WV Flood Risk Assessment & Visualization Tools

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2024 Symposium: Building Flood Resiliency in West Virginia Communities

← *Devastating* June 2016 Flood

Partnerships and Interagency Coordination

No single agency has all the answers but leveraging multiple programs and perspectives can provide a cohesive solution

FEMA

NFIP/CRS

FPMD
FLOODPLAIN MANAGEMENT DIVISION

RiskMAP
Increasing Resilience Together

wsp

West Virginia
Voluntary Organizations
Active in Disaster
COOPERATION | COMMUNICATION | COORDINATION | COLLABORATION

ESF

Meadow
River Valley
Building Trails To A Bright Future

WVULAW
Land Use and
Sustainable
Development
Law Clinic

NSF

CTP
COOPERATING
TECHNICAL
PARTNERS

Resilience
Action Partners

CEP-Tool

HMGP
HAZARD
MITIGATION
GRANT PROGRAM

NATIONAL WEATHER SERVICE

US Army Corps
of Engineers®

SILVER JACKETS
Be Risk Aware!

EMERGENCY MANAGEMENT DIVISION
WVEMD
WEST VIRGINIA

West Virginia
Conservation Agency

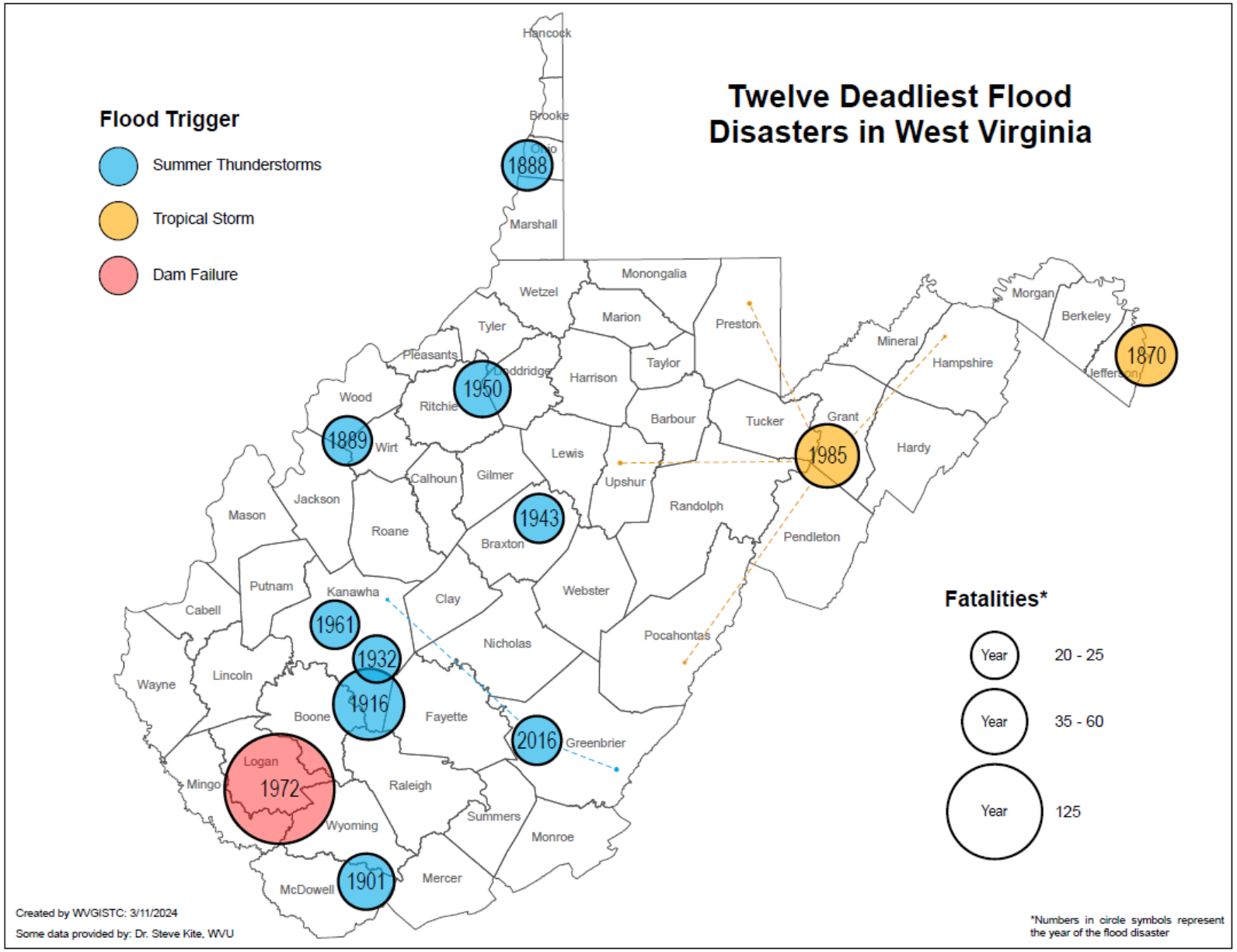
west virginia
CaD

WVGES
GEOLOGY UNDERLIES IT ALL

USGS

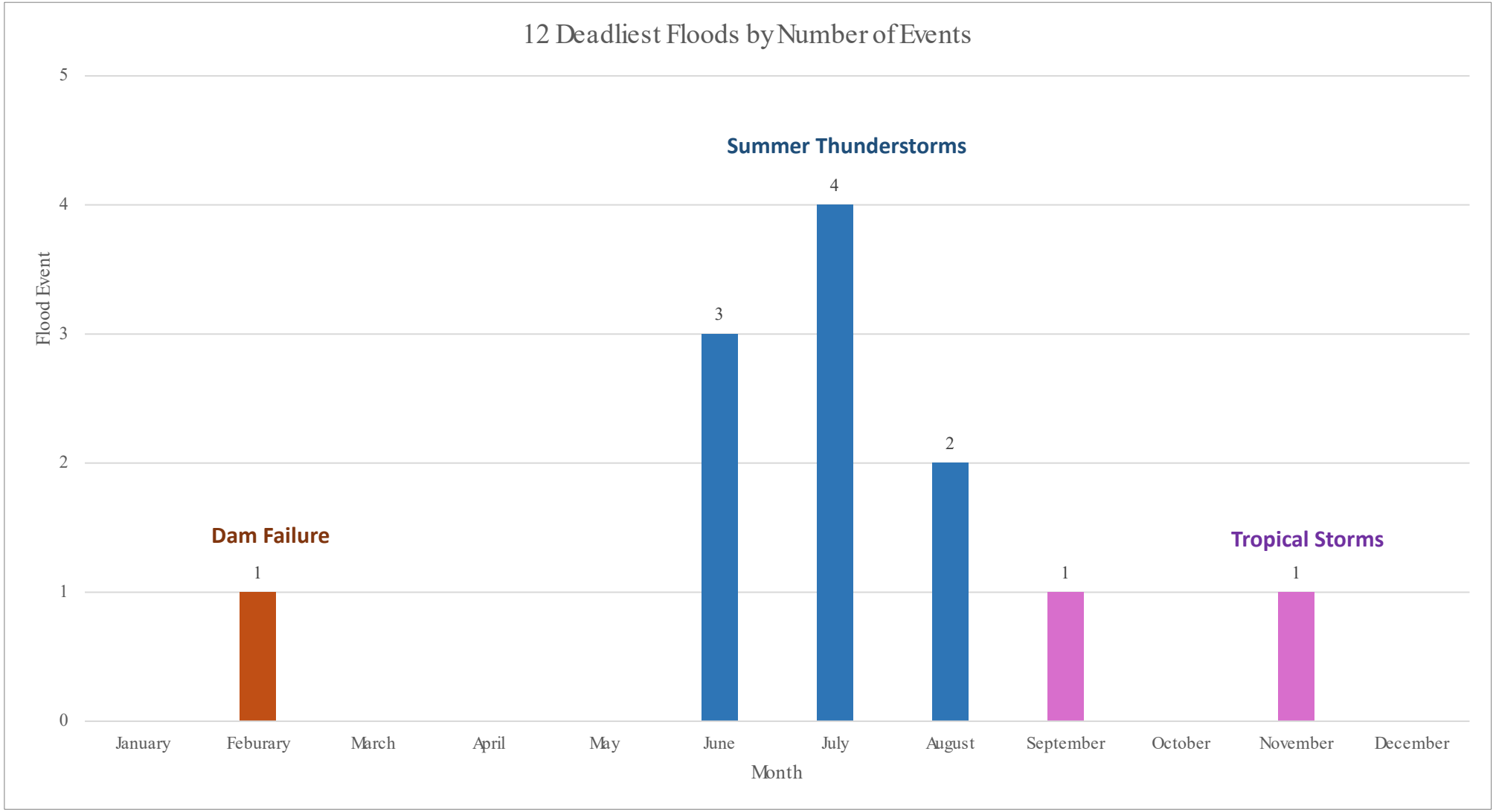
