Approximate A Zone Mapping

Brian Chaille, P.E., CFM

IAFSM 2020 Annual Conference, March 11

ISWS- CHAMP

The staff of the Coordinated Hazard Assessment and Mapping Program
which includes 18 Certified Floodplain Managers (CFM),
seven Professional Engineers (PE), and
seven Geographic Information Sytems Professionals (GISP)

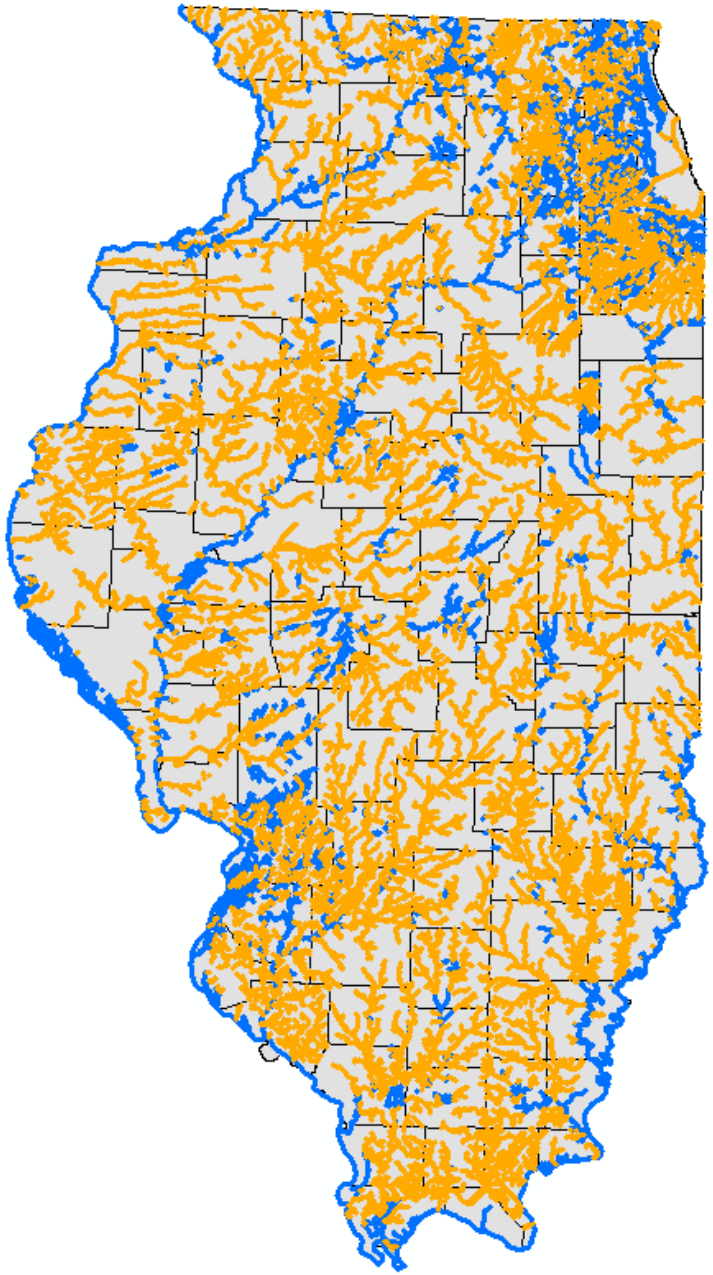
www.illinoisfloodmaps.org

We will cover…

- National Flood Insurance Program (NFIP)
- Floodplain Mapping
- ~~Map Changes and Amendments~~
- Dealing with A Zones
- Establishing a Base Flood Elevation (BFE) in a Zone A Floodplain
- Looking Forward

National Flood Insurance Program (NFIP)

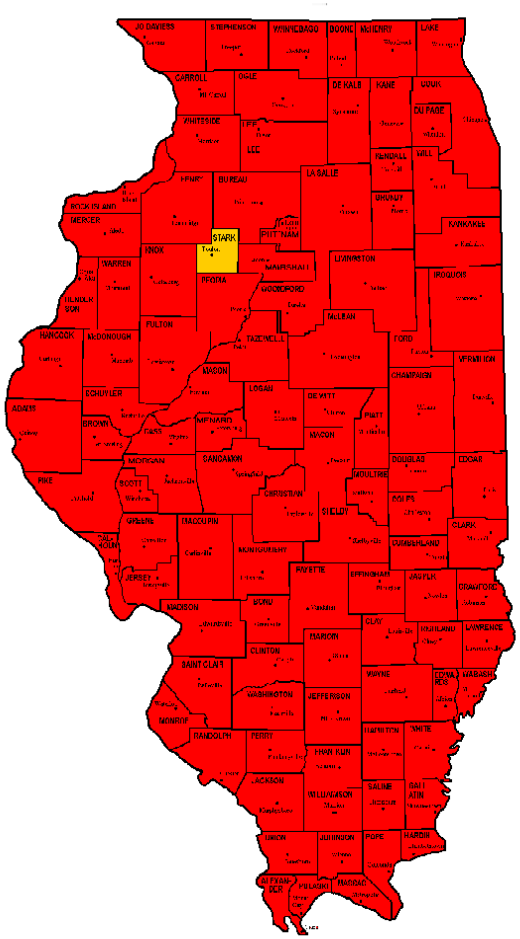
The largest inland system of rivers, lakes, and streams in the entire nation!



26,940 total miles of streams

19,080 miles (73%) are Zone A (The Yellow Lines)

Illinois is a VERY Wet State!

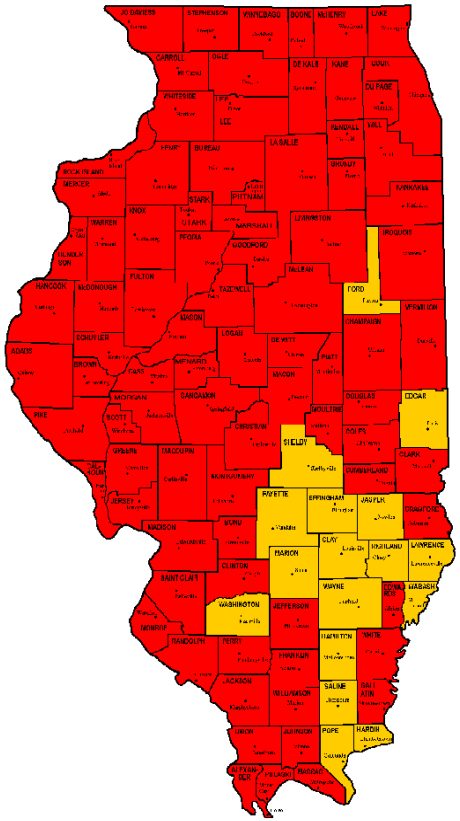


Floods are BY FAR the most common and the most costly disasters in Illinois.

Floods happen EVERY YEAR in Illinois.

Federal Disasters
1993 - 2020

National Flood Insurance Program



NFIP COUNTIES

- NFIP is a voluntary program
- 88 of Illinois' 102 counties & 890 communities are part of program (120 are not)
- FEMA makes flood insurance available along with disaster assistance and grants/loans
- Communities agree to adopt floodplain maps and floodplain management ordinance

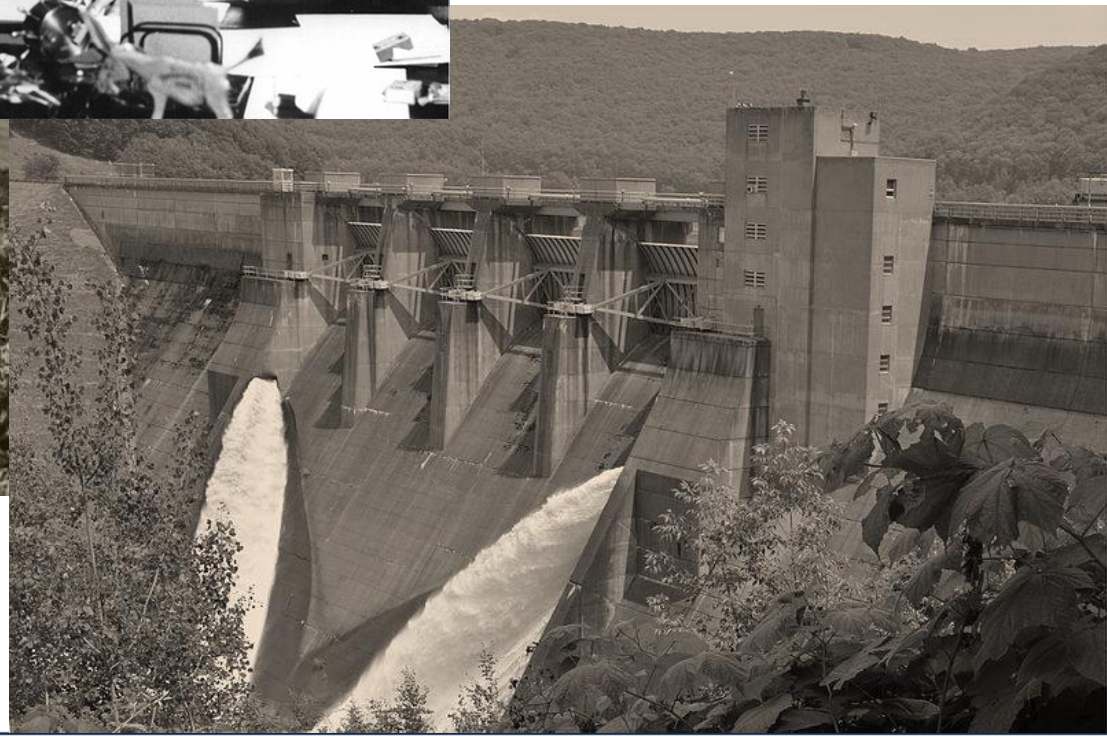
1913 Ohio River Flood

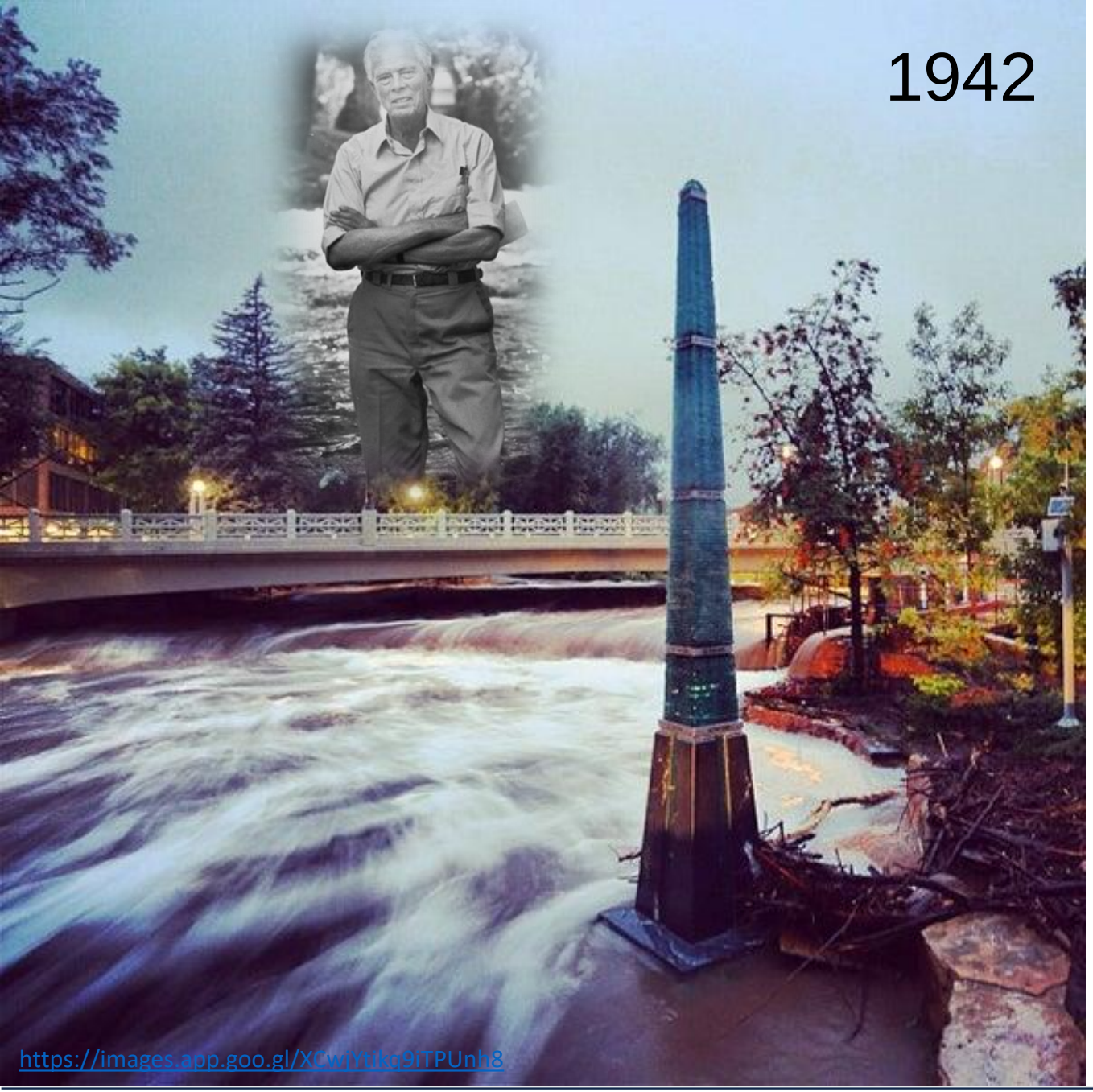
1927 Mississippi River Flood

1930's TVA

Soil Conservation Service

Corps of Engineers





https://images.app.goo.gl/XCwjYtukq9iTPUnh8

Floods are ‘Acts of God’ but flood losses are largely acts of man.

