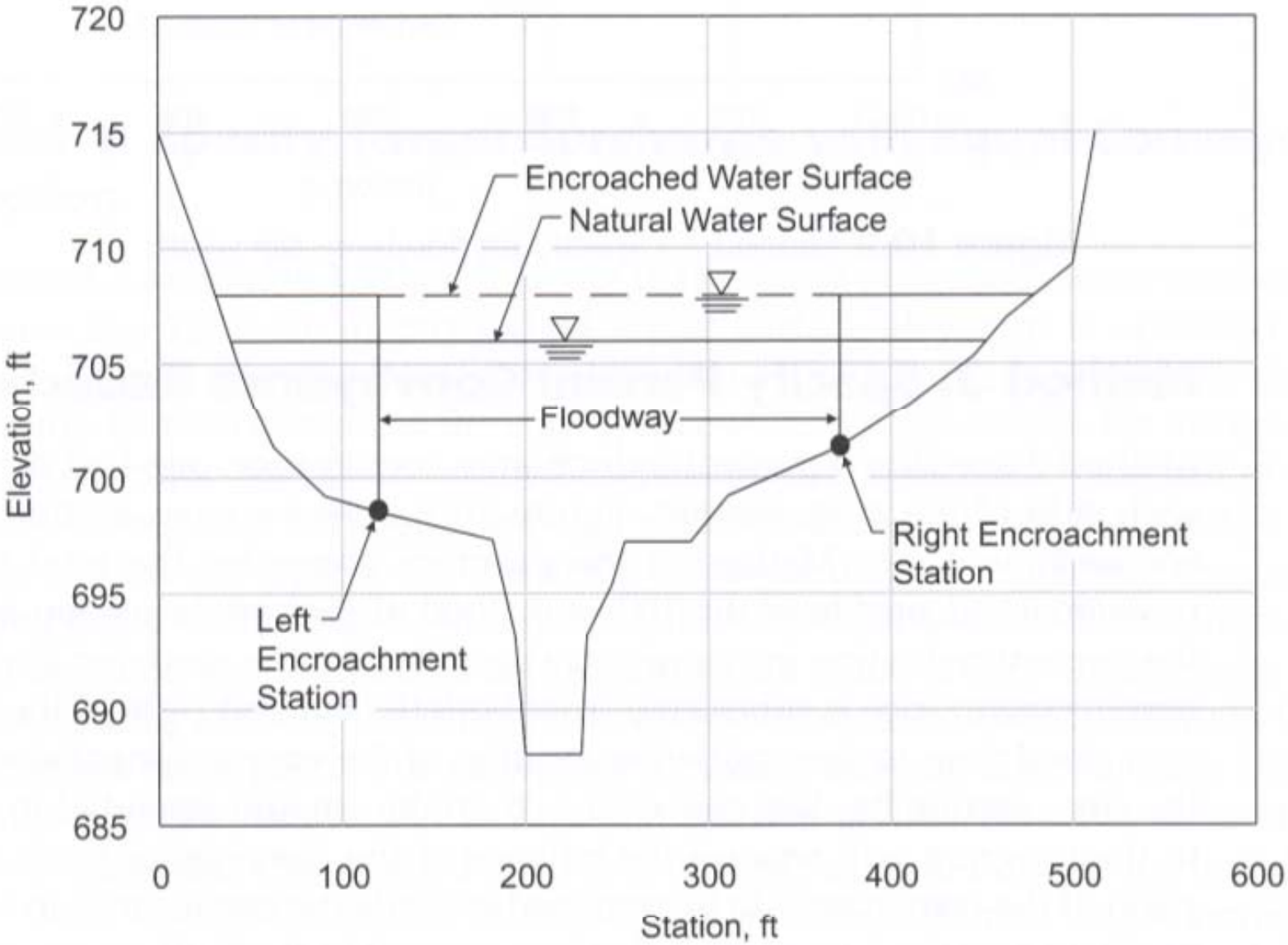
- This model incorporates any physical changes to the floodplain since the Effective model was produced.

# No-Rise Hydraulic Analysis Process

## Requirements

- The area of revision is defined by an effective tie-in at the upstream and downstream limits.
- Detailed Study – Effective tie-in obtained when revised base flood and floodway elevations are within 0.5 ft of the effective elevations,

  and the revised floodway encroachment stations match the effective floodway stations at both the upstream and downstream limits.