USDA
NRCS

12 Deadliest Disasters



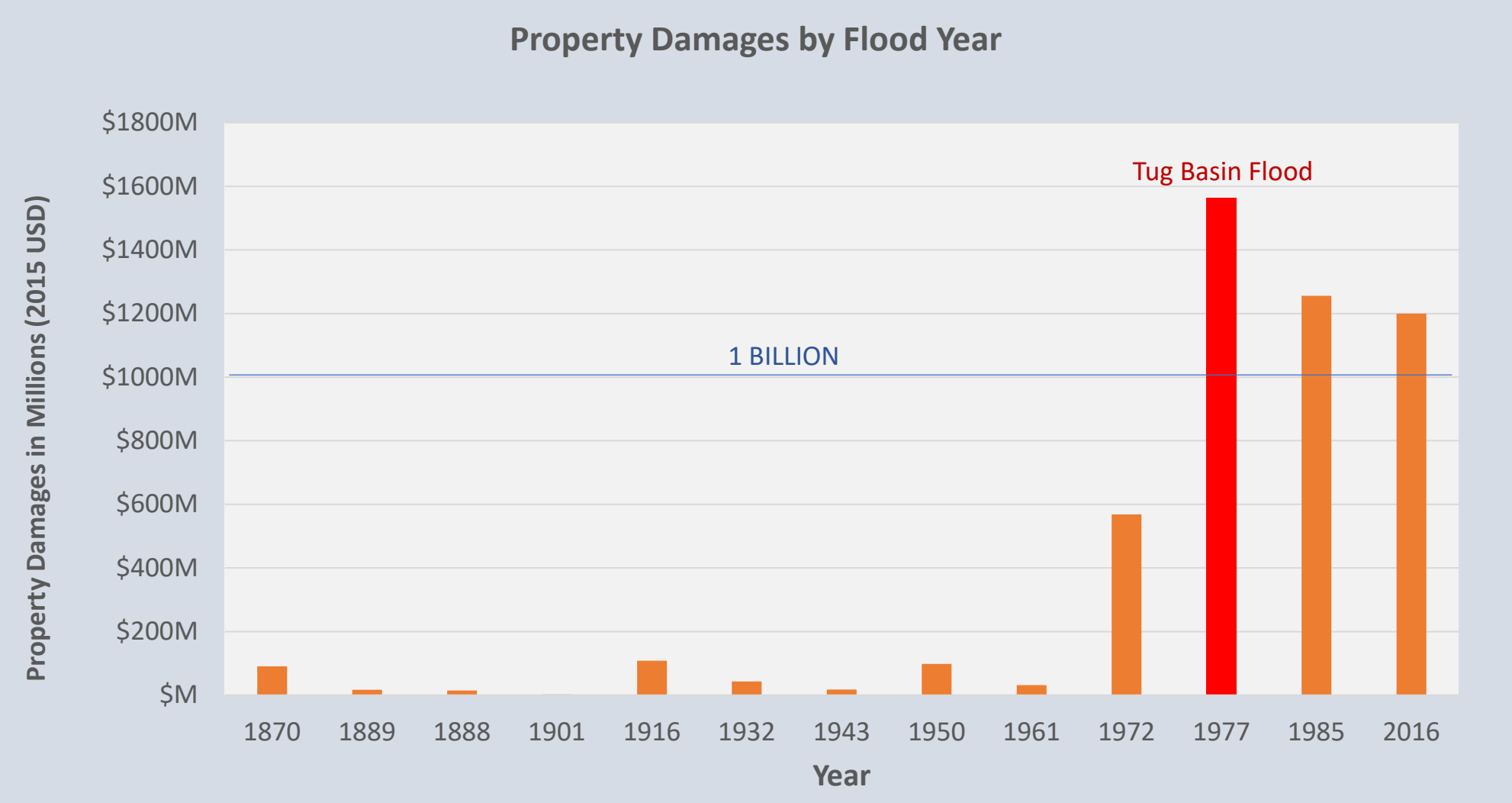
According to the analysis of flood fatalities in the 48 contiguous United States between 1959 and 2019, **West Virginia has the third highest ranking in the nation when flood fatalities** are standardized as the average annual number of fatalities per million inhabitants (Han and Hatim, 2021).

12 Deadliest Disasters



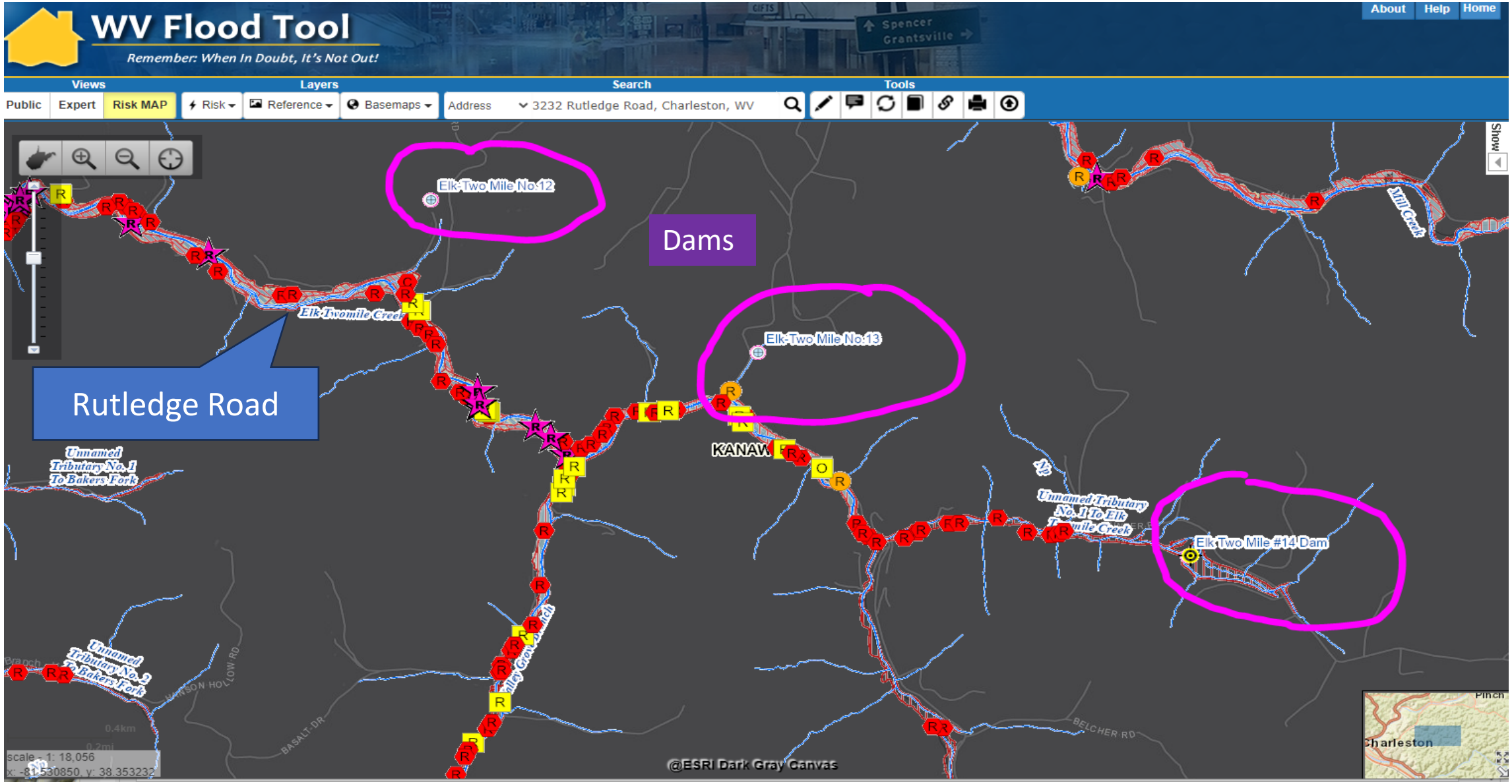
*Four of the Deadliest Floods have occurred in **Kanawha County** from **cloudbursts** during the **summer months***

Major Disasters (Property Damage)



Kanawha County Deadly Flood Disasters

WV Flood Tool RiskMap View: Rutledge Avenue



Elk Twomile Dams (flood mitigation)

West Virginia Conservation Agency

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WV Watershed Focus: Elk Twomile dams

May 18 2020

Chuck Grishaber, floodplain manager for the Kanawha County Commission, said the Elk Twomile dams are a real benefit to the Rutledge Road community. “It’s a great benefit to prevent flooding up there,” he said. “It’s also a great recreational area for fishermen.”