Gilbert F. White

(November 26, 1911 – October 5, 2006)

https://blog.predictiveheuristics.com/2013/12/05/predictions-in-the-future-white-or-black-swans/

1951 Kansas & Missouri Flood


The Sixties
TIM LEARY
LOVE
3 DAYS OF PEACE & MUSIC
SUPPORT OUR BOYS IN VIETNAM
BOB DYLAN

The National Flood Insurance Act of 1968

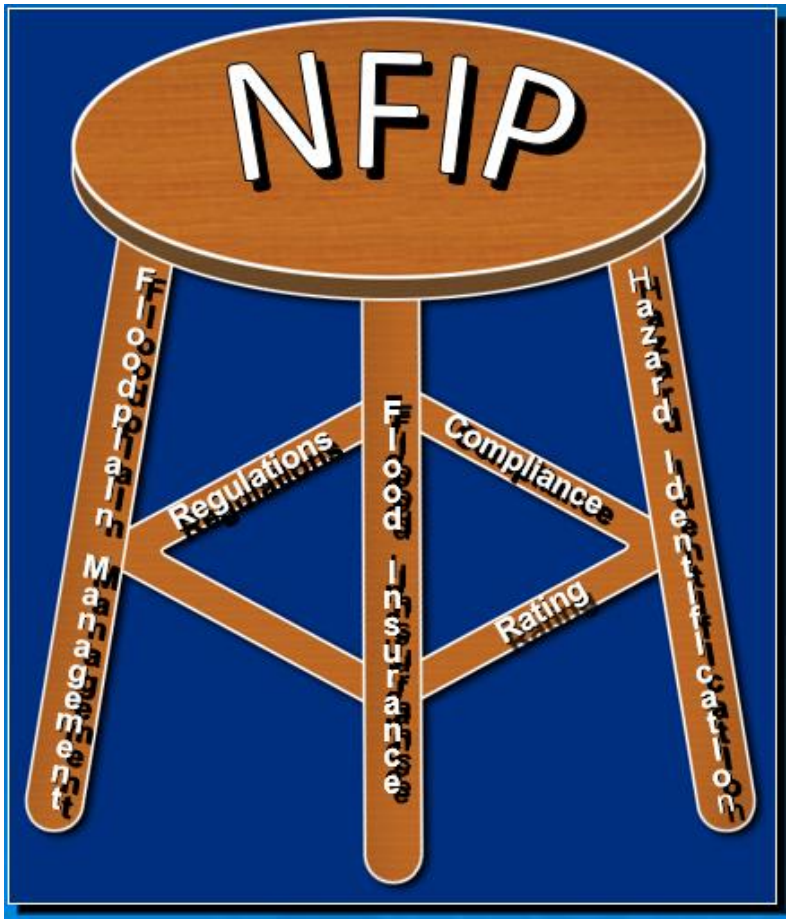
NFIP
and the
Federal Insurance Administration

under HUD

(FEMA 1979)

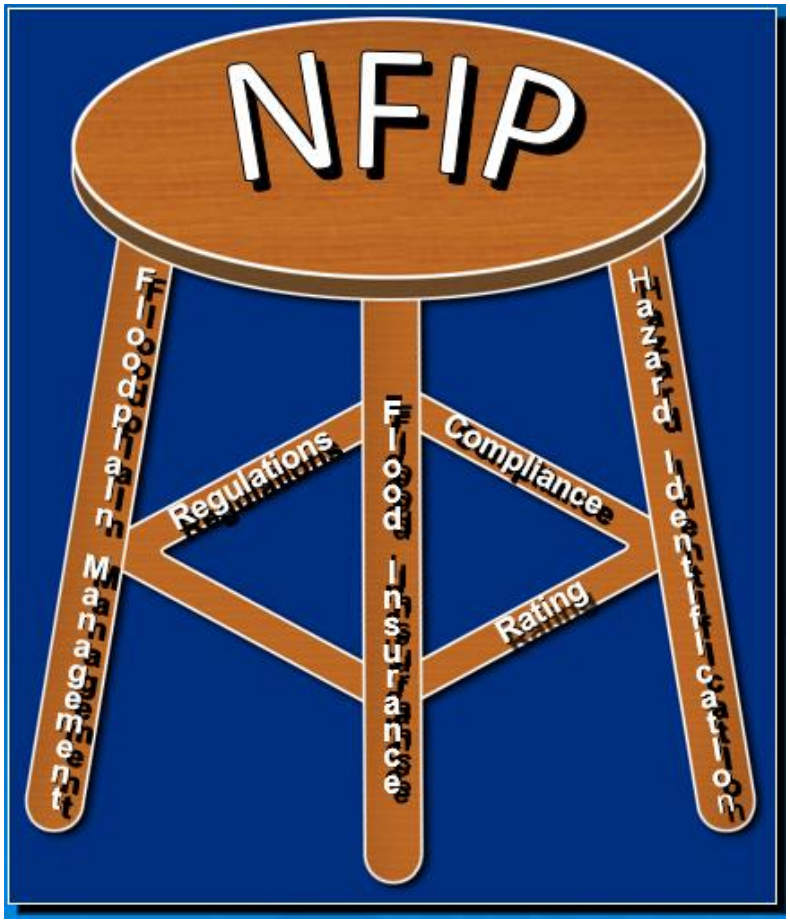
National Flood Insurance Program

- Goal of the NFIP is to reduce flood losses
- Program supported by 3 legs



National Flood Insurance Program

- Goal of the NFIP is to reduce flood losses
- Program supported by 3 legs
  - Floodplain Mapping
  - Floodplain Management
  - Flood Insurance




August 1968
Vietnam War is
90% of News

Chicago Hosts Democratic Convention and War Protests

https://www.flickr.com/photos/davidwilson1949/6056934707/in/photolist-5coszA-aeenEK-2CqzzK-8QZ5mo

Apollo 8 First Earth Rise

Frank Borman, Jim Lovell, William Anders

https://earthobservatory.nasa.gov/images/144427/all-of-you-on-the-good-earth

Soviet's End Prague Spring

Credits: Gamma-Keystone - Getty

The Cold War

https://www.lockheedmartin.com/en-us/news/features/history/pershing.html

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- ~~Map Changes and Amendments~~
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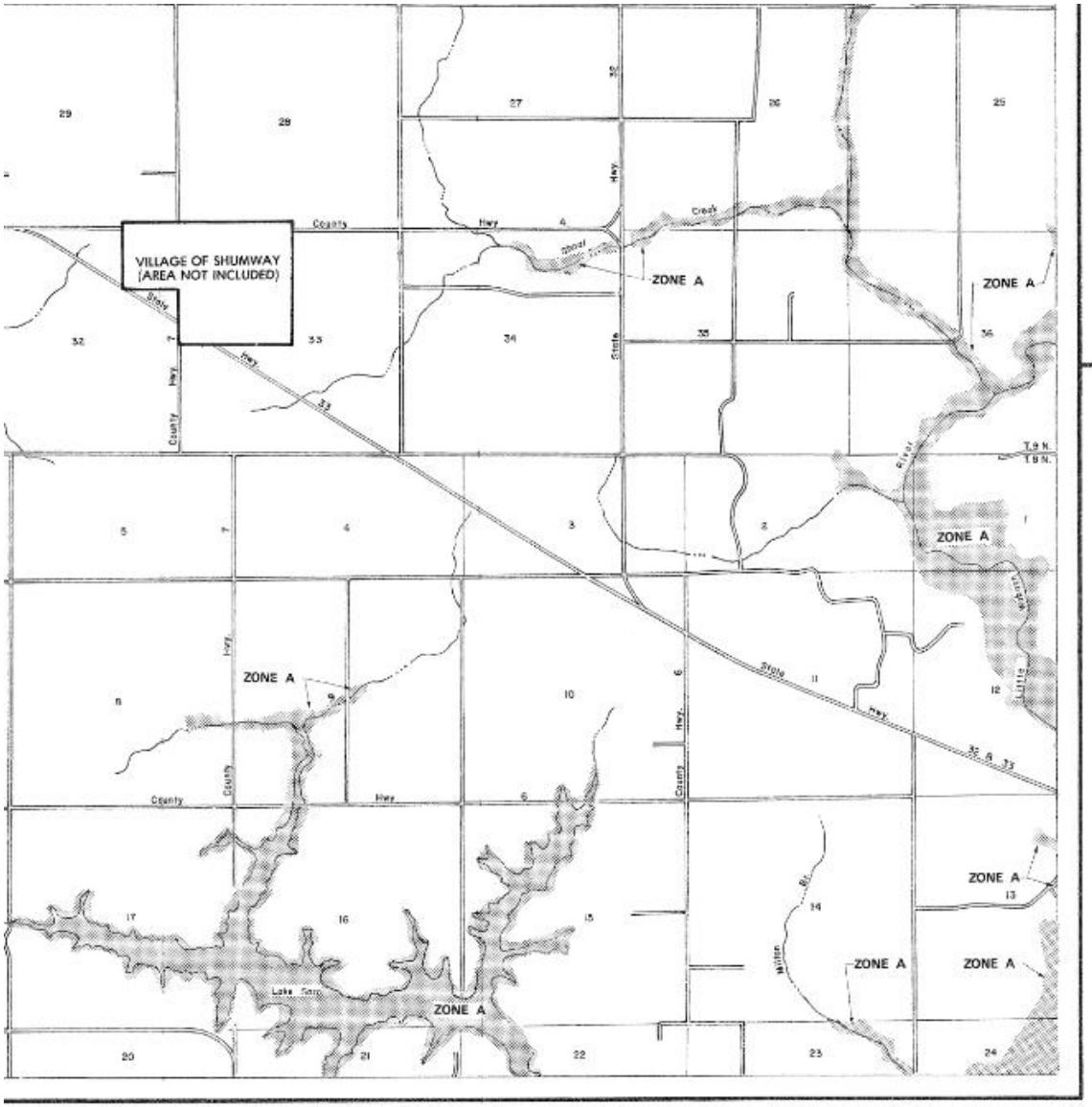
Floodplain Mapping

NFIP Emergency Period and FHBM's



KEY TO SYMBOLS

SPECIAL FLOOD HAZARD AREA — ZONE A

Note: These maps may not include all Special Flood Hazard Areas in the community. After a more detailed study, the Special Flood Hazard Areas shown on these maps may be modified, and other areas added.

CONSULT NFIA SERVICING COMPANY OR LOCAL INSURANCE AGENT OR BROKER TO DETERMINE IF PROPERTIES IN THIS COMMUNITY ARE ELIGIBLE FOR FLOOD INSURANCE.