720
715
710
705
700
695
690
685
Elevation, ft
0
100
200
300
400
500
600
Station, ft
Encroached Water Surface
Natural Water Surface
Floodway
Left Encroachment Station
Right Encroachment Station

# No-Rise Hydraulic Analysis Process

## Requirements

- If the revised model does not tie-in to the Effective study at the project limits, the model must be extended upstream and downstream until it ties-in to the Effective study.

# No-Rise Hydraulic Analysis Process

## No-Rise Condition

- Comparison between pre-project (existing) conditions and post-project (proposed) conditions models.

- Some projects may still require a LOMR even thought they satisfied the No-Rise condition:  Floodway widths revised per 44 CFR 65.7.

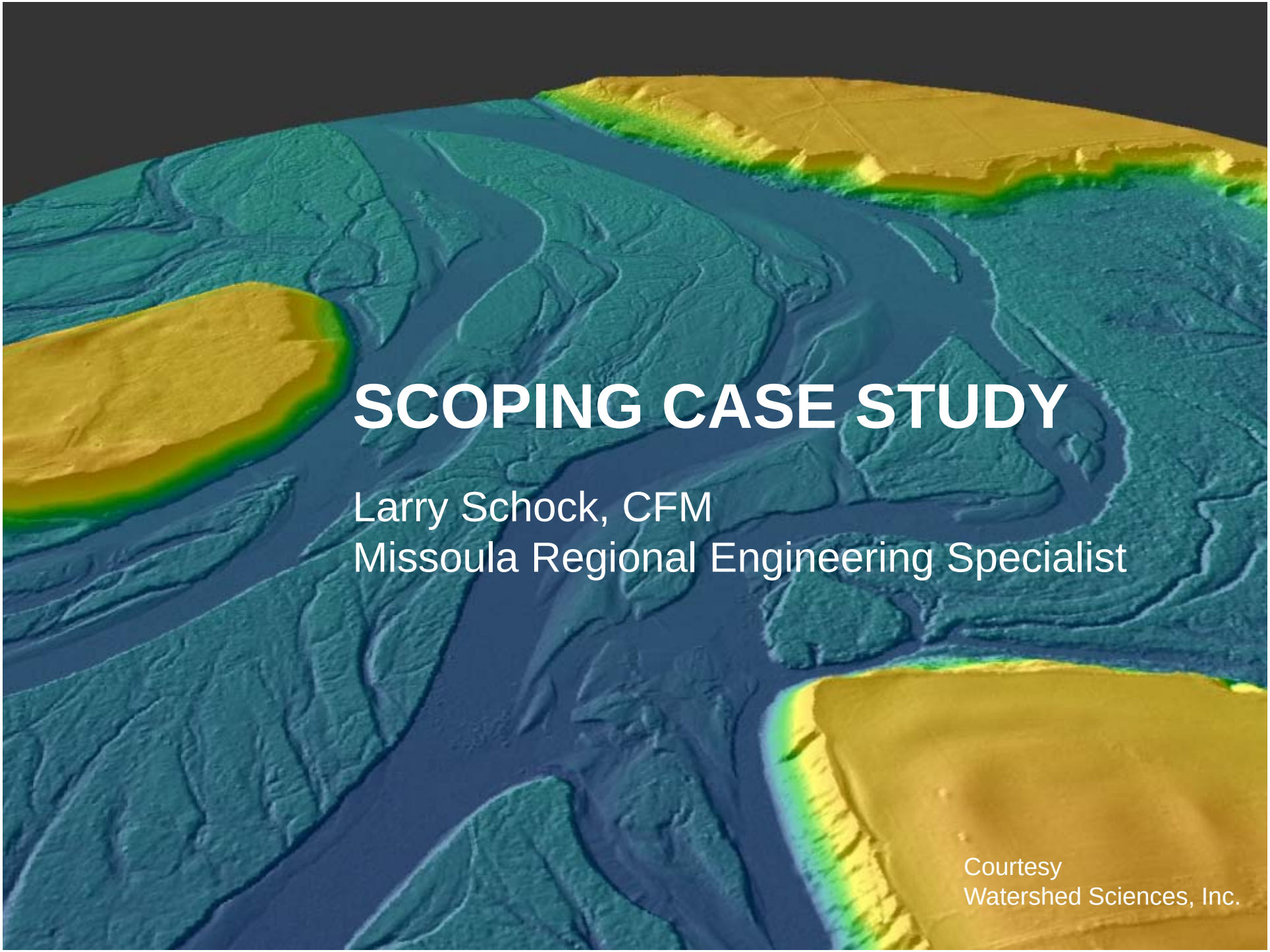