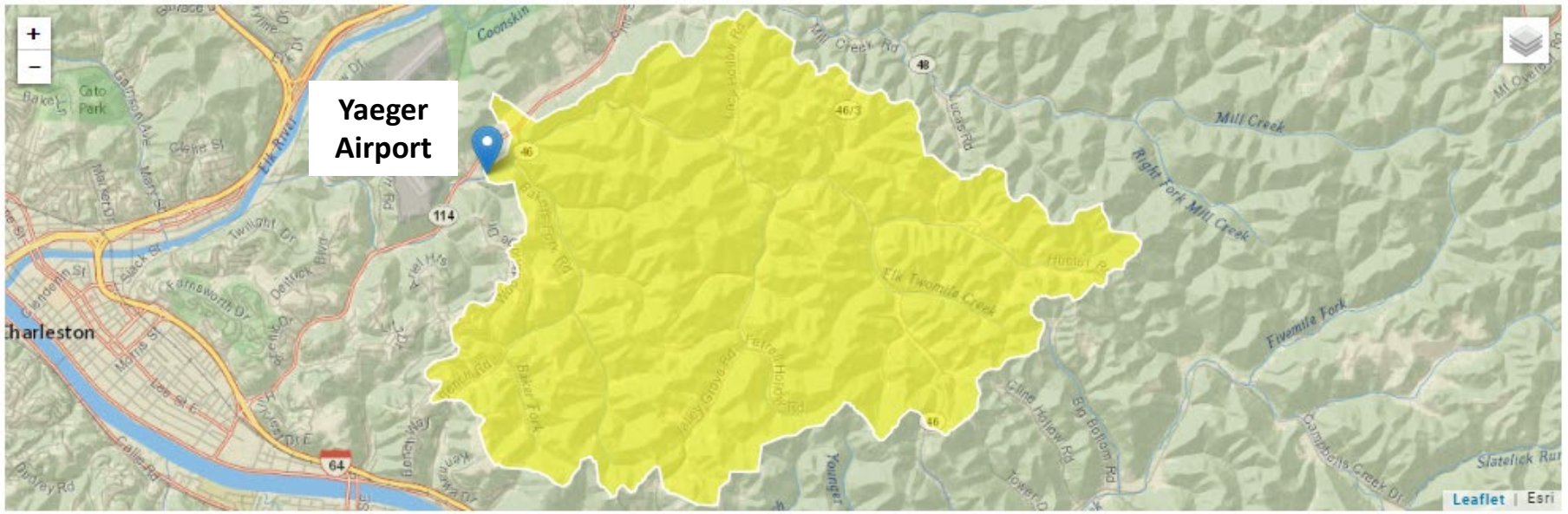
The Kanawha County Commission provides annual funding for maintenance with the WVCA matching the funding dollar for dollar.

StreamStats Report for Rutledge Road (Airport)

No Flood Mitigated Structures in headwaters above Rutledge Road

StreamStats Report

Region ID:	WV
Workspace ID:	WV20240312061829530000
Clicked Point (Latitude, Longitude):	38.36653, -81.57922
Time:	2024-03-12 02:18:52 -0400

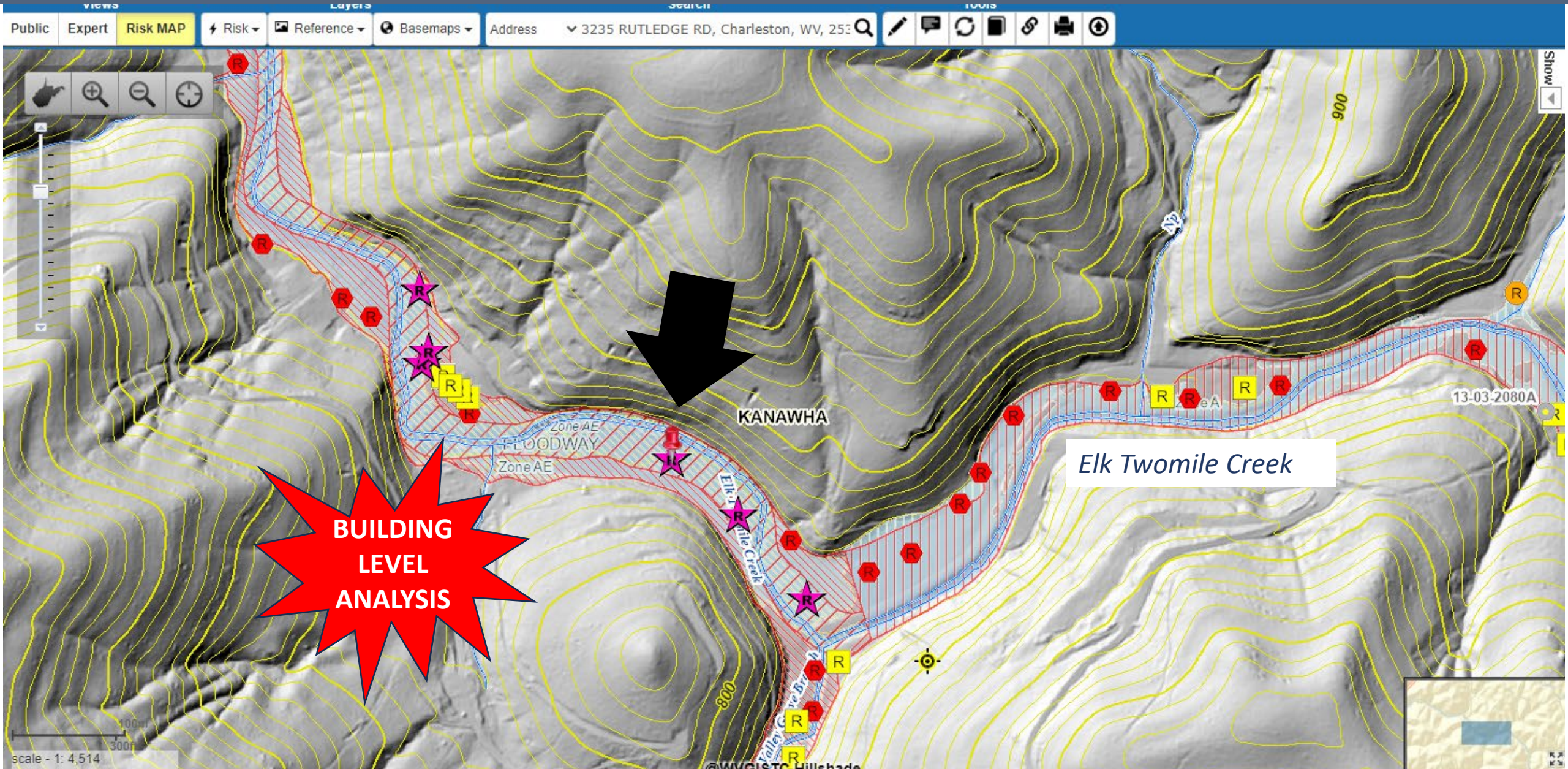


Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	10.9	square miles
LC16DEV	Percentage of land-use categories 21-24 from NLCD 2016	8.6	percent