APPROXIMATE SCALE IN FEET
3000 0 3000

FLOOD HAZARD BOUNDARY MAP

EFFINGHAM COUNTY
ILLINOIS
UNINC. AREAS

PAGE 1 OF 6
(SEE MAP INDEX FOR PAGES NOT PRINTED)

EFFECTIVE DATE:
DECEMBER 23, 1977

COMMUNITY—PANEL NUMBER
170227 0001 A

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

Navier–Stokes Equations

3 – dimensional – unsteady

Glenn Research Center

Coordinates: (x,y,z)

Velocity Components: (u,v,w)

Time : t Pressure: p Heat Flux: q

Density: ρ Stress: τ Reynolds Number: Re

Total Energy: Et Prandtl Number: Pr

Continuity:

$$\frac{\partial \rho}{\partial t}+\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}=0$$

X – Momentum:

$$\frac{\partial(\rho u)}{\partial t}+\frac{\partial(\rho u^2)}{\partial x}+\frac{\partial(\rho uv)}{\partial y}+\frac{\partial(\rho uw)}{\partial z}=-\frac{\partial p}{\partial x}+\frac{1}{Re_r}\left[\frac{\partial \tau_{xx}}{\partial x}+\frac{\partial \tau_{xy}}{\partial y}+\frac{\partial \tau_{xz}}{\partial z}\right]$$

Y – Momentum:

$$\frac{\partial(\rho v)}{\partial t}+\frac{\partial(\rho uv)}{\partial x}+\frac{\partial(\rho v^2)}{\partial y}+\frac{\partial(\rho vw)}{\partial z}=-\frac{\partial p}{\partial y}+\frac{1}{Re_r}\left[\frac{\partial \tau_{xy}}{\partial x}+\frac{\partial \tau_{yy}}{\partial y}+\frac{\partial \tau_{yz}}{\partial z}\right]$$

Z – Momentum

$$\frac{\partial(\rho w)}{\partial t}+\frac{\partial(\rho uw)}{\partial x}+\frac{\partial(\rho vw)}{\partial y}+\frac{\partial(\rho w^2)}{\partial z}=-\frac{\partial p}{\partial z}+\frac{1}{Re_r}\left[\frac{\partial \tau_{xz}}{\partial x}+\frac{\partial \tau_{yz}}{\partial y}+\frac{\partial \tau_{zz}}{\partial z}\right]$$

Energy:

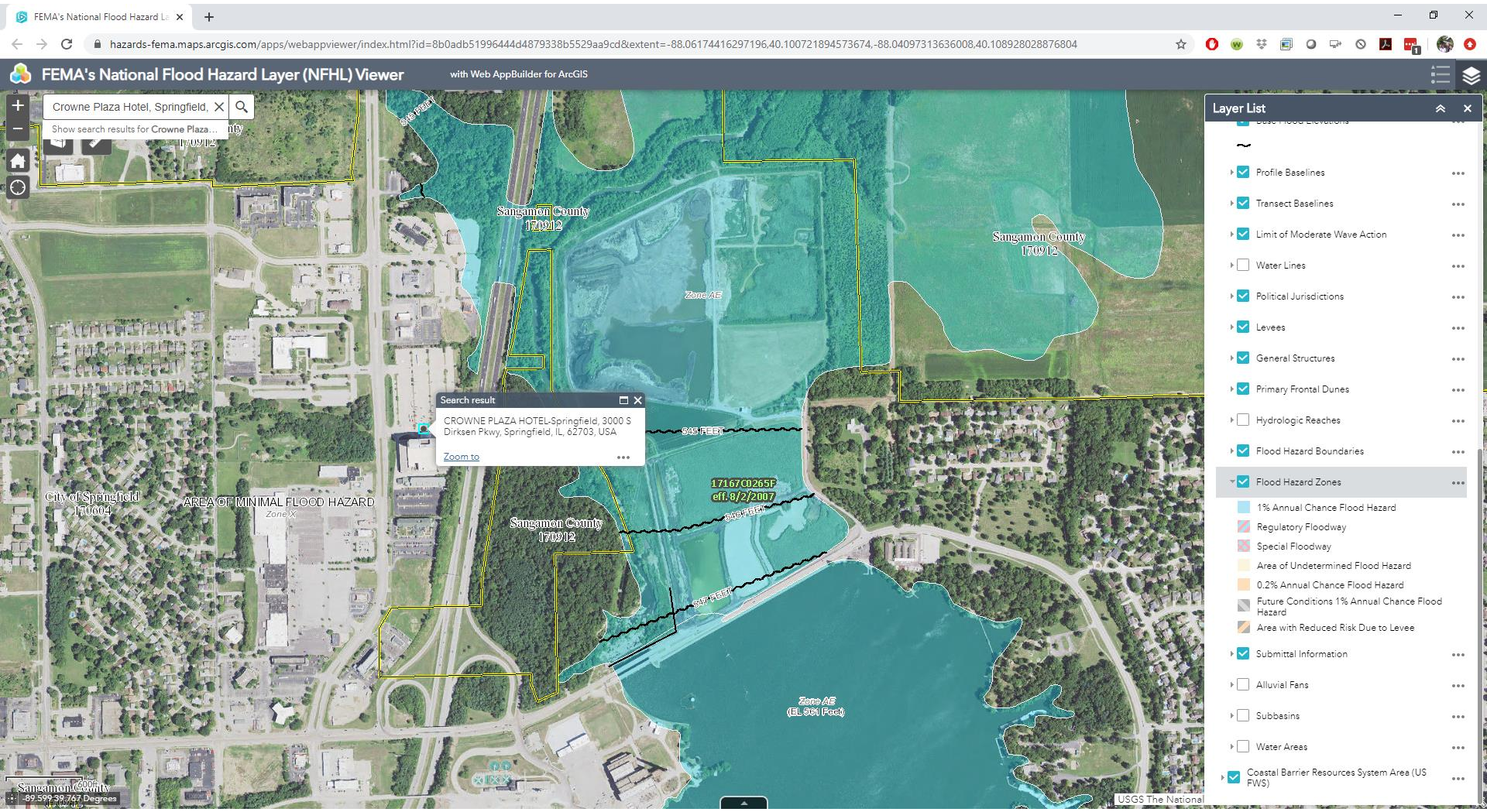
$$\frac{\partial(E_T)}{\partial t}+\frac{\partial(uE_T)}{\partial x}+\frac{\partial(vE_T)}{\partial y}+\frac{\partial(wE_T)}{\partial z}=-\frac{\partial(up)}{\partial x}-\frac{\partial(vp)}{\partial y}-\frac{\partial(wp)}{\partial z}-\frac{1}{Re_r Pr_r}\left[\frac{\partial q_x}{\partial x}+\frac{\partial q_y}{\partial y}+\frac{\partial q_z}{\partial z}\right]$$
$$+\frac{1}{Re_r}\left[\frac{\partial}{\partial x}(u\tau_{xx}+v\tau_{xy}+w\tau_{xz})+\frac{\partial}{\partial y}(u\tau_{xy}+v\tau_{yy}+w\tau_{yz})+\frac{\partial}{\partial z}(u\tau_{xz}+v\tau_{yz}+w\tau_{zz})\right]$$

Floodplain Mapping Requires Knowledge of Three Things

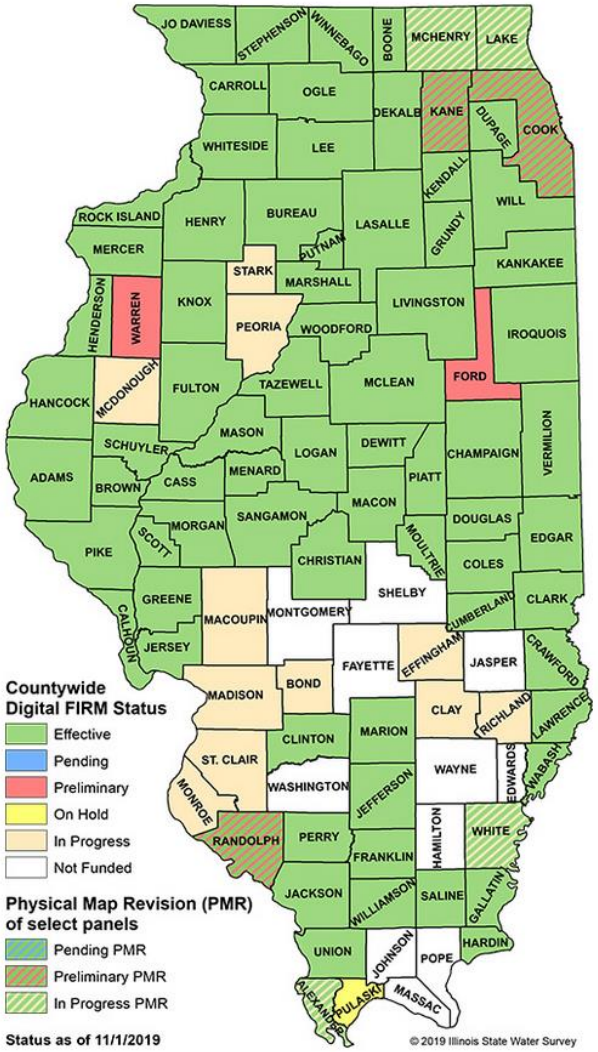
- Topography
  - Floodplain Geometry
    How high is the land?
- Hydrology
  - Flood Flow
    How much water?
- Hydraulics
  - Flood Height
    How deep is the water?

Floodplain Mapping

- Types of FEMA Maps



DFIRMs in Illinois



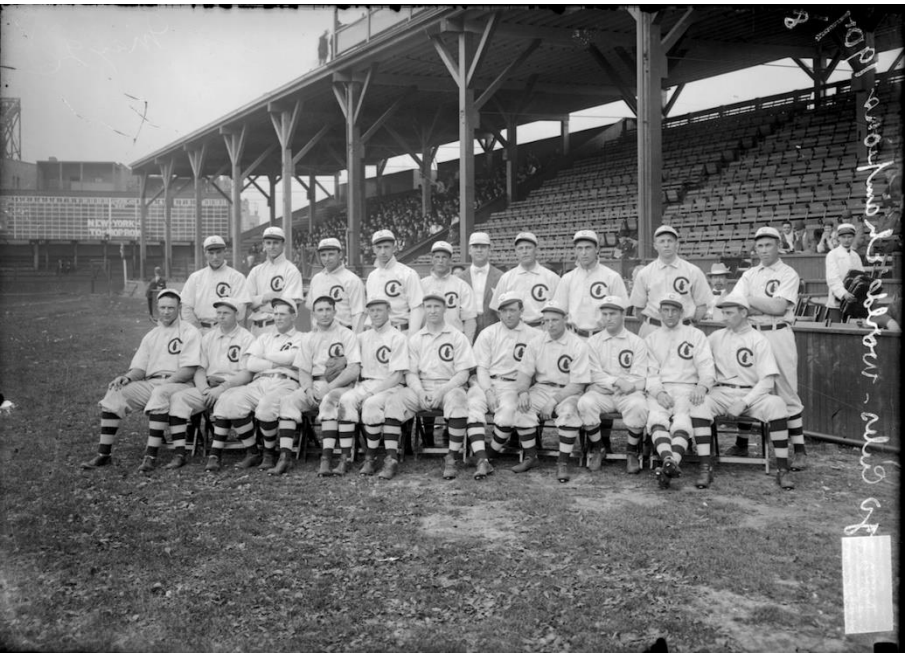
National Flood Insurance Program

- "100-Year" or Base Flood is the basis for the NFIP
  - Floodplain maps identify Base Floodplain
  - Floodplain Management regulations apply to areas located in Base Floodplain
  - Flood Insurance is required in Base Floodplain

- "100-Year Flood" = 1% Annual Chance Flood

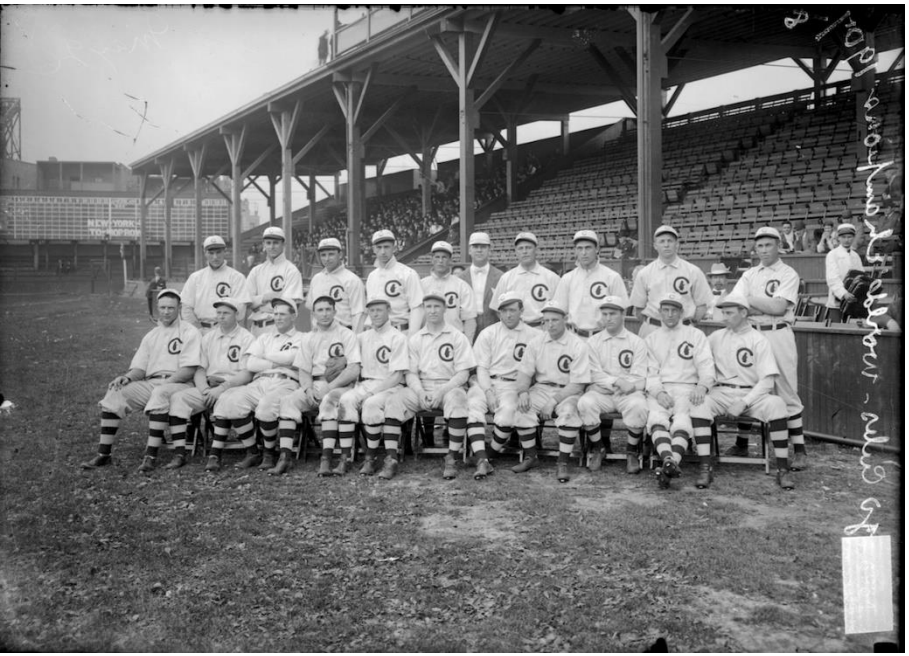
MLB Photos via Getty Images

1908 ← 108 years →2016



MLB Photos via Getty Images

1908 ← 108 years →2016



MLB Photos via Getty Images

Flood Zones

- 1% Annual Chance Flood is basis 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 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 that 1' depth	No	No	No
Zone X (unshaded) or Zone C	N/A	No	No	No
Zone D	N/A	No	Yes	No

