



## Floodplain Mapping 101

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## Topics

### Part 2A – Floodplain Mapping and Studies

- Basic Terms
- Types of FEMA Maps
- Flood Zones
- Flood Insurance Studies (FIS)
- Locating BFEs on Maps and Exhibits

### Part 2B – Map Changes

- Updating Maps (Map Changes)
- Levees

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## Basic Terms and Definitions

- **National Flood Insurance Program (NFIP)** – Voluntary program where communities can participate by agreeing to adopt local floodplain management regulations in exchange for federal flood insurance, disaster assistance, and grants/loans
- **Base Flood** – a flood that has a 1-percent chance of being equaled or exceeded in any given year. Often referred to as the 100-year flood. The 1-percent annual chance (base) flood is the regulatory flood for the NFIP.

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## Basic Terms and Definitions

- **Base Flood Elevation (BFE)** – The elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year
- **Special Flood Hazard Area (SFHA)** – The areas mapped as being inundated by the **base flood** (1% annual chance flood). Often referred to as the floodplain.

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## Floodplain Map Uses

- Floodplain Management (regulation)
- Flood Insurance
- Mitigation



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## Types of FEMA Maps

- Flood Hazard Boundary Maps (FHBM)
- Flood Insurance Rate Map (FIRM)
- Flood Boundary Floodway Map (FBFM)
- Digital Flood Insurance Rate Map (DFIRM)

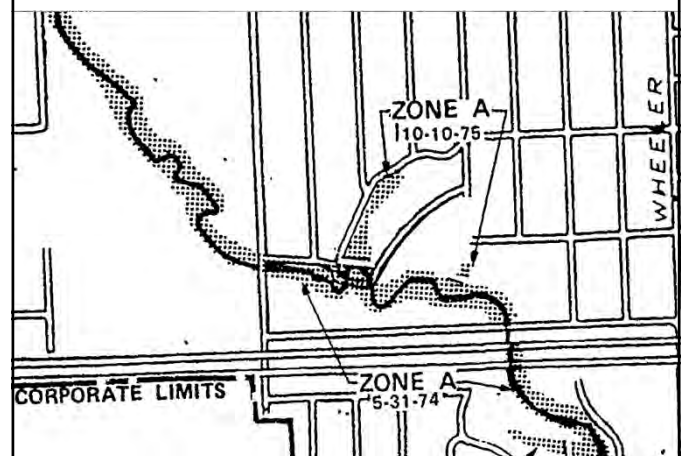
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## Floodplain Map Evolution, Joliet, IL

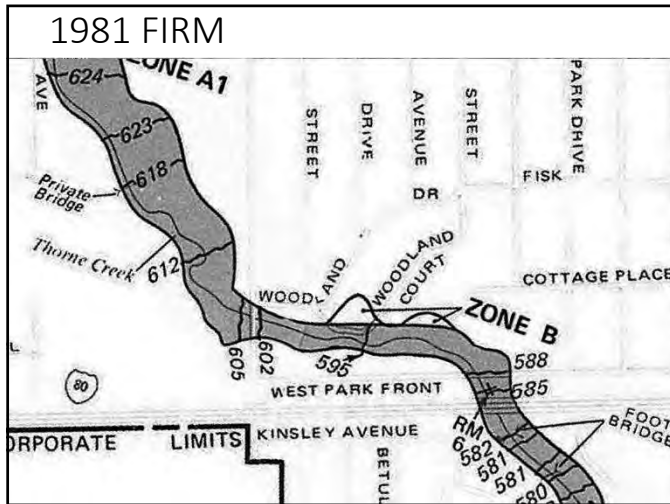


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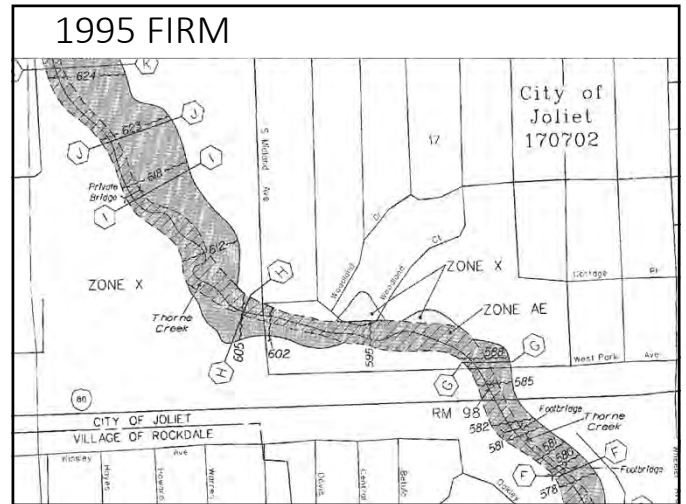
## 1976 FHBM