Risk Assessment: 3235 RUTLEDGE RD, Charleston



Risk Assessment: 3235 RUTLEDGE RD, Charleston

WV Flood Tool link to Street View and 3D Visualization

3232 Rutledge Road Structure (1997)

100-YR Risk Assessment

STRUCTURE

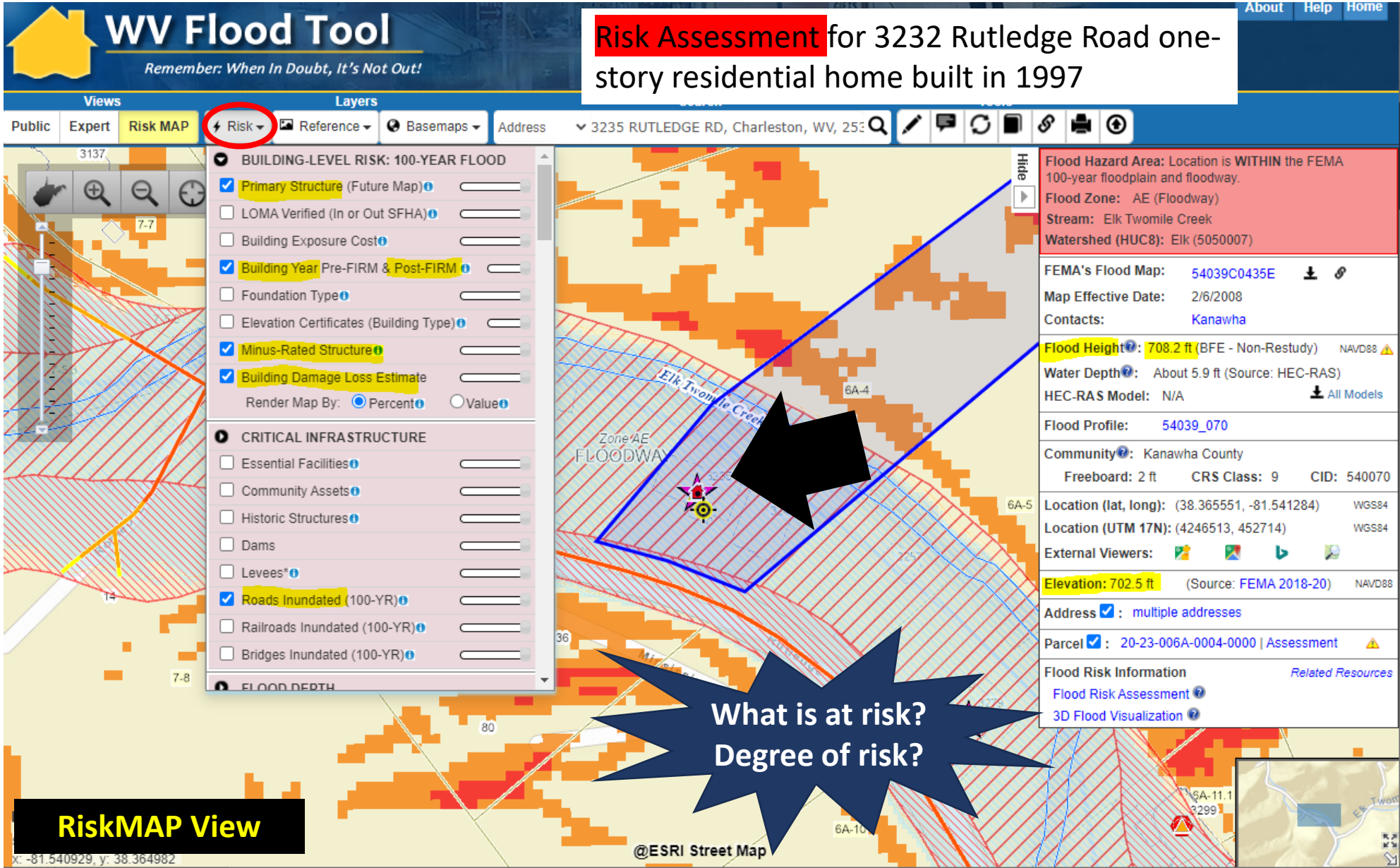
- ✓ Floodway
- ✓ Minus-Rated
- ✓ Moderate Structure Damage Estimated
- ✓ Debris Damage Risk

OTHER RISKS

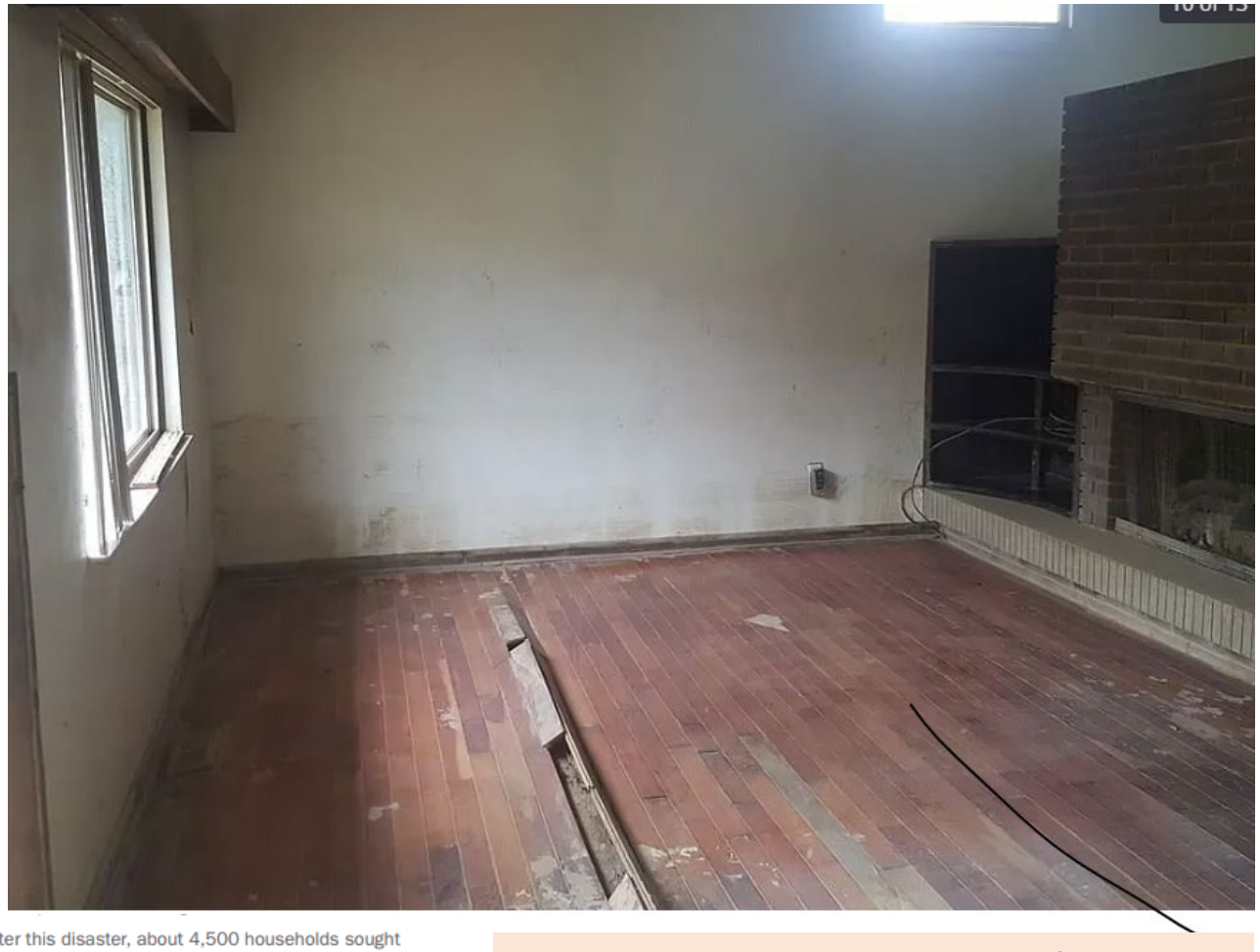
- ✓ Road Inundated
- ✓ Landslide Susceptibility

BUILDING LEVEL ANALYSIS

Source: WV Flood Tool
Panel 5400700153C 1985 FIRM with BFE



Risk Assessment: 200 Riverview Drive (2 fatalities)



- After this disaster, about 4,500 households sought financial assistance through flood insurance claims or FEMA's Individual Assistance program. People who filed flood insurance claims received an average of $53,500 per claim. People without flood insurance received only $8,363 in individual assistance for property repairs. While IA is intended to help people begin their recovery