Flood Zone	Floodplain Frequency?	BFE or Depth Given?	Mandatory Flood Insurance Purchase Requirement?	Regulatory (requires permits)?
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Zone AE or A1-30	**1% AC (100 Year)**	**Yes**	**Yes**	**Yes**
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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**
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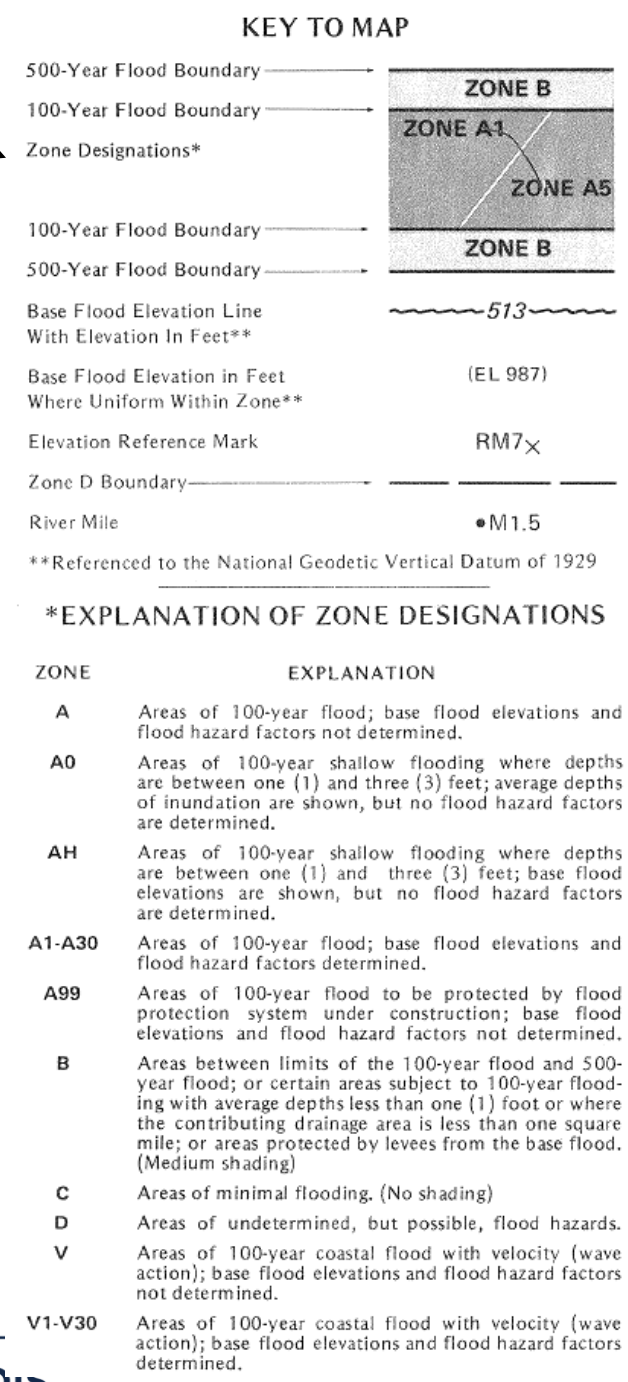
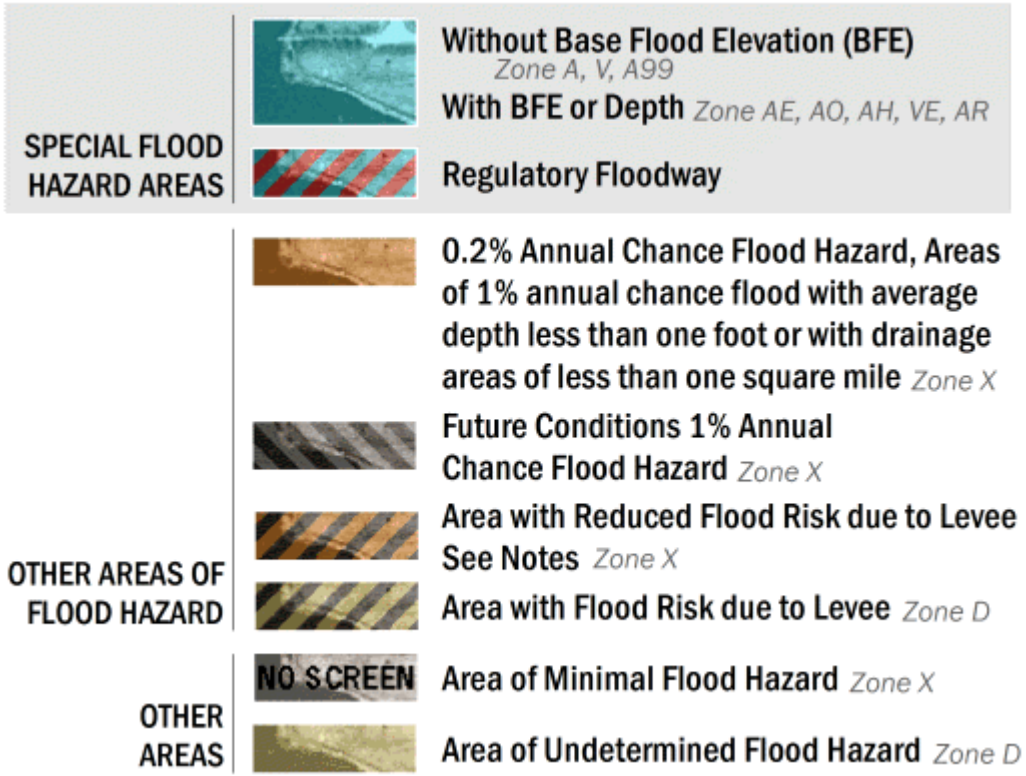
Zone D	N/A	No	Yes	No

SFHAs

Old FIRM Legend

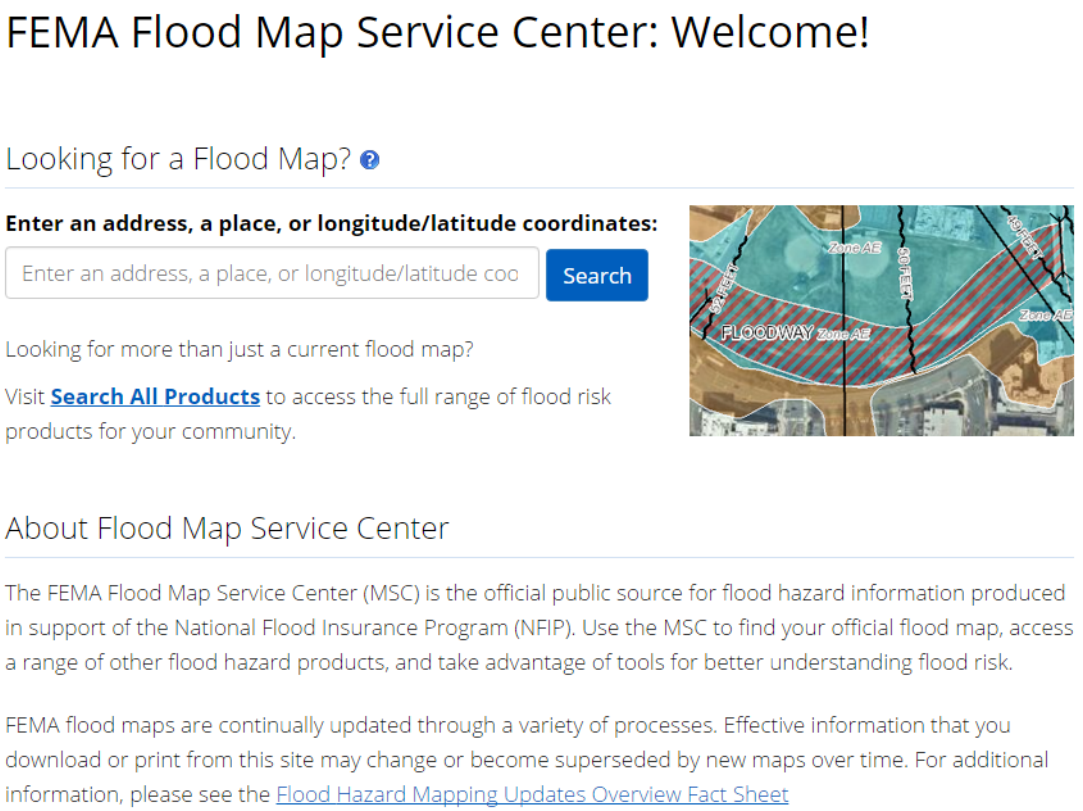


New FIRM Legend



Accessing Floodplain Maps

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



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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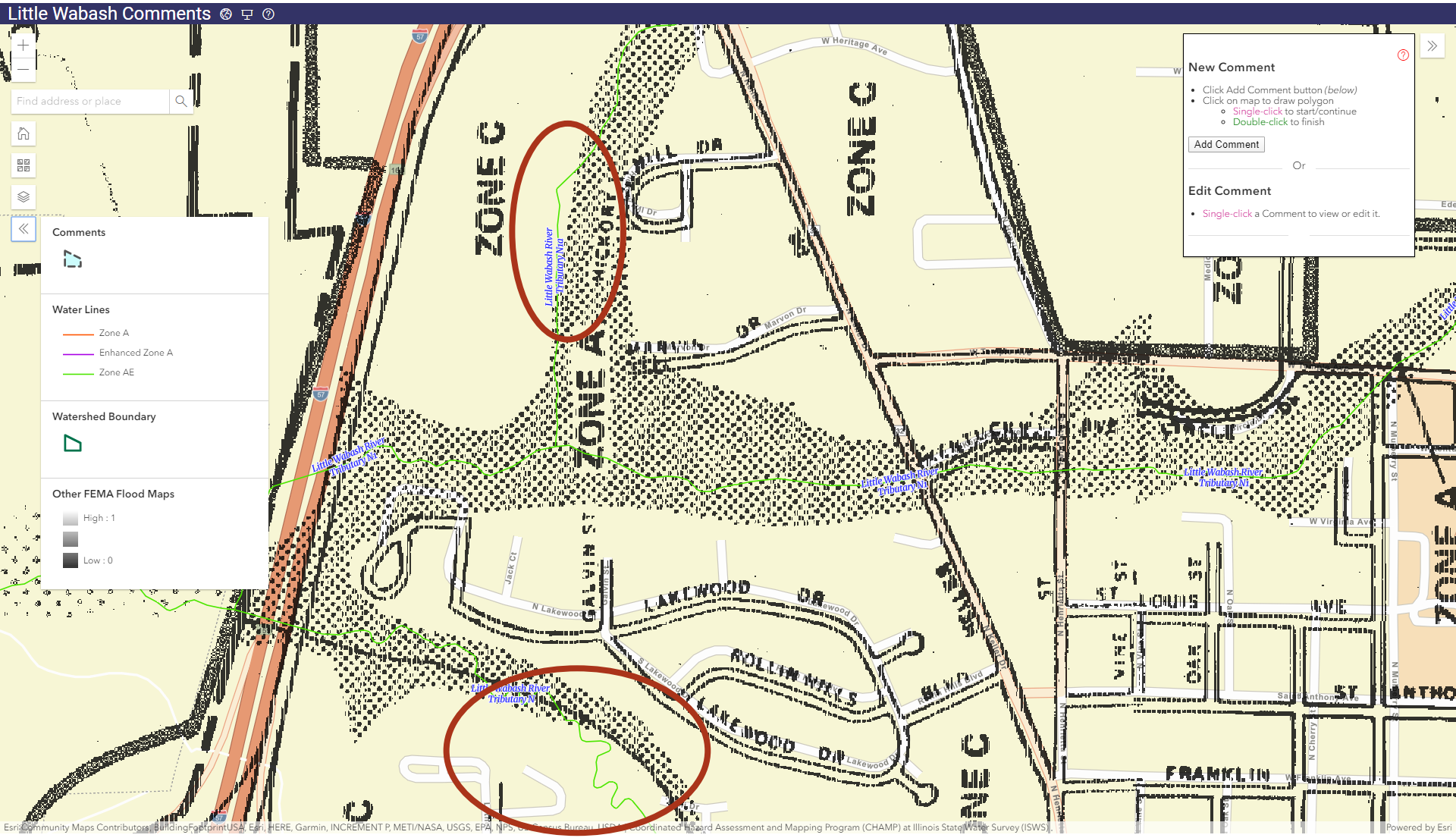
Dealing with A Zones