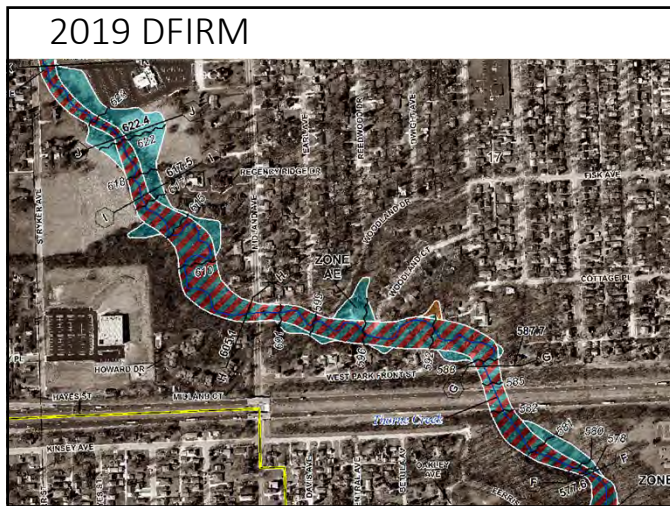
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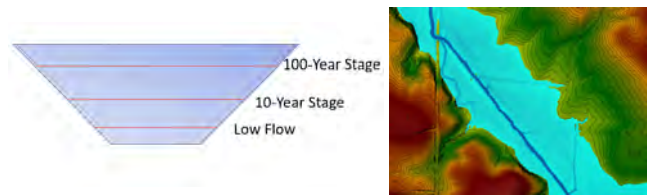
## How Do They Make Floodplain Maps?



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## How Do They Make Floodplain Maps?

- For Riverine Floodplains:
  - Need to know flood stages (elevations)
  - Need topographic data to map the flood stages



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## Floodplain Mapping

- Need hydrology and hydraulic analyses to define flood elevations
- Hydrology – How much precipitation runs off land surfaces and collects in streams and rivers
- Hydraulics – How high does water flow through stream and bridges

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## Hydrology

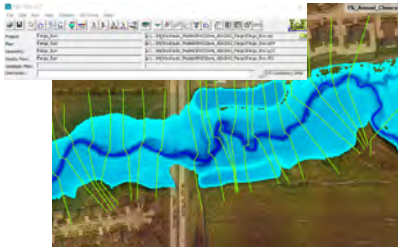
- Hydrology – defines flow rates (discharges) at various flood frequencies
- Most interested in 1% Annual Chance (100-year) stream flow
- Several methods
  - Watershed Modeling
  - Stream gage analysis – statistical approach
  - Regression equations/StreamStats – empirical approach

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## Hydraulics

- Hydraulic analysis determines the depth (height) of flow moving through a stream, bridge, culvert, etc.
- Hydraulics is simulated through modeling software



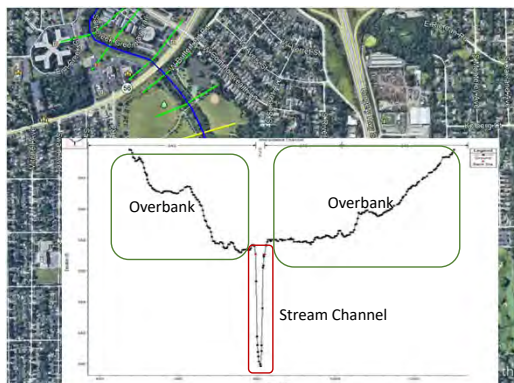
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## Hydraulics

- Typical hydraulic models require:
  - Cross sections of channel and overbank topography
  - Bridge/culvert data
  - Peak flow rates
  - Boundary conditions (starting water-surface elevation)

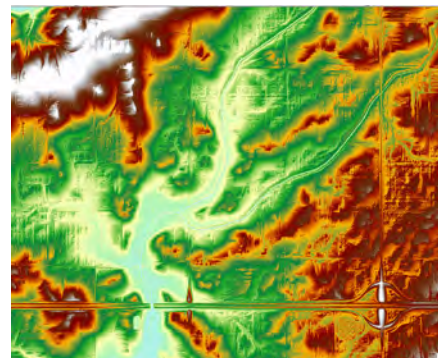
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## Cross Sections



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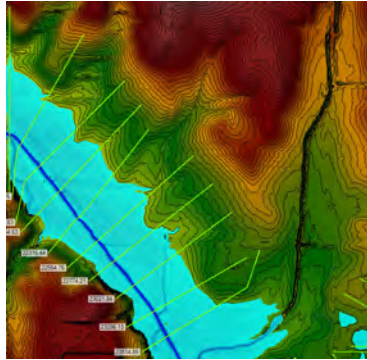
## Topography



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## Topography

- Greater accuracy and precision for floodplain mapping



## Topography

- Bench Marks (BM) and Reference Marks (RM)
- BM or RM = Carefully measure elevation points from which other elevations are surveyed. These are a surveyor's starting elevation.
- Datums (Not all elevations mean the same thing!)
  - MSL = Mean Sea Level
  - NGVD 29 = National Geodetic Vertical Datum of 1929
  - NAVD 88 = North American Vertical Datums of 1988
  - Local datum = Relatively referenced datum (challenging to convert to other datums)
- 650' NGVD29  $\neq$  650' NAVD88  $\neq$  650' Local
- FIS Report provides explanation of datum used.