Source: FEMA Flood Report

Flood Insurance Claim Avg: $53,500

IA for People w/o Insurance: $8,863

Riverview Drive: Pre-FIRM Minus-Rated Structure

100-YR Risk Assessment

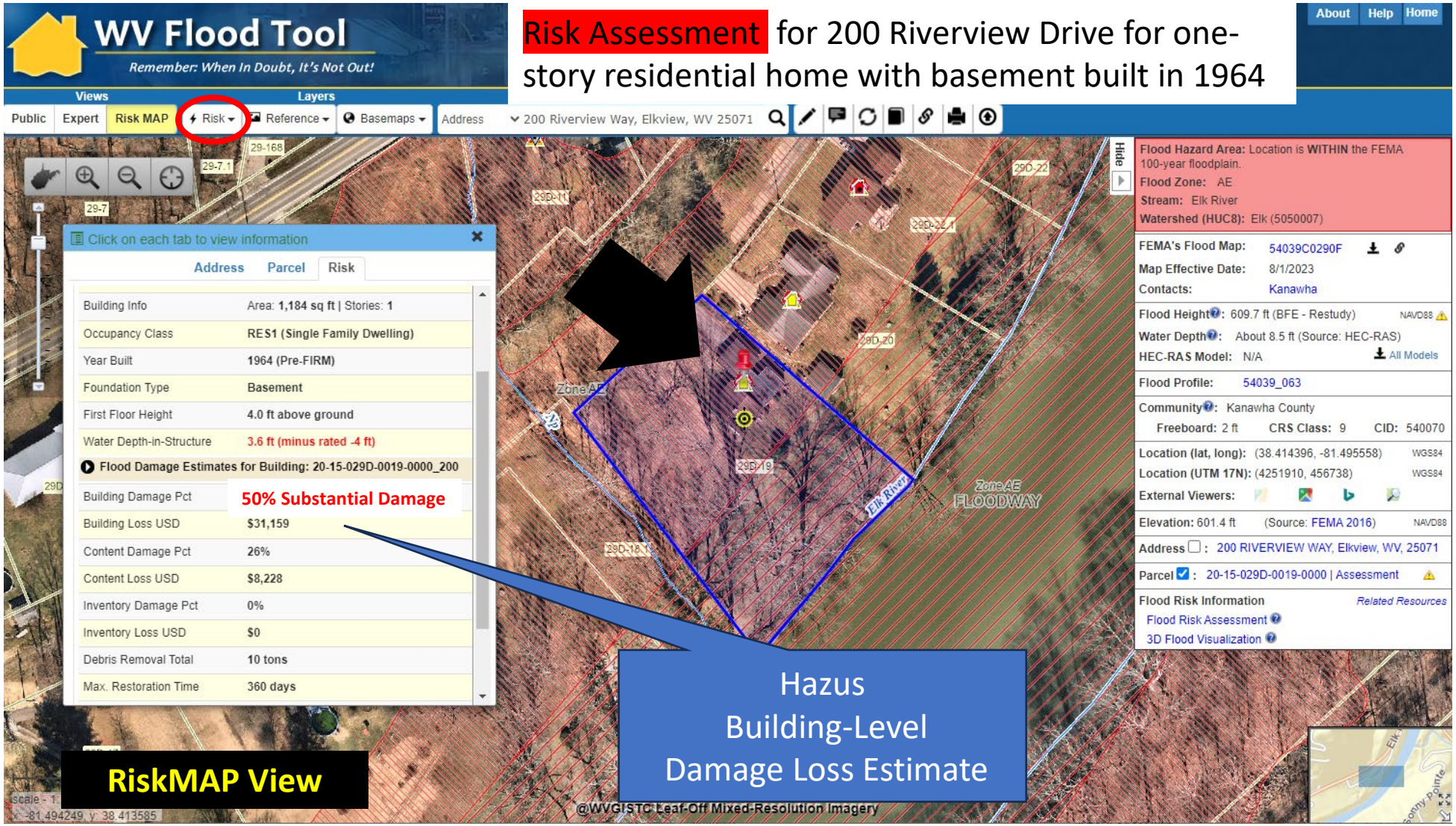
STRUCTURE

- ✓ **Subgrade Basement**
- ✓ **Minus-Rated**
- ✓ **High Flood Depth**
- ✓ **Nearly Substantial Damage Estimated**
- ✓ **Hydrodynamic Flood Forces (Foundation Collapse)**

BUILDING LEVEL ANALYSIS

Source: [WV Flood Tool]

Risk Assessment for 200 Riverview Drive for one-story residential home with basement built in 1964



200 Riverview Drive: FEMA 50% Rule

WV Flood Tool Parcel Report

Sales History — Learn More

Sale Date	Price	Sale Type	Source Code	Validity Code	Book	Page
1/6/2017	$84,000	Land and Buildings	4	5	2963	0536
3/4/2008	$121,000	Land and Buildings	4	5	2715	0557
12/6/2007	$129,726	Land and Buildings	4	5	2710	0187
6/21/2006	$154,500	Land and Buildings	1	2	2663	0795
4/1/2002	$139,000	Land and Buildings	4	0		
7/1/1999	$123,500	Land and Buildings	1			

Parcel History

Tax Year	Tax Class	Owner	Owner Address	Book/ Page	Lege	Building	Total
2023	2	LUCAS CARMEL D JR	4635 PENNSYLVANA AVE, CHARLESTON, WV 25302	2970/ 0245	LTS ADN	$62,800	$107,500
2022	2	LUCAS CARMEL D JR	4635 PENNSYLVANA AVE, CHARLESTON, WV 25302	2970/ 0245	LTS 13-14 SUGA AMP ADN	$64,500	$109,200
2021	2	LUCAS CARMEL D JR	4635 PENNSYLVANA AVE , CHARLESTON , WV 25302	2970 / 0245	LTS 13-14 SUGAR CAMP ADN	$64,500	$109,200
2020	2	LUCAS CARMEL D JR	4635 PENNSYLVANA AVE, CHARLESTON, WV 25302	2970/ 0245	LTS 13-14 SUGAR CAMP ADN	$65,800	$110,500
2019	3	LUCAS CARMEL D JR	4635 PENNSYLVANA AVE, CHARLESTON, WV 25302	2970/ 0245	LTS 13-14 SUGAR CAMP ADN	$23,500	$68,200
2018	3	LUCAS CARMEL D JR	4635 PENNSYLVANA AVE, CHARLESTON, WV 25302	2970/ 0245	LTS 13-14 SUGAR CAMP ADN	$23,900	$68,600
2017	2	ADAMS JONI	200 RIVERVIEW WAY, ELKVIEW, WV 25071	2715/ 0557	LTS 13-14 SUGAR CAMP ADN	$21,600	$66,300
2016	2	ADAMS JONI	200 RIVERVIEW WAY, ELKVIEW, WV 25071	2715/ 0557	LTS 13-14 SUGAR CAMP ADN	$105,600	$150,300

FEMA 50% Rule

80% Decrease

Zillow — Edit | Save | Share | More

2 bd | 2 ba | 2,281 sqft

200 Riverview Way, Elkview, WV 25071

Off market

Zestimate®: None | Rent Zestimate®: **$1,670** | 2023 assessed: **$107,500**

Est. refi payment: $516/mo Refinance your loan

Home value | Owner tools | Home details | Neighborhood details

Price history

Date	Event	Price
4/24/2017	Sold	$13,250 -24.3% $6/sqft Source: KVBR #212076 Report
3/1/2017	Listed for sale	$17,500 -88.7% $8/sqft Source: Homepath Report
6/21/2006	Sold	$154,500 +11.2% $68/sqft Source: Public Record Report
4/1/2002	Sold	$139,000 +12.6% $61/sqft Source: Public Record Report

Risk Assessment: 2466 JORDAN CREEK RD

All these homes along Jordan Creek Road near Clendenin were swept away during the flood

WV Flood Tool

Flood Tool Views

(www.mapwv.gov/flood)

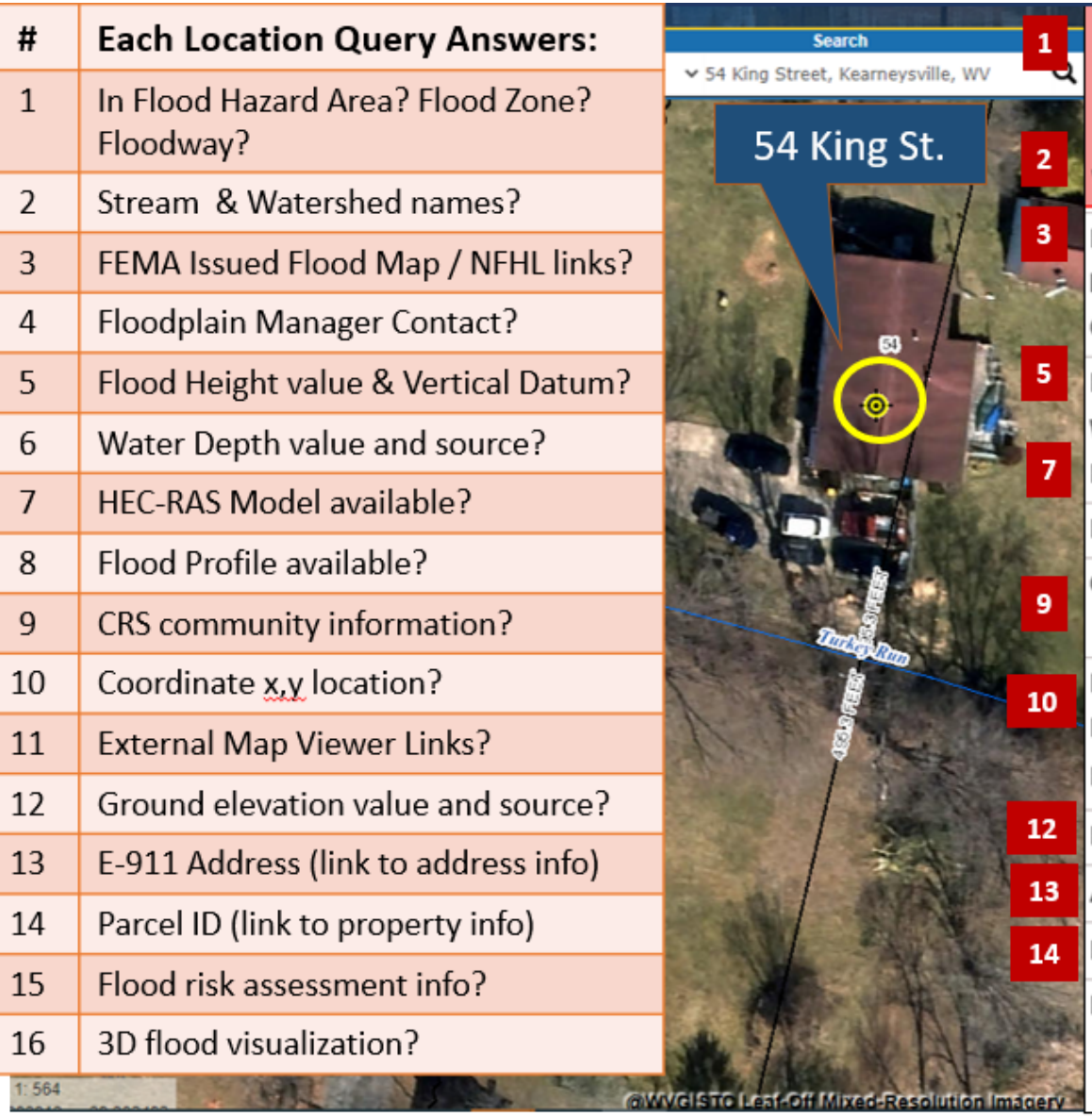
- **Public View** for general public
- **Expert View** for floodplain managers
- **RiskMAP View** for flood risk planners