Dealing with A Zones



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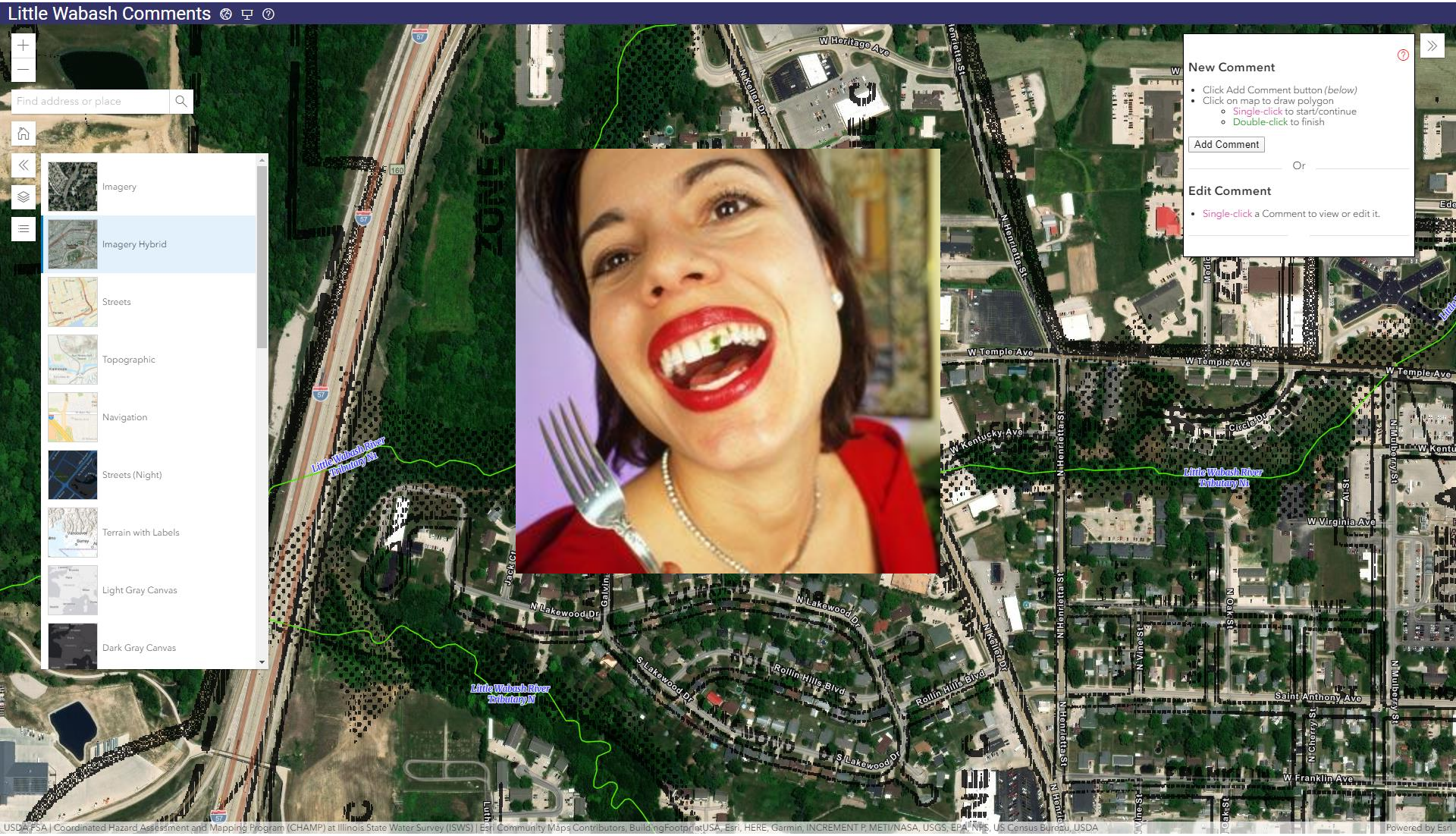

Dealing with A Zones

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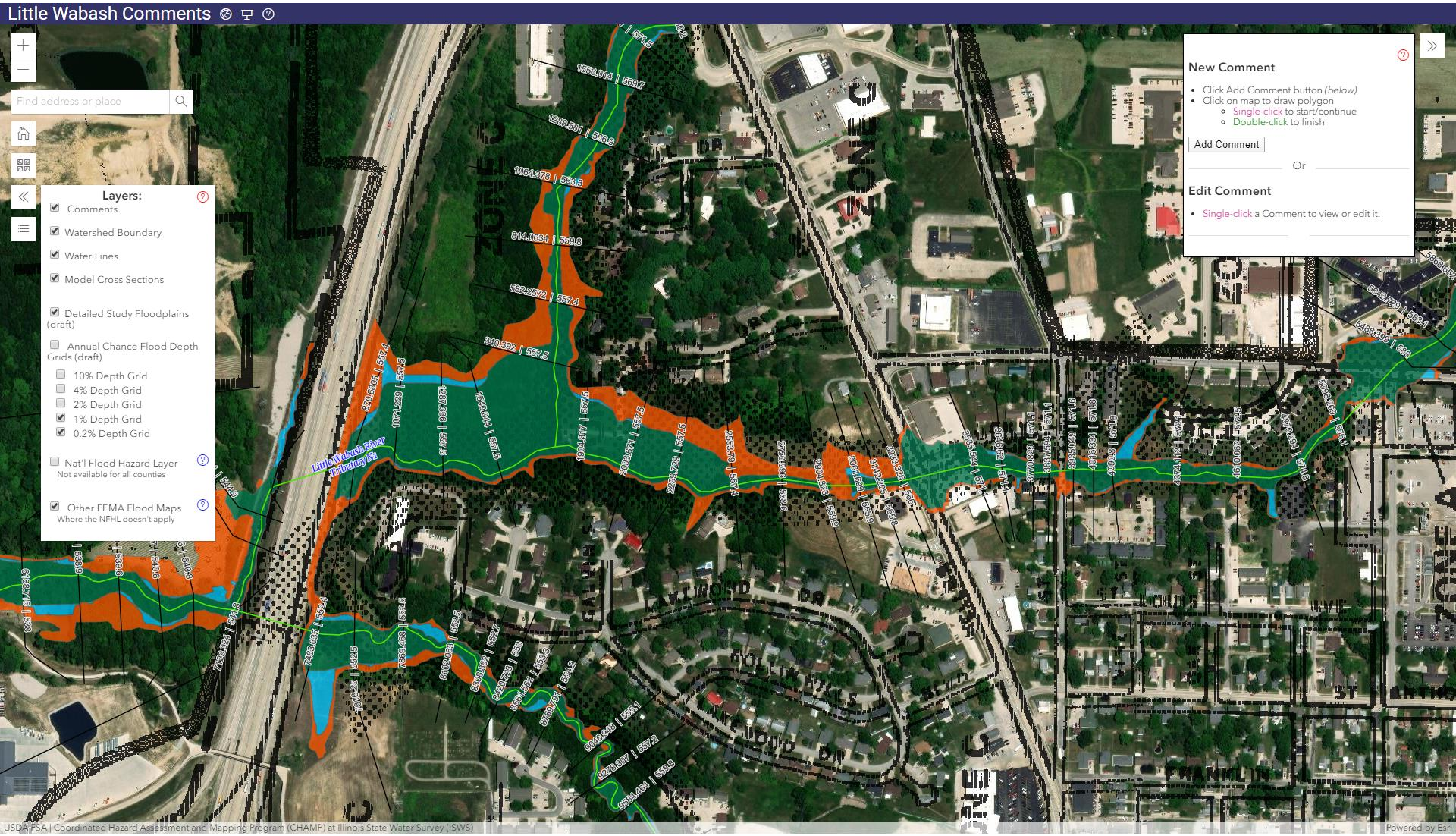

Approximate A Zones

- Approximate A Zones do not have BFEs
- Minimum Requirement of the NFIP: Permits
  - Permits must require that the lowest floor of all new construction be built above the BFE; necessitates the estimation of a BFE
  - “Reasonably safe from flooding”
- “Vital reference” : FEMA Publication 265 “Managing Floodplain Development in Approximate A Zones”
  - Good examples of > 50 lot or 5 acre BFE determination rule.
- CFR 60.3

Resources

- Subdivision Design and Flood Hazard Areas (PAS 584) https://www.fema.gov/media-library/assets/documents/126942

- Understanding and Managing Flood Risk: A Guide for Elected Officials https://www.floodsciencecenter.org/products/elected-officials-flood-risk-guide/

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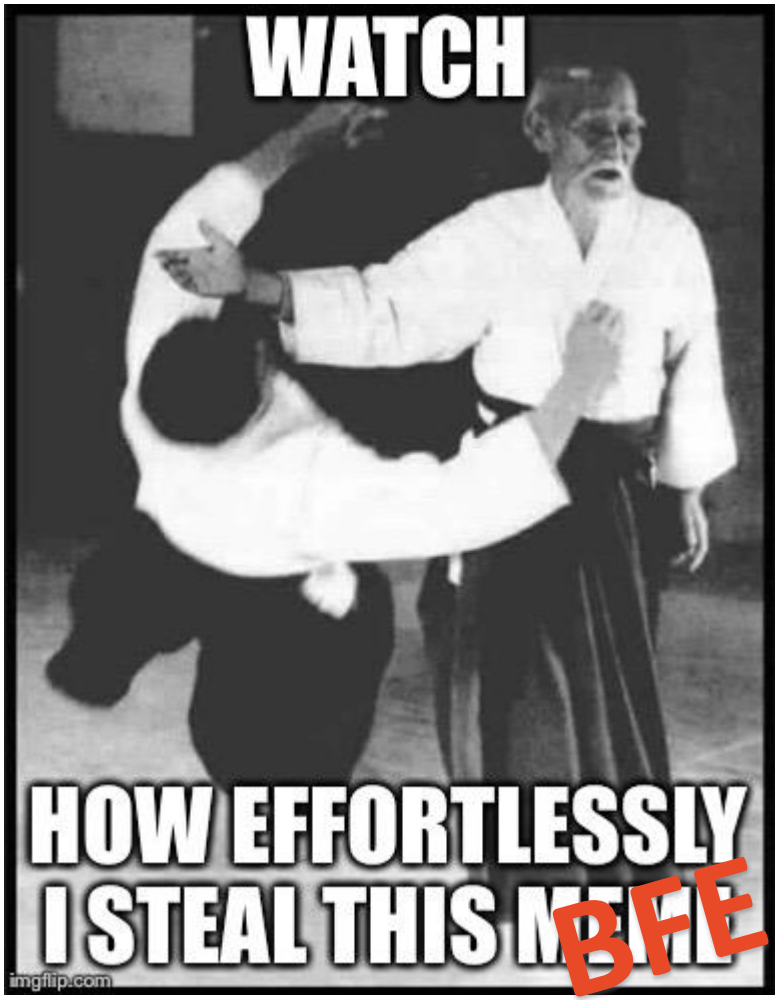
Establishing a Base Flood Elevation (BFE) in a Zone A Floodplain

First: "Steal it!"