# No-Rise Hydraulic Analysis Process

## No-Rise Condition

- Applicant/Engineer should include a comparison table summarizing all the models and water surface elevations (BFEs) at each cross section within the model. This table must substantiate 0.00 increases at every cross section, otherwise a CLOMR will be required for the project.

| | Water Surface Elevations, ft | | |
|---|---|---|---|
| River Station | Effective | Existing | Proposed |
| 2000 | 321.30 | 321.30 | 321.30 |
| 2200 | – | 321.80 | 321.75 |
| 2300 | 321.85 | 322.10 | 321.90 |
| 2400 | – | 322.25 | 322.50 |
| 2600 | – | 322.40 | 322.60 |
| 2700 | – | 322.50 | 322.65 |
| 2900 | 322.75 | 322.75 | 322.70 |
| 3000 | 322.80 | 322.80 | 322.80 |

Based on the table results, is a CLOMR required ?



# SCOPING CASE STUDY

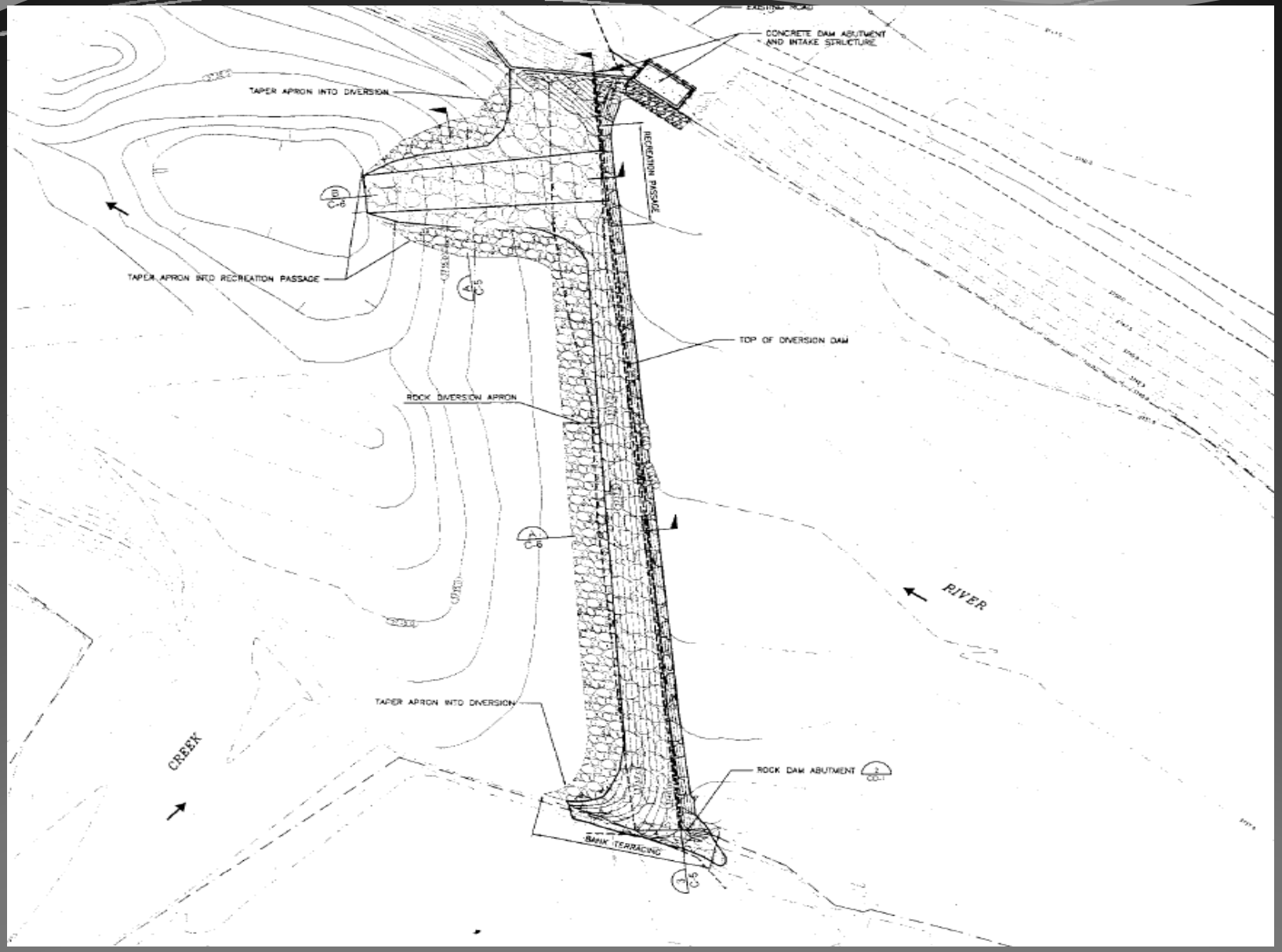
Larry Schock, CFM
Missoula Regional Engineering Specialist