WV Flood Tool Layers

FLOOD RISK LAYERS	REFERENCE LAYERS	FLOOD LAYERS
BUILDING-LEVEL RISK (100-YR)	TAX PARCELS	FLOOD HAZARD
Primary Structure (Future Map Conditions)	Parcels (1.4 million) POPUP TABLE	NFHL Flood Areas (Effective, Draft, Preliminary)
Building Exposure Cost POPUP TABLE	Detailed Parcel Reports and History	High-Risk Advisory Flood Zones (Zone A and AE)
Building Year Pre-FIRM/ Post-FIRM	Sketch Diagrams	Base Flood Elevations
Foundation type		Cross-Sections
Minus-Rated Structure	E-911 ADDRESSES / ROADS	LOMAs / LOMRs
Building Damage Estimates POPUP TABLE	E-911 Addresses (1 million)	LOMAs Location Verified
	E-911 Road Centerlines	Panel Index (link to FEMA issued map)
CRITICAL INFRASTRUCTURE	DOT Primary Routes	Structures, Levees, Mile Markers*
Essential Facilities		Flood Elevation Certificates
Community Assets - Non-Historical	BUILDING FOOTPRINTS	FEMA Stream Names
Community Assets - Historical	Building Footprints (Microsoft - 1 million)	
Dams and Levees	Building Footprints (WVGISTC - 2 million)	FLOOD DEPTH
Roads / RR/ Bridges Inundated		HEC-RAS Model Backed (1% Flood)
	BOUNDARIES	Hazus Flood Depth (1% Flood)
OTHER HAZARDS	Community Boundaries	USGS High Water Marks
Landslide Incident	Watershed Boundaries	
Landslide Susceptibility		FLOOD PREDICTION
	ELEVATION CONTOURS	USGS Real-Time Gages
MITIGATED PROPERTIES & OPEN SPACE	1-foot contours (zoomed-in scales)	
Mitigated Structure	10-foot contours (zoomed-out scales)	BASEMAPS
Buyout Parcel		Aerial Imagery (11 unique sets)
Public Land	GEOGRAPHIC NAMES / STREAMS	Road/Street Basemaps
Private Land	Existing and historical towns	Hillshade lidar-derived (1 meter)
	Streams lines and names	Topographic Maps

FLOOD QUERY RESULTS PANEL

#	Each Location Query Answers:
1	In Flood Hazard Area? Flood Zone? Floodway?
2	Stream & Watershed names?
3	FEMA Issued Flood Map / NFHL links?
4	Floodplain Manager Contact?
5	Flood Height value & Vertical Datum?
6	Water Depth value and source?
7	HEC-RAS Model available?
8	Flood Profile available?
9	CRS community information?
10	Coordinate x,y location?
11	External Map Viewer Links?
12	Ground elevation value and source?
13	E-911 Address (link to address info)
14	Parcel ID (link to property info)
15	Flood risk assessment info?
16	3D flood visualization?



Flood Hazard Area: Location is **WITHIN** the FEMA 100-year floodplain and floodway.
Flood Zone: AE (Floodway)
Stream: Turkey Run
Watershed (HUC8): Conococheague-Opequon (2070004)

FEMA's Flood Map: 54037C0115E NFHL
Map Effective Date: 12/18/2009
Contacts: Jefferson

Flood Height: 495.6 ft (BFE - Non-Restudy) NAVD88
Water Depth: About 2.4 ft (Source: HEC-RAS)
HEC-RAS Model: N/A All Models

Flood Profile: 54037_028

Community: Jefferson County
CID: 540065 **CRS Class:** 6

Location (lat, long): (39.302764, -77.983755) WGS84
Location (UTM 17N): (4354713, 760089) WGS84
External Viewers:

Elevation: 493.1 ft (Source: FEMA 2012) NAVD88

Address: 54 KING ST, Kearneysville, WV, 25430

Parcel: 19-07-022B-0022-0000 | Assessment

Flood Risk Information *Related Resources*
Flood Risk Assessment
3D Flood Visualization

Parcel ID Web Link: https://www.mapwv.gov/flood/map/?v=1&pid=19-07-022B-0021-0000

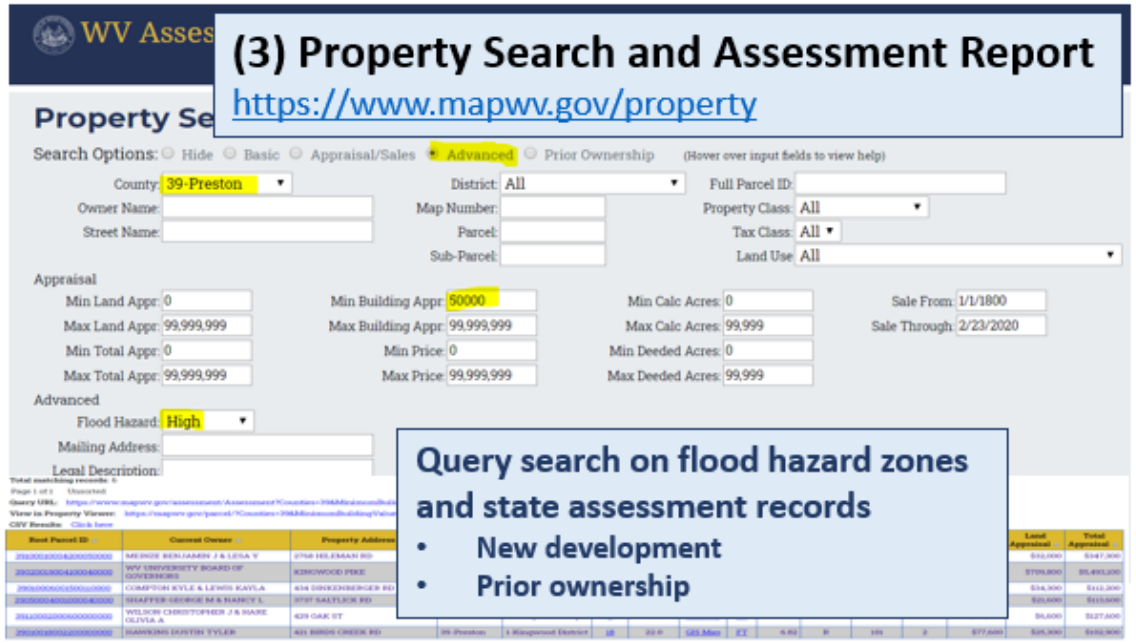
Performance Measure: Query Results display within 5 seconds