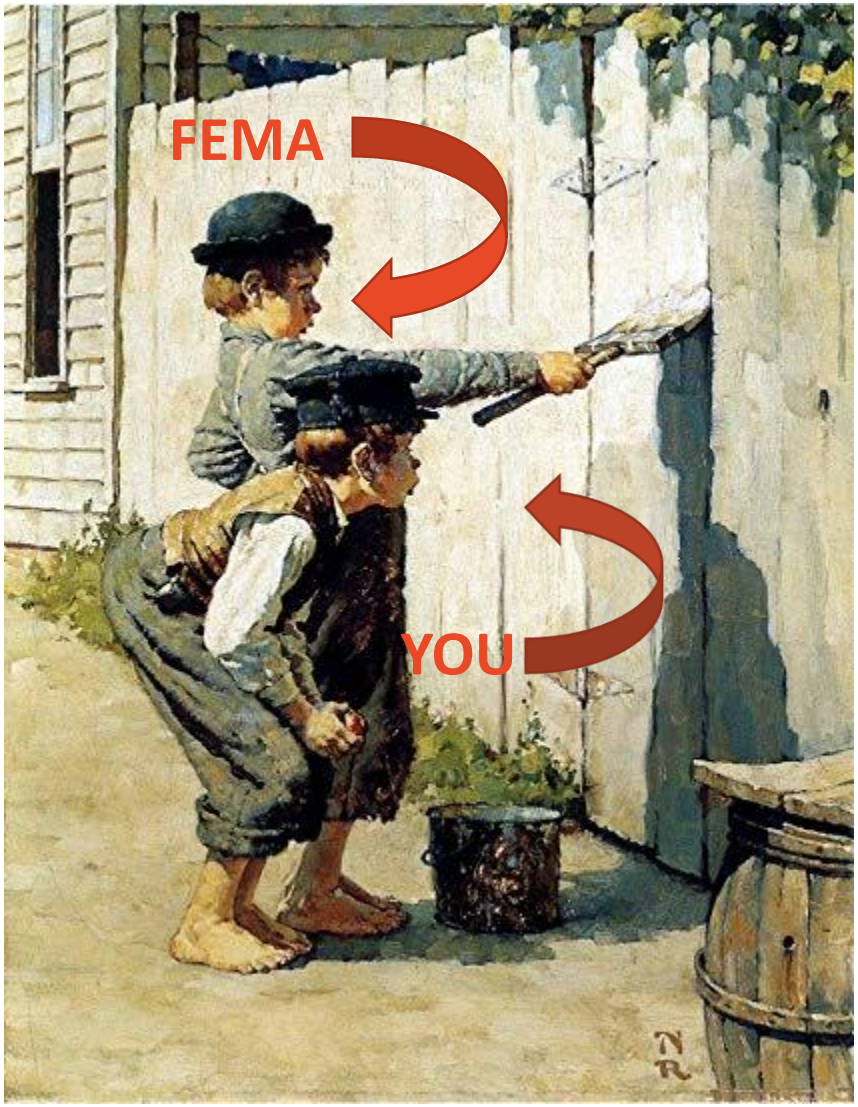
FEMA - "Managing Floodplain Development in Approximate Zone A Areas: A Guide for Obtaining and Developing Base (100-Year) Flood Elevations"
"Before computational methods are used…

- existing floodplain studies or computations
  - IDOT and Local Bridge Plans and Bridge Hydraulic Studies
  - FEMA, USACE, NRCS, ISWS, USGS …



Second: "Let FEMA do it!"

- FEMA Cares!
- If your client has more time than money
- If the structures are so high above the river that it's obvious that the flood risk is low
- You and your client don't mind being rejected the first time
- You don't mind your name or company's name not being on the application



Third: "Learn Hydrology and Hydraulics"

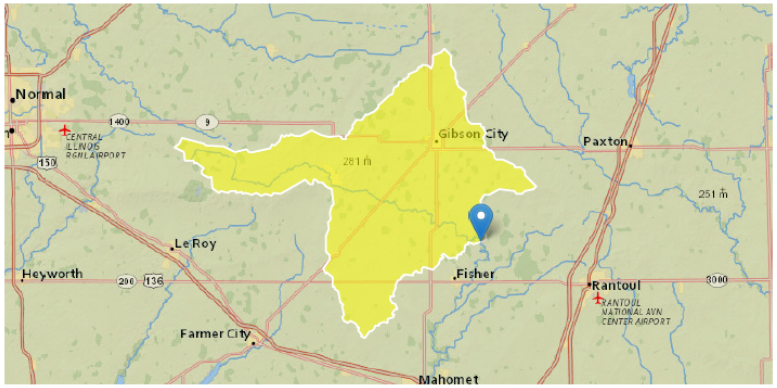
- Stream Stats
- Use available topographic data for cross-section
- Survey channel profile
- Normal Depth Calculation

StreamStats

https://streamstats.usgs.gov/ss/

StreamStats Report

Region ID: IL
Workspace ID: IL20200114014910784000
Clicked Point (Latitude, Longitude): 40.35384, -88.31347
Time: 2020-01-13 19:49:27 -0600



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	214.18	square miles
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	5.424	feet per
SOILPERM	Average Soil Permeability	1.149	inches per hour
ILREG3	Indicator variable for IL region 3, enter 1 if site is in region 3 else 0	1	dimensionless
URBTHE2010	Fraction of drainage area that is in urban classes 7 to 10 from Theobald 2010	0.016	dimensionless

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	214.18	square miles	0.03	9554
CSL10_85	Stream Slope 10 and 85 Method	5.424	feet per mi	0.81	317
SOILPERM	Average Soil Permeability	1.149	inches per hour	0.3	8
ILREG3	Region 3 Indicator enter 1	1	dimensionless	1	1
URBTHE2010	Fraction_of_Urban_Land_Theobald_2010	0.016	dimensionless	0	1

Peak-Flow Statistics Flow Report[Region 3 peak rural AMS 2004 5103]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	3820	ft^3/s	2060	7110	39.5	39.5	2.7
5 Year Peak Flood	6760	ft^3/s	3610	12600	40	40	3.2
10 Year Peak Flood	8910	ft^3/s	4660	17000	41.6	41.6	3.9
25 Year Peak Flood	11800	ft^3/s	5930	23400	44.2	44.2	4.7
50 Year Peak Flood	14000	ft^3/s	6820	28700	46.6	46.6	5.2
100 Year Peak Flood	16200	ft^3/s	7650	34300	49	49	5.6
500 Year Peak Flood	21600	ft^3/s	9410	[illegible]	54.9	54.9	6.2

Peak-Flow Statistics Flow Report[Region 3 Peak Urban 2016 5050]

Statistic	Value	Unit
Urban 2 Year Peak Flood	3890	ft^3/s
Urban 5 Year Peak Flood	6860	ft^3/s
Urban 10 Year Peak Flood	9040	ft^3/s
Urban 25 Year Peak Flood	11900	ft^3/s
Urban 50 Year Peak Flood	14200	ft^3/s
Urban 100 Year Peak Flood	16400	ft^3/s
Urban 500 Year Peak Flood	21800	ft^3/s

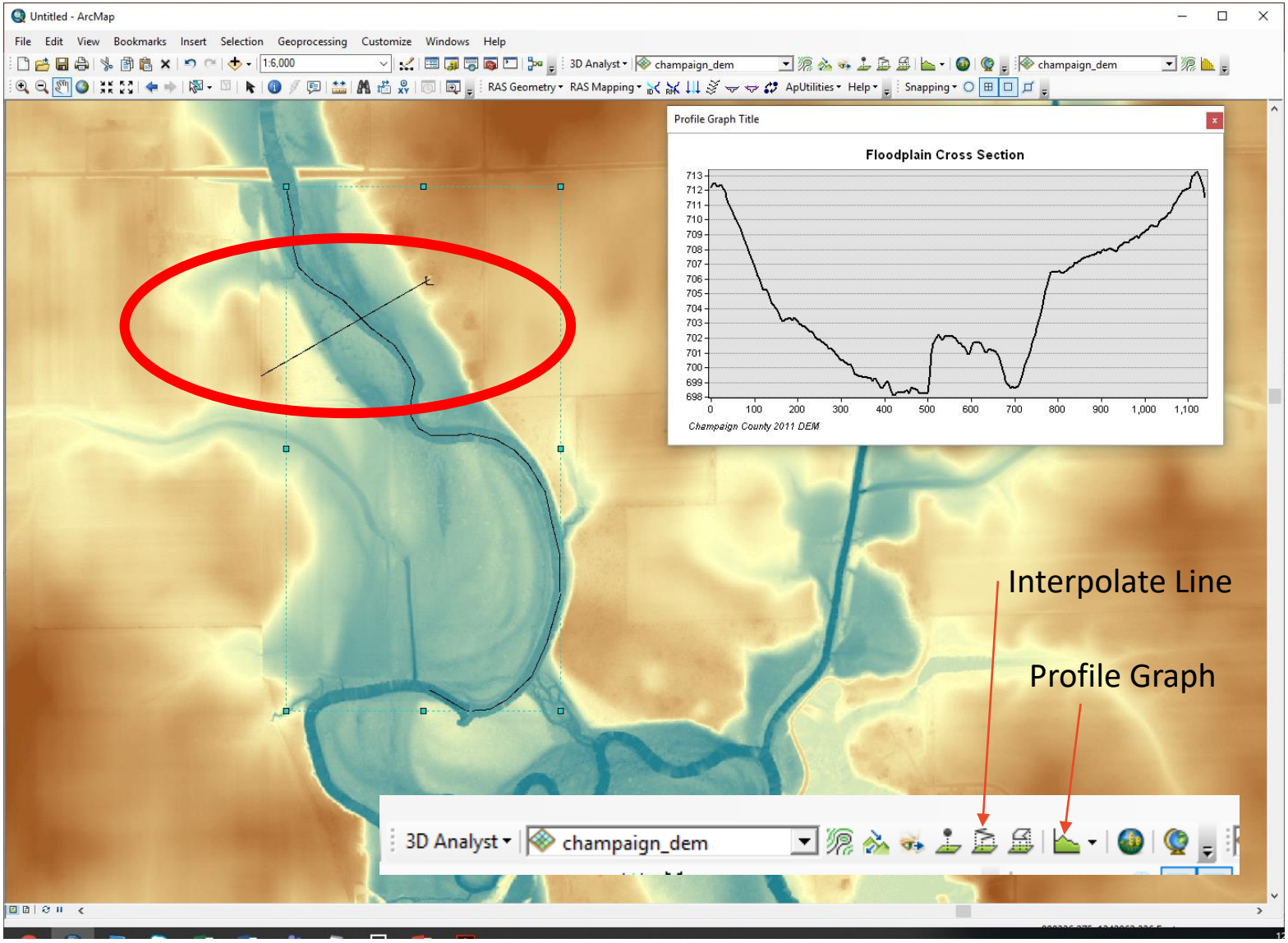
Peak-Flow Statistics Citations

Soong[illegible]shii, A.L., Sharpe, J.B., and Avery, C.F.,2004, Estimating Flood-[illegible]Discharge Magnitudes and Frequencies for Rural Streams in Illinois, U.S. Geo[illegible] Investigations Report 2004-5103. 147 p. (http://il.water.usgs.gov/pubs/sir2004-5103.pdf)

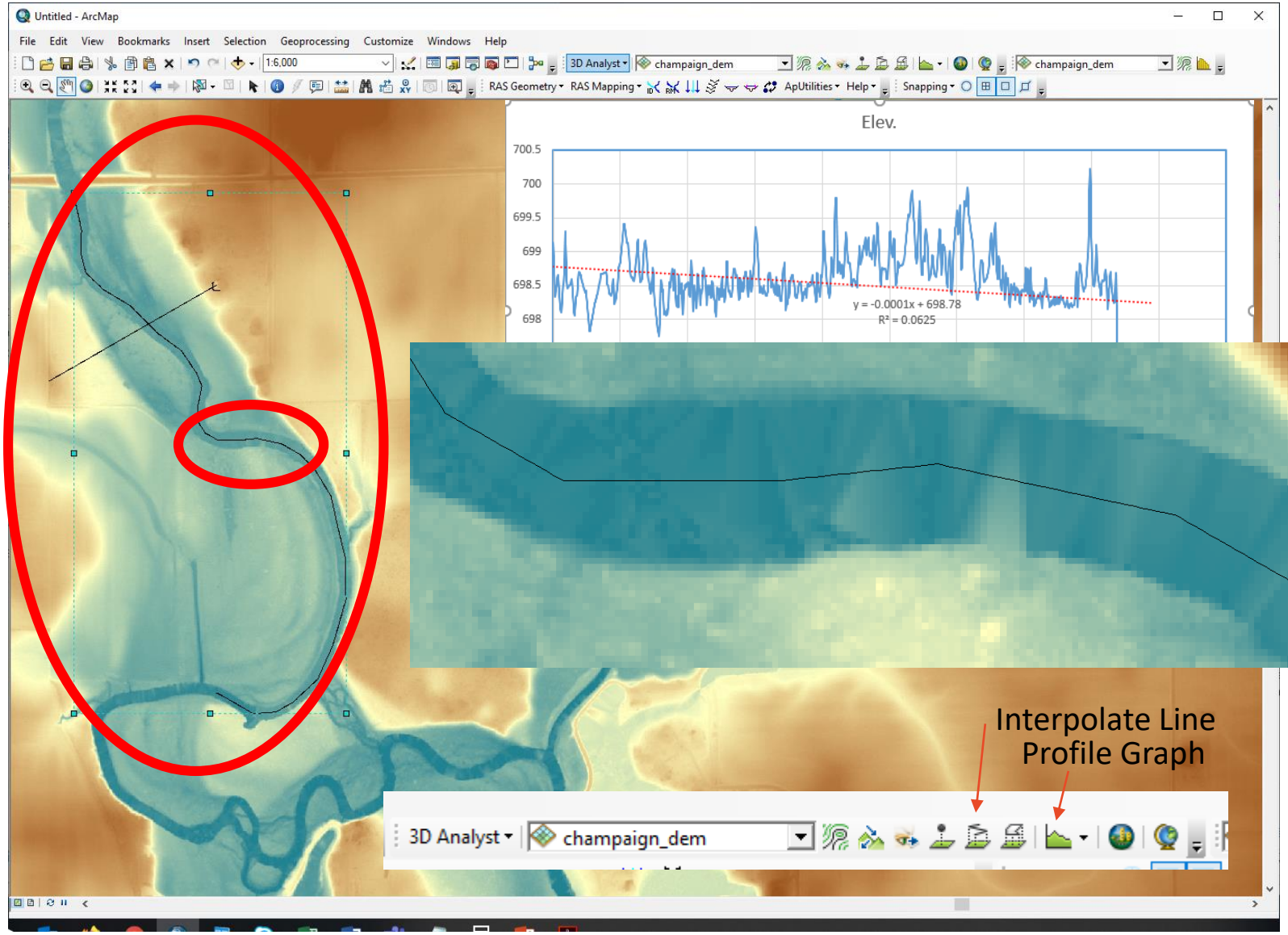
Over, T.M. , Saito, R.J., Veilleux, A.G., Sharpe, J.B., Soong, D.T., and Ishii, A.L.,2016, Estimation of peak discharge quantiles for selected annual exceedance probabilities in northeastern Illinois: U.S. Geological Survey Scientific Investigations

Illinois GIS Clearinghouse Height Modernization

https://clearinghouse.isgs.illinois.edu/data/elevation/illinois-height-modernization-ilhmp-lidar-data



Survey Channel Profile



Normal Depth Calculation

Instructions: Select variable to solve, adjust slider bars, click on graph to modify the cross section. CSV cross section data can be loaded in the input box below. This online calculator is for demonstration and educational purposes only.