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## Flood Zones

- 1% Annual Chance Flood is flood frequency that is regulatory for the NFIP
  - 1% Annual Chance Flood is known as the "**Base Flood**"
  - 1% Annual Chance Flood Elevation is known as "**Base Flood Elevation**" or "**BFE**"
  - The floodplain delineation of the "Base Flood" is known as "**Special Flood Hazard Areas**" or "**SFHA**"
- Not all flood hazards are equal therefore floodplain maps have variety of Flood Zones
  - Each flood zone has unique regulatory requirements and flood insurance ratings



## Flood Zones

- Flood Zone name depends on Floodplain Map Vintage
- A Zones depict 1% Annual Chance Floodplain
  - **Zone A** (No BFEs) = typically riverine approximate
  - **Zone AE** or **A1-30** (includes BFEs) = riverine detailed
  - **Zone AO** depth of 1' to 3' given = shallow sheet flow
  - **Zone AH** (includes BFEs) = shallow ponding



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## Approximate A Zones

- Approximate A Zones do not have BFEs
- Permits still required
  - Permits necessitate the estimation of a BFE
- Vital reference : FEMA Publication 265 "Managing Floodplain Development in Approximate A Zones"



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## A Zones



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## Zone AO



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## Zone AH



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## Other A Zones

- **Zone AR** – Floodplain resulting from decertification of a previously accredited flood protection system that is being restored to provide at least 1% Annual Chance protection
- **Zone A99** – Floodplain to be protected by a Federal flood protection system under construction; no BFEs



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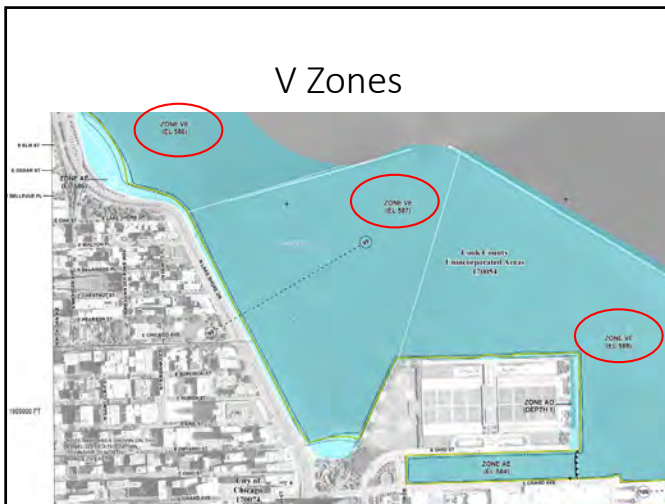
## Coastal Flood Zones

- V Zones depict 1% Annual Chance Coastal Floodplain
  - **Zone V** (no BFEs) = Approximate Coastal
  - **Zone VE/V1-30** (includes BFEs) = Detailed Coastal
- Two hazard components to V zones:
  - Inundation of Base Flood of coastal waters
  - Velocity (wave action) hazard, hence Zone V



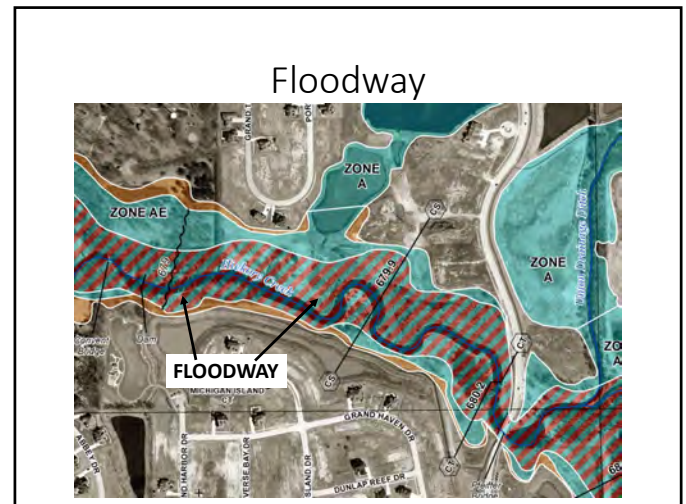
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## V Zones



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## Floodway

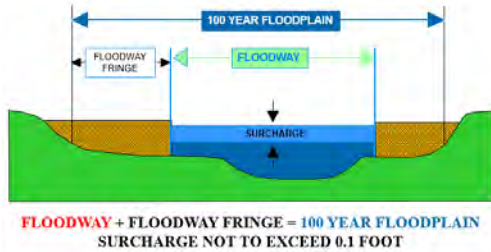


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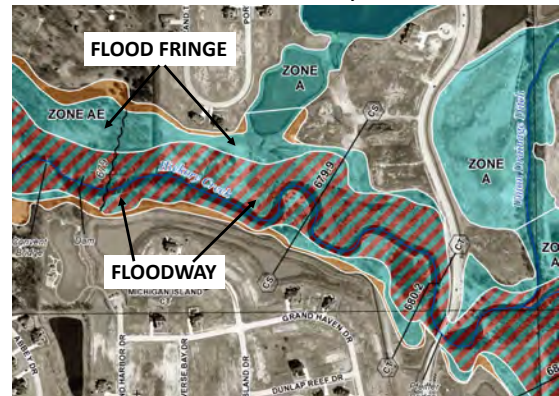
## Floodway