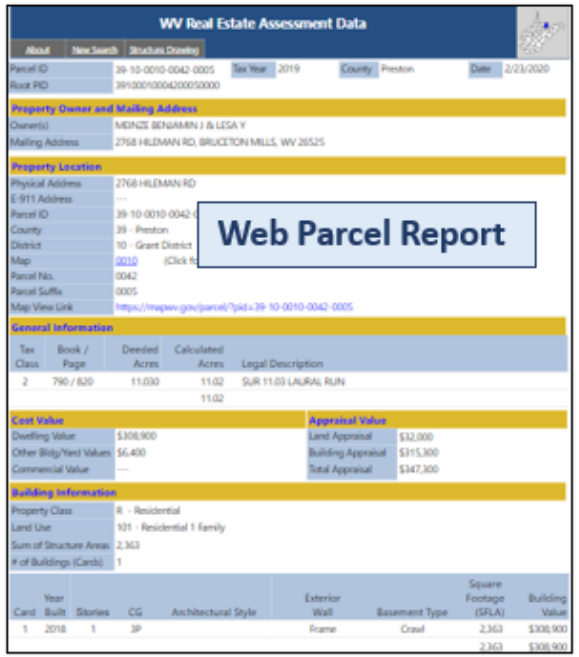
WV Flood Tool (& property tool)

(1) Flood Tool: Desktop Version
https://www.mapwv.gov/flood

(2) Flood Tool: Mobile Version
https://www.mapwv.gov/flood/mmap

Public resource applications that support floodplain management and flood reduction activities





WV Flood Resiliency Framework

An online toolkit that includes a suite of risk assessment and visualization tools for empowering communities across the state with the knowledge they need for coordination and capacity building to better prepare for future floods.

1) FLOOD RISK INDICATOR TOOLS:

- The **WV Flood Tool** shows flood characteristics, exposure, vulnerability, loss estimates, and mitigation measures at the property level, while the **WV Flood Risk Index** aggregates hazard data to indicate the communities most at risk of riverine flooding.

2) FLOOD RISK VISUALIZATION TOOLS:

- A collection of movies, animations, story maps, and other flood visualization tools presented at the building and community levels for communicating and understanding flood risk.

3) OTHER HAZARDS TOOLS:

- Interactive tools that provide risk assessment information about other hazards in the state, such as the **WV Landslide Tool**.

4) WEBSITE HUB:

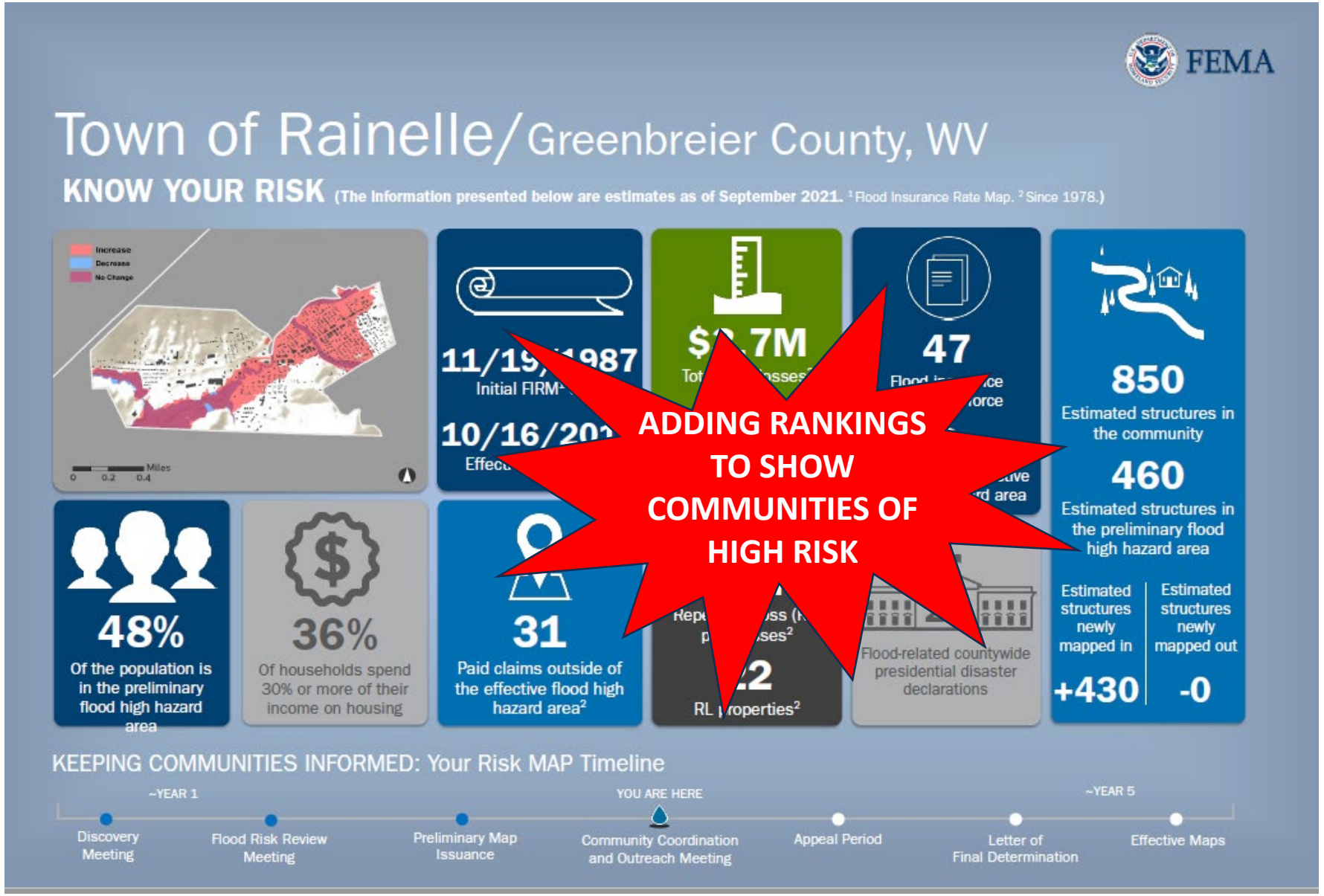
- A website hub organizes the data and tools to maximize engagement, communication, collaboration, and data. It includes a section for published reports, plans, guides, and other useful risk assessment resources.