Solve For:
Water Surface (normal depth)

Slope: 0.00005 (ft/ft)

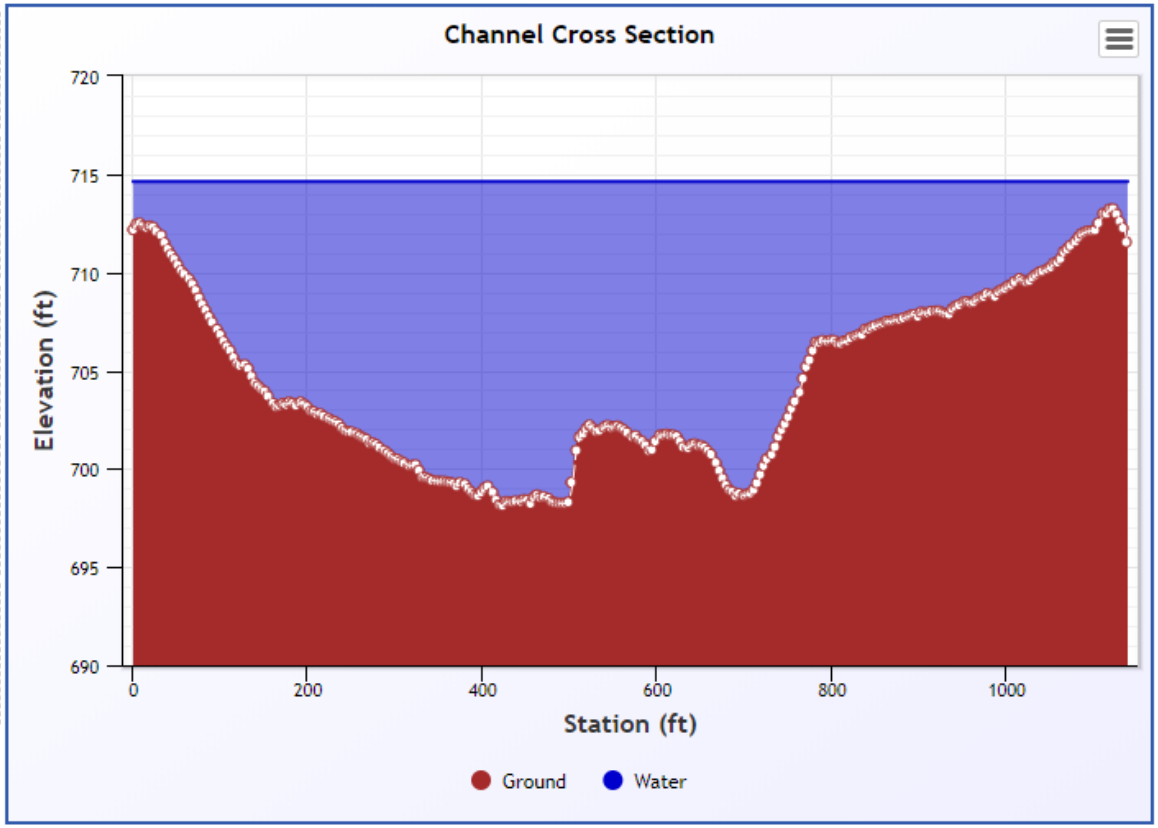
WSE: 714.62 (ft)

Channel Manning n: 0.035

Flow: 16400 (ft3/s)

100 40000

Reset Cross Section



Select HECRAS Geometry: Choose File No file chosen Load HEC-RAS Data

Flow Area:	11612.0 (ft2)
Wetted Perimeter:	1140.5 (ft)
Max Depth:	16.49 (ft)
Average Velocity:	1.41 (ft/s)
Top Width:	1138.49 (ft)
Iterations:	682
Froude Number:	0.08

Normal Depth Conclusion

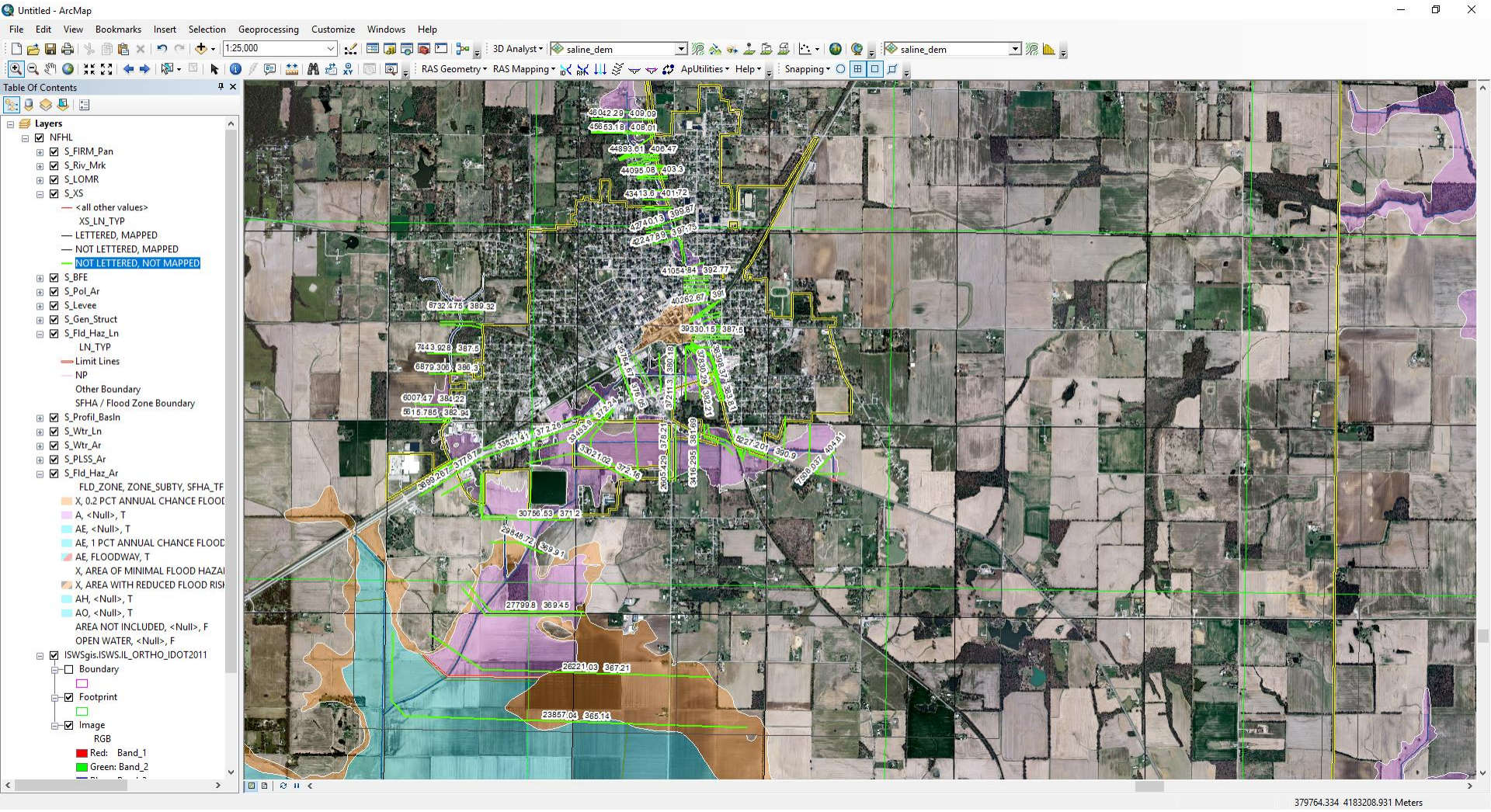
Parameter	Parameter Change	BFE Change
Channel Depth	- 8 ft.	- 0.8 ft.
Roughness Manning's "n"	+ 0.01	+ 1.4 ft.
Slope	- 0.00005 ft./ft.	+ 2.0 ft.

- Most Conservative: 716.3 ft.
- Most Optimistic: 711.9 ft.
- Difference 4.4 ft.

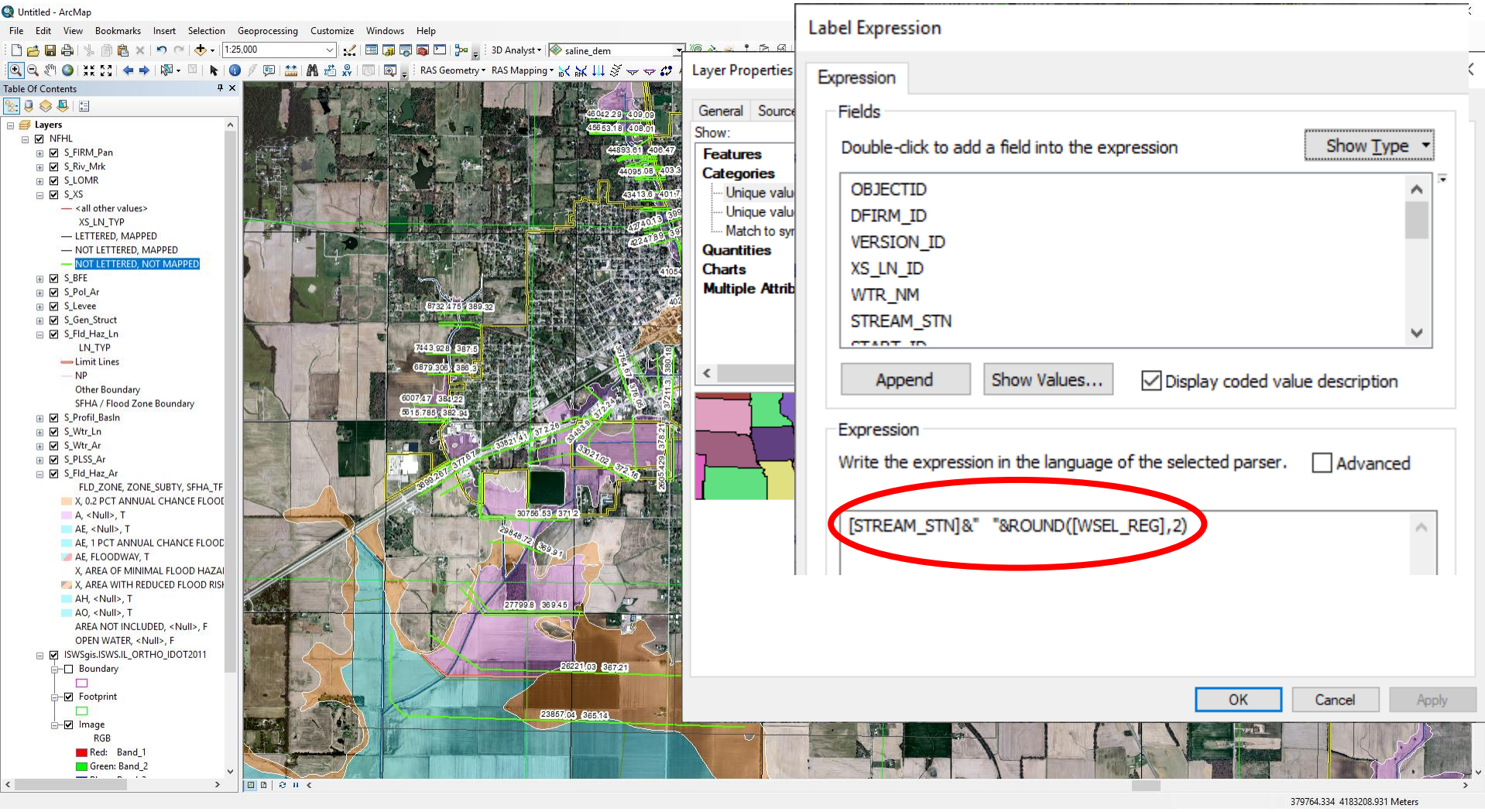
Fourth: "Get Lucky!"