- National Standard = 1 foot floodway surcharge
- Illinois Standard = 0.1 foot floodway surcharge



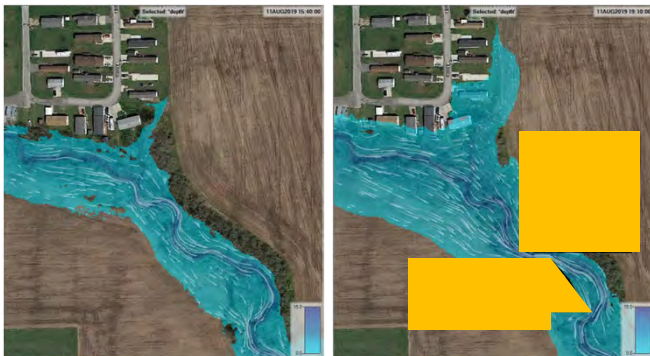
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## Floodway



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## Floodway



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## Non Regulatory Flood Zones

- Zone X (shaded)/Zone B – 0.2% Annual Chance (500-year) floodplain or 1% Annual Chance (100-year floodplain with average depth less than 1 foot
- Zone X/Zone C – Area of minimal flood hazard
- Zone D – Area of undetermined flood hazard (no regulatory requirements but some lenders may require flood insurance)



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## Non Regulatory Flood Zones



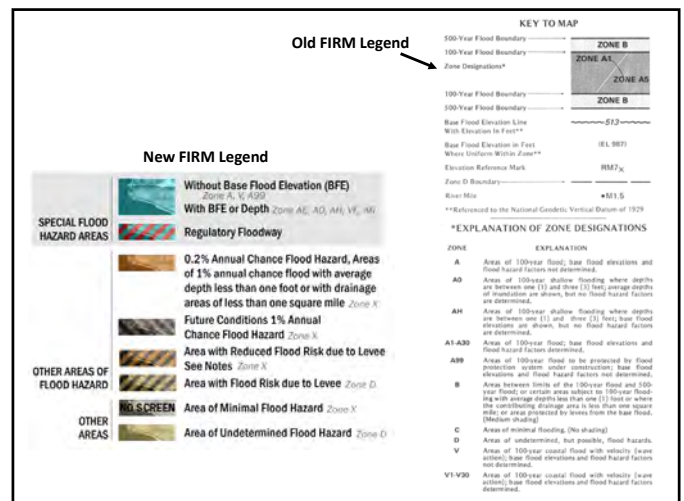
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Flood Zone	Floodplain Frequency?	BFE or Depth Given?	Mandatory Flood Insurance Purchase Requirement?	Regulatory (requires permits)?
Zone A	1% AC (100 Year)	No	Yes	Yes
Zone AE or A1-30	1% AC (100 Year)	Yes	Yes	Yes
Zone AO	1% AC (100 Year)	Yes	Yes	Yes
Zone AH	1% AC (100 Year)	Yes	Yes	Yes
Zone AR	1% AC (100 Year)	Yes	Yes	Yes
Zone A99	1% AC (100 Year)	No	Yes	Yes
Zone V	1% AC (100 Year)	No	Yes	Yes
Zone VE or V1-30	1% AC (100 Year)	Yes	Yes	Yes
Floodway	1% AC (100 Year)	Yes	Yes	Yes
Zone X (shaded) or Zone B	0.2% (500-Year); sometimes 1% less than 1' depth	No	No	No
Zone X (unshaded) or Zone C	N/A	No	No	No
Zone D	N/A	No	No	No

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Flood Zone	Floodplain Frequency?	BFE or Depth Given?	Mandatory Flood Insurance Purchase Requirement?	Regulatory (requires permits)?
Zone A	1% AC (100 Year)	No	Yes	Yes
Zone AE or A1-30	1% AC (100 Year)	Yes	Yes	Yes
Zone AO	1% AC (100 Year)	Yes	Yes	Yes
Zone AH	1% AC (100 Year)	Yes	Yes	Yes
Zone AR	1% AC (100 Year)	Yes	Yes	Yes
Zone A99	1% AC (100 Year)	No	Yes	Yes
Zone V	1% AC (100 Year)	No	Yes	Yes
Zone VE of V1-30	1% AC (100 Year)	Yes	Yes	Yes
Floodway	1% AC (100 Year)	Yes	Yes	Yes
Zone X (shaded) or Zone B	0.2% (500-Year); sometimes 1% less than 1' depth	No	No	No
Zone X (unshaded) or Zone C	N/A	No	No	No
Zone D	N/A	No	No	No

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## Accessing Floodplain Maps

- FEMA Map Services Center – [www.msc.fema.gov](http://www.msc.fema.gov)
- Effective Maps
- Historic Maps
- Flood Insurance Studies (FIS)
- Letters of Map Change (LOMCs)
- DFIRM Database



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## Accessing Floodplain Maps

- National Flood Hazard Layer (NFHL) - <https://www.fema.gov/national-flood-hazard-layer-nfhl>
- Online Interactive Map of All DFIRM data
- Can be loaded into Google Earth
- Displays LOMCs