Courtesy
Watershed Sciences, Inc.

# Floodplain Project Scoping Case Study

Irrigation diversion dam replacement project.

- The 320 t. long, 16 ft. wide, structure spans the entire width of a major river.
- Located within a FEMA Floodplain which had a Detailed Flood Insurance Study that included Floodway, Floodfringe, and BFE's.


CONCRETE DAM ABUTMENT AND INTAKE STRUCTURE
TAPER APRON INTO DIVERSION
RECREATION PASSAGE
TAPER APRON INTO RECREATION PASSAGE
TOP OF DIVERSION DAM
ROCK DIVERSION APRON
RIVER
TAPER APRON INTO DIVERSION
CREEK
ROCK DAM ABUTMENT
BANK TERRACING

# Floodplain Project Scoping Case Study

- Floodplain application submitted on 8/21/09.
- 404, 124, 318, and Navigable Rivers Land Use License applications also submitted on 8/21/09.
- Proposed starting data of project was 9/15/09.

# Floodplain Project Scoping Case Study

- DNRC received the application from the County requesting a technical review on 8/25/09.
- Initial deficiency letter sent by the County to the consultant on 8/31/09.
- DNRC technical review comments sent to the County on 9/14/09.

# Floodplain Project Scoping Case Study

- After the exchange of numerous emails and three meetings which included the applicant's consultant, the County, and the DNRC, the floodplain application was deemed technically sufficient on 11/25/09
- However the project still could not proceed until they received a Navigable Rivers Land Use agreement.
- The floodplain permit was issued on 12/15/09.

# Floodplain Project Scoping Case Study

- From date of the floodplain application submittal on 8/21/09, to it's issuance on 12/15/09, it took 116 days.
- Floodplain permit issued 91 days after the desired starting date of 9/15.
- The contractor was ready to mobilize on 10/1, but had to sit idle for 76 days.

# Floodplain Project Scoping Case Study

What Went Wrong?

- The consultant did not fully scope the project in three key areas:
  - Timing
  - Complexity
  - Permitting

# Floodplain Project Scoping Case Study

## What Went Wrong? – Timing

- The application was only submitted 3 weeks prior to the desired starting date.
- Most permits take at least 30 days to public notice and/or process, provided that they are correct and complete when submitted.
- Larger more involved projects take longer to review.

# Floodplain Project Scoping Case Study

## What Went Wrong? – Complexity

- The requirements and complexities of the floodplain permit process were not fully understood.
- The consultant did not realize that a FEMA No Rise Certification or a CLOMR/LOMR were needed for the project.
- The complexity of the HEC-RAS model for the project and the No Rise Certification were not fully understood.

# Floodplain Project Scoping Case Study

What went wrong? - Permitting

- All of the aspects involved in the multi-agency permitting process were not fully understood.
- The consultant did not understand what permits were required for the project, or the time frames involved.
- The level of detail required for the permitting process was not fully understood.

# Questions?
# Thank You

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Image Courtesy Watershed Sciences, Inc.