- Find Model Backed Zone A Elevations

Model Backed Zone A Elevations



Model Backed Zone A Elevations



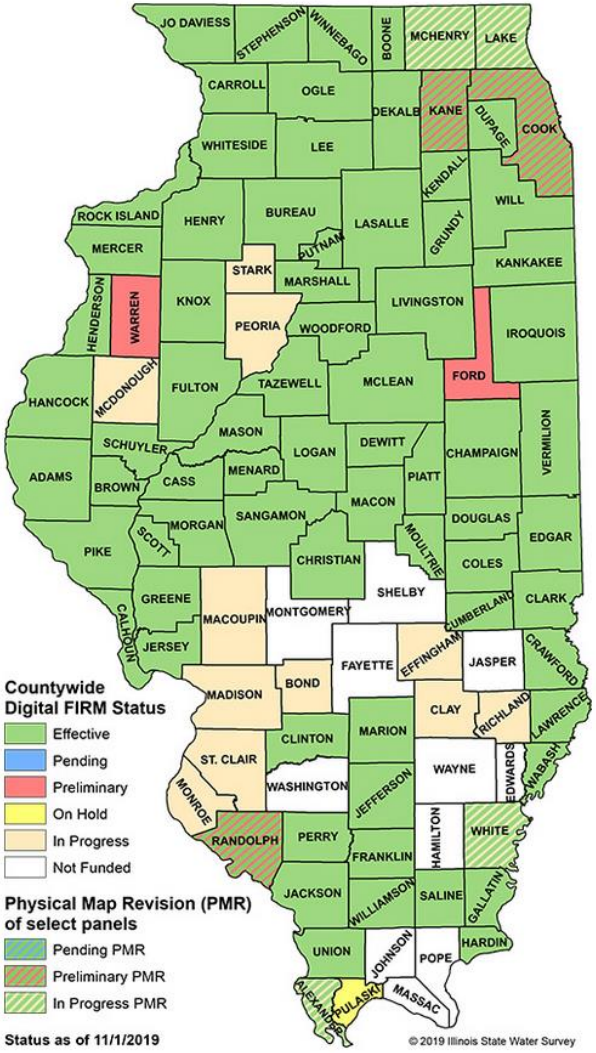
We will cover…

- ~~National Flood Insurance Program (NFIP)~~
- ~~Floodplain Mapping~~
- ~~Map Changes and Amendments~~
- ~~Dealing with A Zones~~
- ~~Establishing a Base Flood Elevation (BFE) in a Zone A Floodplain~~
- Looking Forward

Looking Forward

DFIRMs in Illinois

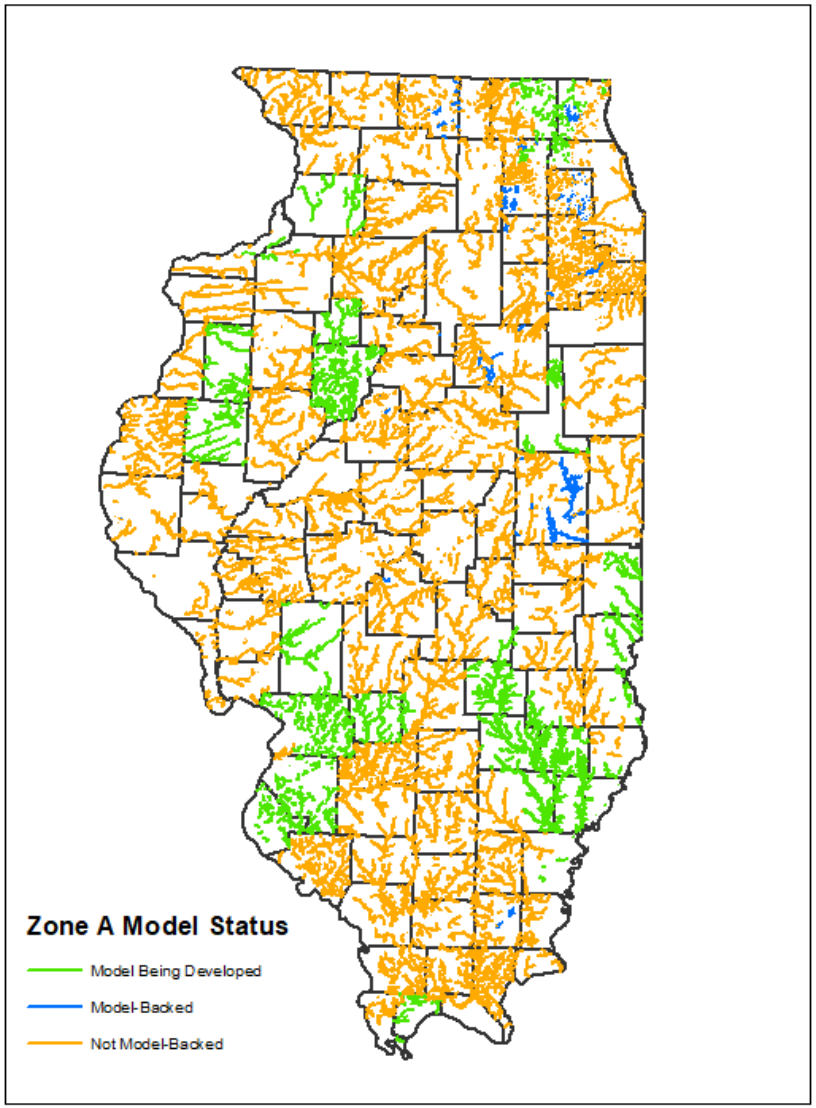
- Ford and Warren counties have new Preliminary DFIRMs
- Large portions of Randolph, Cook and Kane counties have new Preliminary DFIRMs based on new studies
- Large portions of Lake, McHenry, White and Alexander have new studies in progress
- Peoria, Effingham, Clay, Madison, St. Clair, Monroe, Macoupin, McDonough, Bond, and McHenry are funded for new studies



FEMA Model Backed A Zones

- http://illinoisfloodmaps.org/dfd.aspx
- — Model being Developed
- — Model backed
- — Not Yet Model Backed

- Model Backed
  - Still Approximate
  - “Option B” Base Level Engineering
    - No Bridges or Structures, but cross sections are placed appropriately for structure modeling
    - Cross-sections are auto-placed and hand adjusted
    - Single Channel Manning’s “n”, overbanks from Land Use Land Cover
    - No channel bathymetry



Precipitation

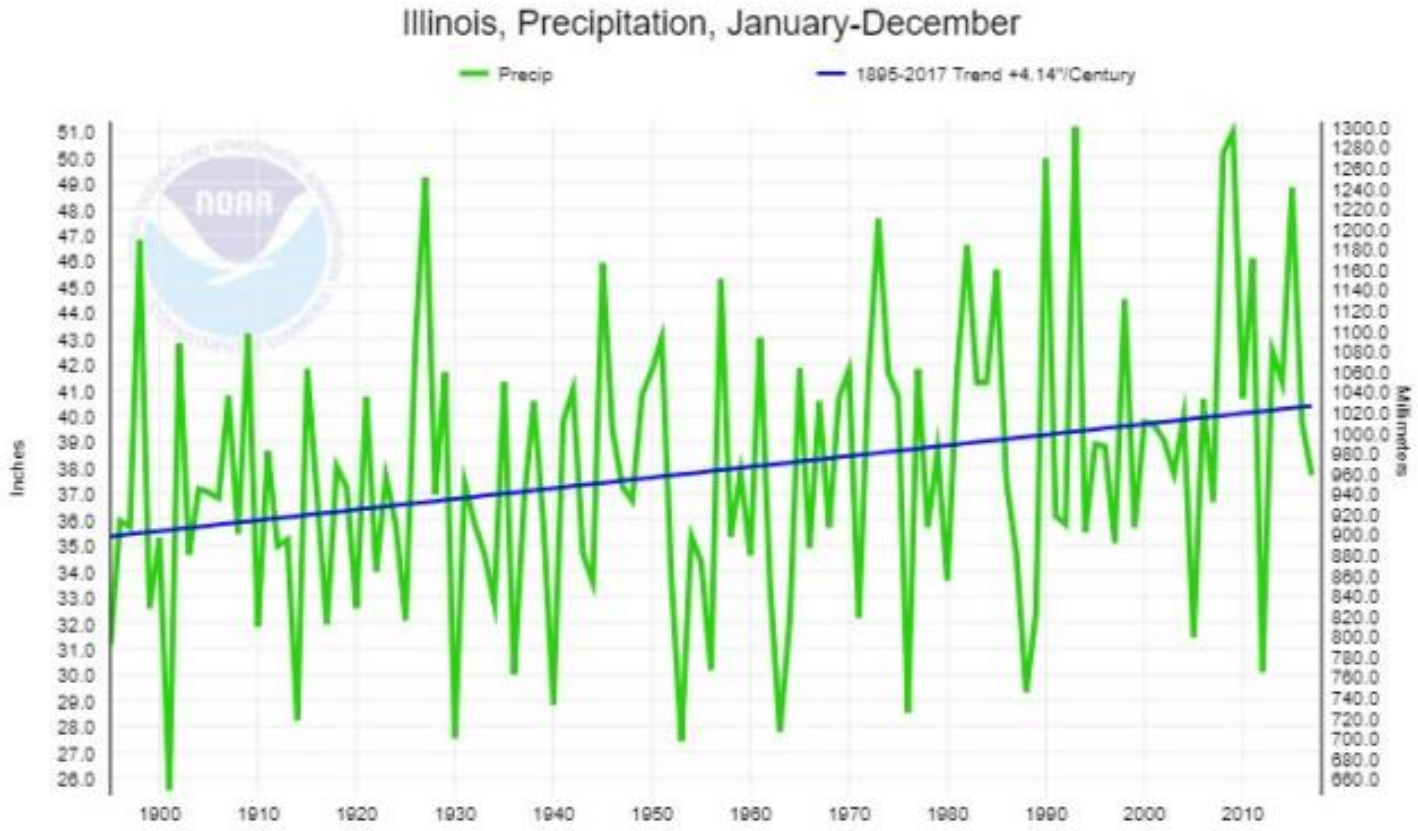
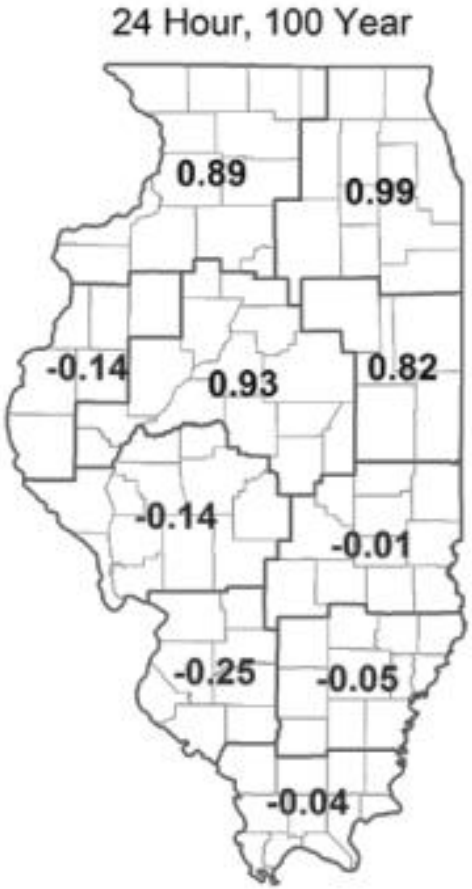


Figure 3 Statewide average annual precipitation for Illinois from 1895 to 2017. The green line shows the year-to-year variability. The blue line is a linear trend showing an increase of 4.14 inches over the past century. Source: NOAA NCEI, 2018.

Precipitation

- TP-40 (1961)
- ISWS Bulletin 70 (1989)
- ISWS Updated Bulletin 70 (2019)
  aka. Bulletin 75



ILLINOIS

Illinois State Water Survey

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