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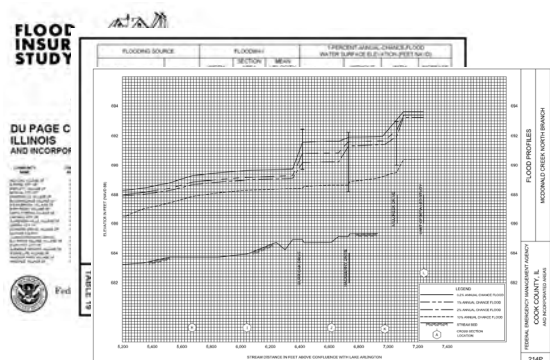
## Flood Insurance Study (FIS)

- Appraises a community's flood problems
- Community's flood history
- Study information
- Provides hydrology and hydraulic results
- Provides flood elevation profiles
- Provides floodway data information



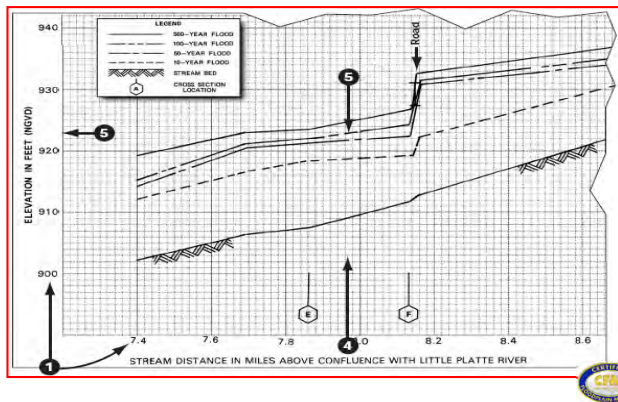
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## FIS Components



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## Flood Profile



## Floodway Data Table

FLOODING SOURCE			FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE	
						(FEET NGVD)			
Green River									
A	0	188	1,691	6.9	267.5	257.3 <sup>2</sup>	257.4 <sup>2</sup>	0.1	
B	380	161	1,539	7.6	267.5	258.0 <sup>2</sup>	258.1 <sup>2</sup>	0.1	
C	480	161	1,550	7.6	267.5	258.1 <sup>2</sup>	258.2 <sup>2</sup>	0.1	
D	980	155	1,143	10.3	267.5	259.6 <sup>2</sup>	259.7 <sup>2</sup>	0.1	
E	1,560	319	2,103	5.6	267.5	262.9 <sup>2</sup>	262.9 <sup>2</sup>	0.0	
F	1,770	288	2,345	5.0	267.5	265.2 <sup>2</sup>	265.2 <sup>2</sup>	0.0	
G	2,270	73	849	13.8	267.5	265.3 <sup>2</sup>	265.3 <sup>2</sup>	0.0	
H	2,770	119	1,564	7.5	267.5	267.5	268.5	1.0	
I	2,940	169	1,971	6.0	267.5	267.5	268.5	1.0	
J	3,440	170	1,802	6.5	268.1	268.1	269.1	1.0	
K	4,540	207	2,164	5.4	270.1	270.1	270.7	0.6	
L	4,840	227	1,839	6.4	270.3	270.3	271.0	0.7	
M	5,370	113	837	14.0	271.2	271.2	271.5	0.3	

<sup>1</sup> Feet Above Confluence With Lake Highwater

<sup>2</sup> Elevation Computed Without Consideration of Backwater From Lake Highwater

TABLE 1 FEDERAL EMERGENCY MANAGEMENT AGENCY FLOODWAY DATA  
City of Floodville, CA GREEN RIVER

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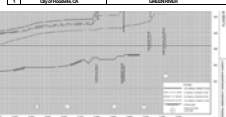
## Accuracy Precedence for BFEs

- #1 Floodway Data Table (Most Accurate)
- #2 Flood Profiles (2<sup>nd</sup> Most Accurate)
- #3 BFE on FIRM Panel (Least Accurate)

FLOODING SOURCE		FLOODWAY		BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY
FEET NGVD							
Green River	A	0	188	6.9	267.5	257.3 <sup>2</sup>	257.4 <sup>2</sup>
B	380	161	1,539	7.6	267.5	258.0 <sup>2</sup>	258.1 <sup>2</sup>
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E	1,560	319	2,103	5.6	267.5	262.9 <sup>2</sup>	262.9 <sup>2</sup>
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H	2,770	119	1,564	7.5	267.5	267.5	268.5
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J	3,440	170	1,802	6.5	268.1	268.1	269.1
K	4,540	207	2,164	5.4	270.1	270.1	270.7
L	4,840	227	1,839	6.4	270.3	270.3	271.0
M	5,370	113	837	14.0	271.2	271.2	271.5

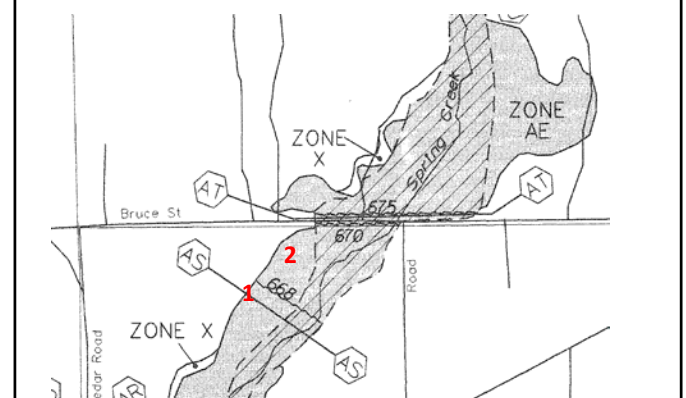
Flow from Green River into West Long Bridge  
Regulatory Cross Section Number 400 is Located at Section 200 and Station 1000

FLOODWAY DATA	
CROSS SECTION	DISTANCE <sup>1</sup>
A	0
B	380
C	480
D	980
E	1,560
F	1,770
G	2,270
H	2,770
I	2,940
J	3,440
K	4,540
L	4,840
M	5,370



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## Determining a BFE Example



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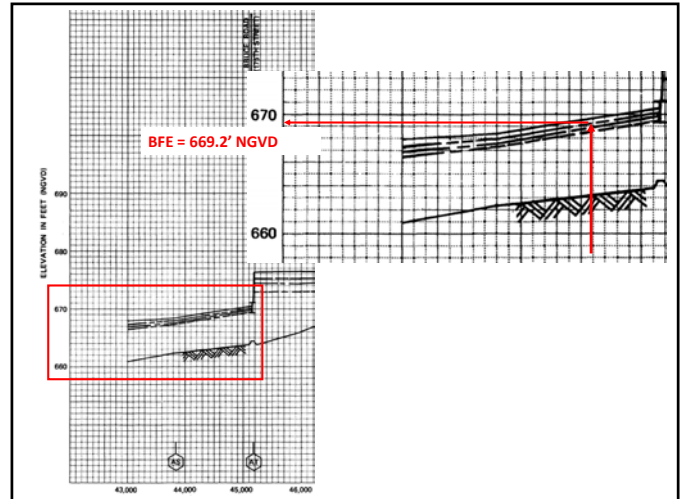


FLOODING SOURCE		FLOODWAY			WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Spring Creek (continued)								
AA	20,945	174	730	3.26	619.1	619.1	619.2	0.1
AB	21,245	136	413	5.76	619.7	619.7	619.8	0.1
AC	22,305	237	1,137	2.09	627.6	627.6	627.6	0.0
AD	23,745	172	566	3.53	628.6	628.6	628.7	0.1
AE	25,445	369	892	2.24	631.6	631.6	631.7	0.1
AF	26,058	565	2,866	0.70	635.5	635.5	635.6	0.1
AG	27,238	597	2,469	0.81	635.8	635.8	635.9	0.1
AH	28,088	50	270	7.41	636.3	636.3	636.4	0.1
AI	29,428	416	1,050	1.81	636.7	636.7	636.8	0.1
AJ	31,708	220	481	3.95	641.7	641.7	641.8	0.1
AK	34,358	606	1,049	1.81	650.2	650.2	650.3	0.1
AL	35,408	166	396	3.99	654.2	654.2	654.3	0.1
AM	36,548	253	729	2.17	656.8	656.8	656.9	0.1
AN	37,898	226	597	2.65	659.0	659.0	659.1	0.1
AO	38,948	584	944	1.67	661.2	661.2	661.3	0.1
AP	40,118	216	502	3.15	663.1	663.1	663.2	0.1
AQ	41,288	118	423	3.74	665.9	665.9	666.0	0.1
AR	43,362	40	252	6.03	665.9	665.9	666.0	0.1
AS	43,823	232	634	2.88	667.8	667.8	667.8	0.0
AT	45,193	1,331	6,251	0.20	675.2	675.2	675.3	0.1
AU	47,583	205	561	2.29	676.0	676.0	676.1	0.1
AV	48,863	125	602	2.08	677.5	677.5	677.6	0.1
AW	49,563	173	760	1.59	677.9	677.9	678.0	0.1
AX	49,898	108	564	1.86	678.9	678.9	679.0	0.1
AY	51,608	557	3,770	0.28	679.1	679.1	679.3	0.2
AZ	55,028	1,372	4,340	0.24	679.3	679.3	679.4	0.1

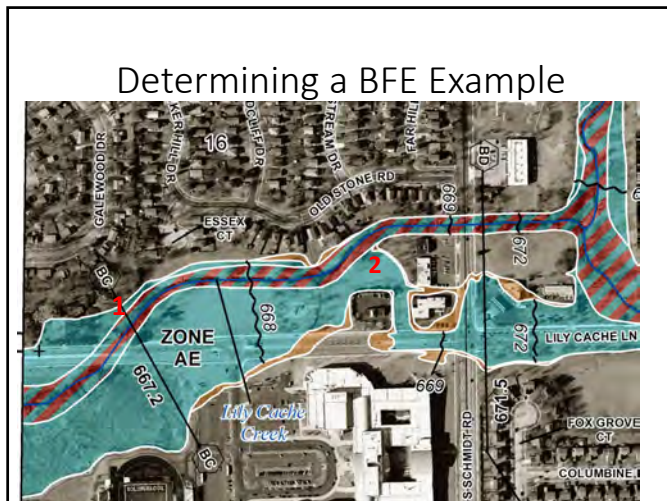
<sup>1</sup>Feet above confluence with Hickory Creek

**BFE = 667.8' NGVD**

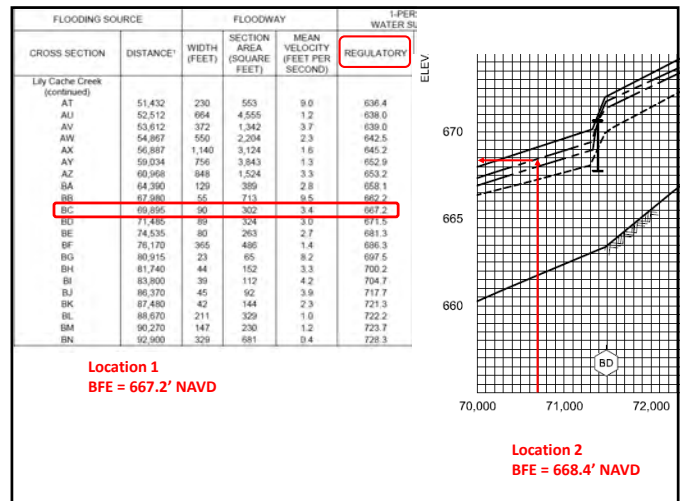
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## Determining a BFE Example



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## End of Part 2A

### Part 2A

- Basic Terms
- Types of FEMA Maps
- Flood Zones
- Flood Insurance Studies (FIS)
- Locating BFEs on Maps and Exhibits

**Any questions before we move on to Part 2B?**

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## Updating Maps (Map Changes)

- Sometimes the maps are just wrong!
- There is a process to correct or update the maps



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## Types of Map Changes

### MT-1 Map Changes

- Letter of Map Amendment (LOMA)
- Conditional letter of Map Amendment (CLOMA)
- Letter of Map Revision Based on Fill (LOMR-F)
- Conditional Letter of Map Revision Based on Fill (CLOMR-F)

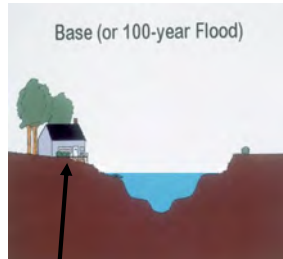
### MT-2 Map Changes

- Letter of Map Revision (LOMR)
- Conditional Letter of Map Revision (CLOMR)
- Physical Map Revisions (PMR)

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## Letter of Map Amendment (LOMA)

House partially shown in floodplain

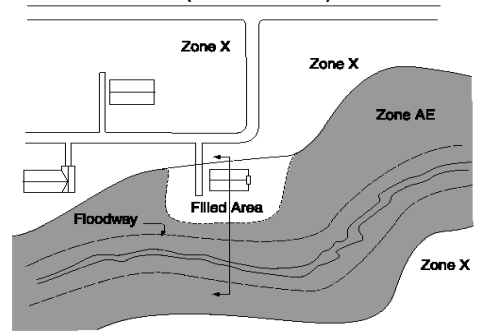


But NATURAL ground elevation prove it to be higher than the flood elevation

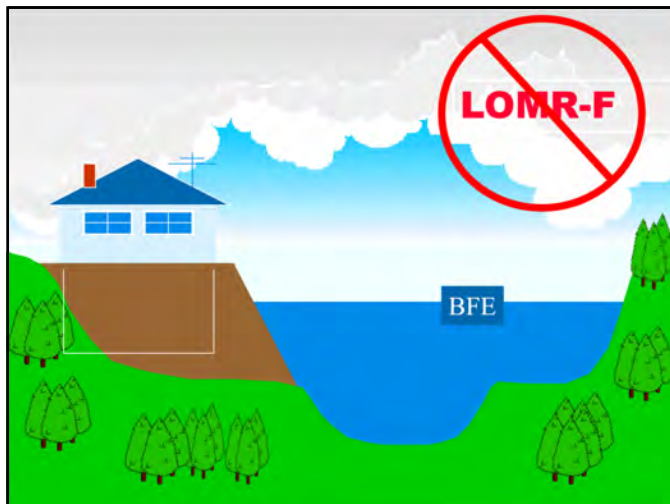


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## Letter of Map Revision Based on Fill (LOMR-F)

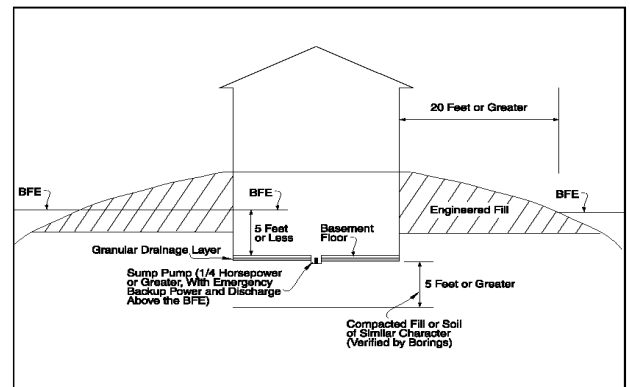


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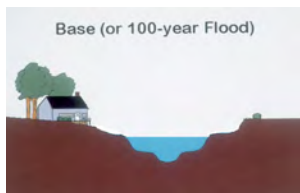
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## Technical Bulletin 10-01



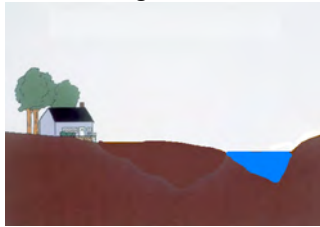
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## Letter of Map Revision (LOMR)



Floodplain as shown on the floodplain map

New floodplain based on physical change



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## Letter of Map Revision (LOMR)



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## Conditional Map Changes

- FEMA's comments on the impacts of a proposed project on the floodplain/floodway/BFEs
- Ensures that structures are constructed in compliance with NFIP regulations
- Map change not official until follow-up LOMC request made with certified as-built drawings

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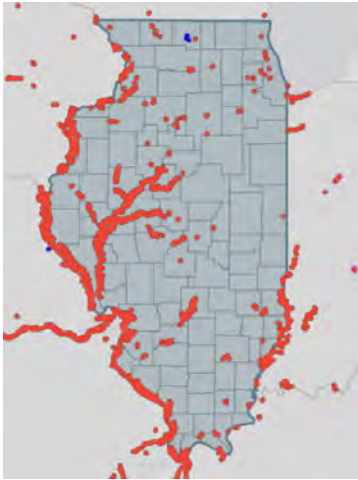


### Levees in Illinois

Failures occur somewhere in Illinois with every major flood!

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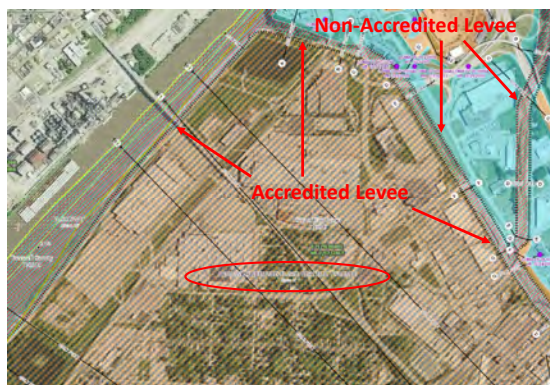
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## Levee Accreditation

- Not all levees are created...
  - ...for the same purpose
  - ...for the same flood frequency
  - ...using engineering design standards
- **Only levees that meet the requirements of 44 CFR 65.10** can be accredited to show protection provided against the base flood on the floodplain map

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## Accredited Levees



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## Levee Accreditation

- Levees may be able to meet 44 CFR 65.10 requirements but the floodplain map will not show base flood protection until the documentation is accepted by FEMA and a revised floodplain map is issued showing protection.
- Accredited Levees...
  - ...can be overtopped or fail (sometimes resulting in damage/loss of life greater than without levee)
  - ...can deteriorate over time
  - ...require regular maintenance

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## 44 CFR 65.10 Accreditation Requirements

- Freeboard (3 ft. or more)
- Closures
- Embankment Protection
- Stability Analysis
- Settlement Analysis
- Interior Drainage
- Operation & Maintenance Plan



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## Community/Levee Owner Responsibilities

- Levee Owners are responsible to provide the 44 CFR 65.10 documentation to FEMA for initial and continued accreditation status on the floodplain map
- Massive effort to obtain accreditation and maintain accreditation

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## Levee Myths

Myth	Truth
I won't flood if I live behind an accredited levee	Accredited levees can fail or be overtopped by larger events; does not eliminate all risk
My home will never be mapped in floodplain since I live behind an accredited levee	Levee accreditation is not granted in perpetuity; maintenance and upgrades are often needed to maintain accreditation status
Levees only fail when overtopped by floodwaters	Levees can fail due to seepage, erosion, or collapse

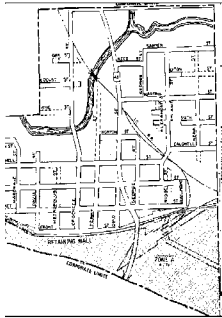
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## Brookport, Illinois



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## Brookport, Illinois



Brookport, Illinois  
Flood Insurance Rate Map 1976

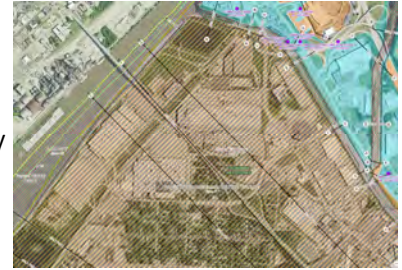


Brookport, Illinois  
IDNR Residual Risk Map 2007

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## Residual Risk Awareness

- Hundreds of thousands of residents live behind levees
- Yet only 1% carry flood insurance!



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## Summary Review

### Part 2B Topics

- Updating Maps (Map Changes)
- Levees

**Any Questions?**

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