Community Risk Profile

TIME TO UPGRADE

with

WV Flood Risk Index

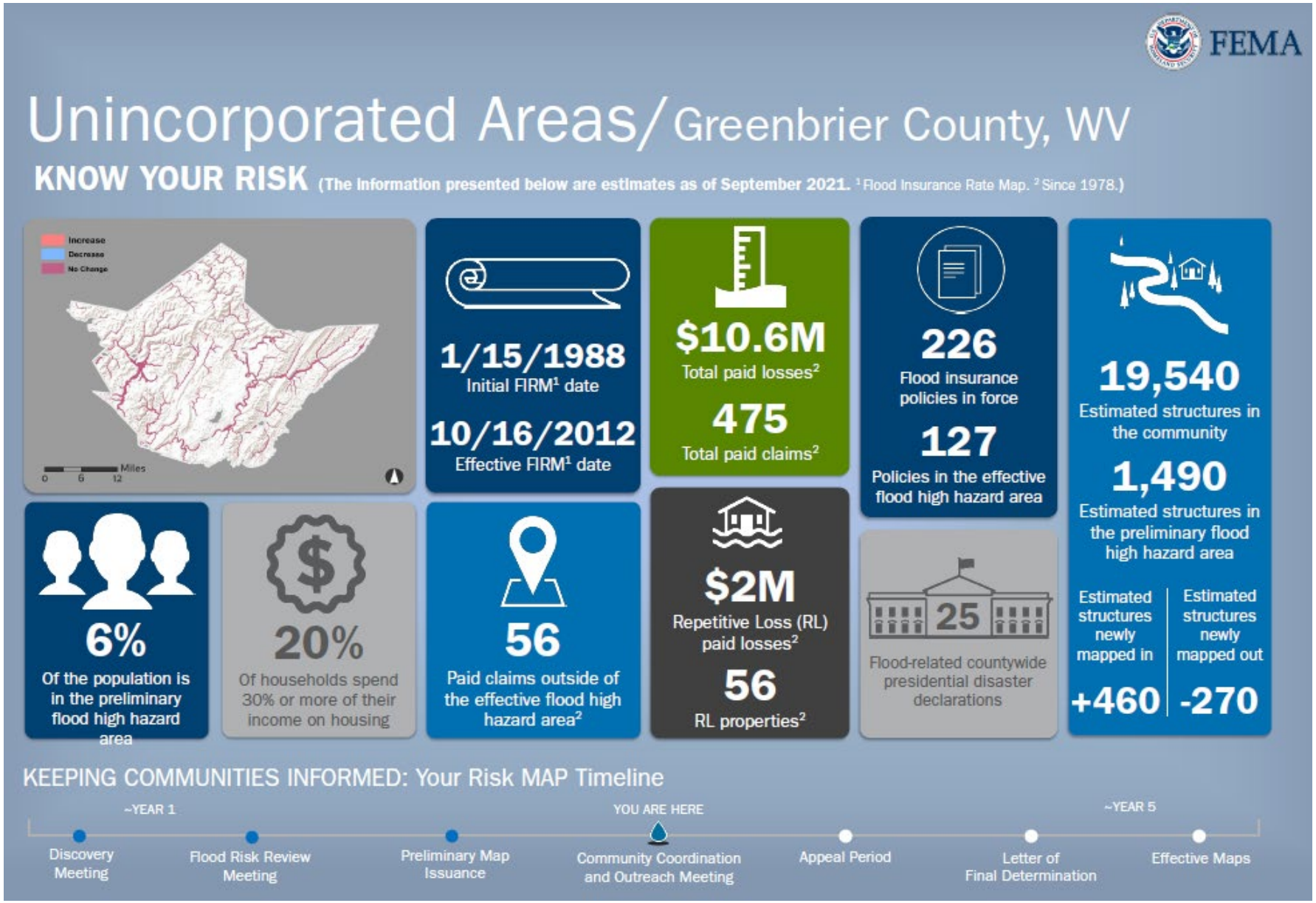


Community Risk Profile

TIME TO UPGRADE

with

WV Flood Risk Index



Risk Assessments at Multiple Scales

GEOGRAPHIC SCALES		APPLICATIONS				WVFRF TOOLS		
Geographic Unit	**# Units**	**Floodplain Management & Mitigation**	**FEMA Mapping**	**Risk Planning**	**Disaster Management**	**Risk Tools**	**Flood Visualization Tools**	**Document Center Tools**
PROPERTY LEVEL								
Structures[1]	98,000	**X**	X	X	**X**	**WV Flood Tool** (Individual Data)	Yes	Yes
Parcels	275,000	**X**	X	X	**X**			Yes
Other Features[2]		X	**X**	X	**X**			
COMMUNITY LEVEL								
Incorporated Places	211	X	X	X	X	**WV Flood Risk Index** (Aggregate Level)	Yes	Yes
Unincorporated Areas	55	X	X	X	X			Yes
Communities (NFIP)[3]	266	**X**	**X**	**X**	**X**		Yes	Yes
COUNTY-REGION-STATE LEVEL								
Counties	55	X	X	**X**	**X**	**WV Flood Risk Index** (Aggregate Level)	Yes	Yes
Regions (RPDCs)	11	X	X	**X**	X			Yes
State	1	**X**	X	**X**	**X**			Yes
DRAINAGE LEVEL								
Watersheds	32	X	**X**	X	X	**WV Flood Risk Index** (Aggregate Level)		Yes
Streams (named)	6,748	X	**X**	X	X			Yes

NOTES:

[1] Primary structures located in high-risk effective and advisory floodplains (1%-annual-chance flood)

[2] Other Features include roads, bridges, National Register Areas, flood mitigation structures (dams, levees, floodwalls)

[3] Total 284 communities in state: 266 NFIP; 18 incorporated places not in NFIP

FLOOD RISK INDEX TOOL

Flood Risk Index Tool Overview

This tool offers a range of flood risk indicators of various categories and integrates them at different aggregate levels. It generates dynamic (e.g., interactive maps) and static (e.g., downloadable reports) results to enhance understanding of the risk. Additionally, the tool provides functions for comparing risk among communities or other units of different scales.

Key Concepts:

- Incorporating best available **quantitative** and **qualitative** risk data
- Considering both **risk** and **mitigation** factors
- **Ranking** and calculating **indicator/index scores** to identify communities/counties/regions of highest risk
- Analyzing risk at multiple **scales**

Political Scales:

- Communities
  - Incorporated
  - Unincorporated
- Counties
- Planning & Development Council Regions
- State

Drainage Areas Scales:

- Watersheds
- Streams

Principal Functions of Flood Risk Index Tool

- Risk Factor Scores and Cumulative Index
- Web Reports (include additional flood data besides indicators)
- Visualizations and Charts
- Rationale and Recommendations (integrates quantitative data with qualitative information from risk behavior/knowledge studies)
- Data Export

Risk Factor Scores and Cumulative Index

Major Categories (5)	Detailed Categories (22)	Tool Indicators (64)
1) Flood Hazard Risk	Floodplain Area	6 indicators
	Floodplain Length	
	Declared Disasters	
	Flood Depth	
2) Structure Risk	Building Counts / Ratios	41 indicators
	Building Types & Values	
	Vulnerable Structures	
	FIRM Status	
	Building Year / New Construction	
	Significant Structures	
	Physical Damage Estimates	
	Recorded Building Damages	
	Transportation Infrastructure	
3) People/Social Risk	Social Vulnerability	4 indicators
	Population Exposure	
	Population Displacement & Shelter Needs	
4) Other Hazards	Dams/Levees	4 indicators
	Landslide	
5) Mitigation Measures	Structural Measures	9 indicators
	Physical Non-Structural Measures	
	Non-Physical Non-structural Measures	

Risk Factor Scores and Cumulative Index …

1) Flood Hazard Risk Indicators

Major Category	Detailed Category	Code	Indicator	Short Description	Unit
Flood Hazard Risk	Floodplain Area	**SFHA**	**Floodplain Area**	Acreage of modified Special Flood Hazard Area (SFHA), or 1%-annual-chance (100-yr) floodplain Areas excluded from Total aSFHA: Open water lakes > 10 acres; Large river bank-to-bank > 500 ft.; Federal lands > 10 acres.	Acres

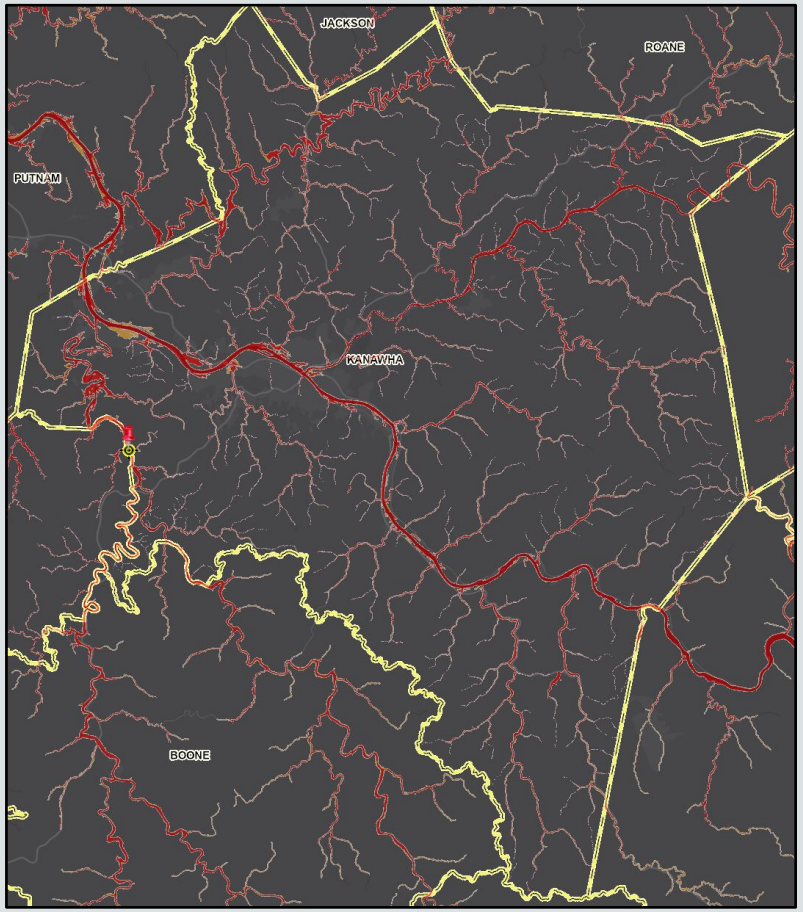
Rationale	Recommendations	Data Source
For unincorporated areas and at the county level, it can be more challenging for communities larger in geographic size to enforce their floodplain management ordinance. Often larger jurisdictions have more acres and miles of floodplain extent than compared to smaller communities. In smaller communities, the floodplain area is compacted and thus new development in the floodplain should be easier to monitor than larger rural areas or countywide. The acreage of the SFHA (aSFHA) is a programming variable required for those communities participating in FEMA's Community Rating System (CRS) program.	Larger jurisdictions must be vigilant in monitoring and permitting new development for an expansive geographic area that includes a large amount floodplain area/miles.	FEMA FIRM Streams and Waterbodies (USGS NHD 24K), National Public Lands (USGS PAD-US)

Risk Factor Scores and Cumulative Index …

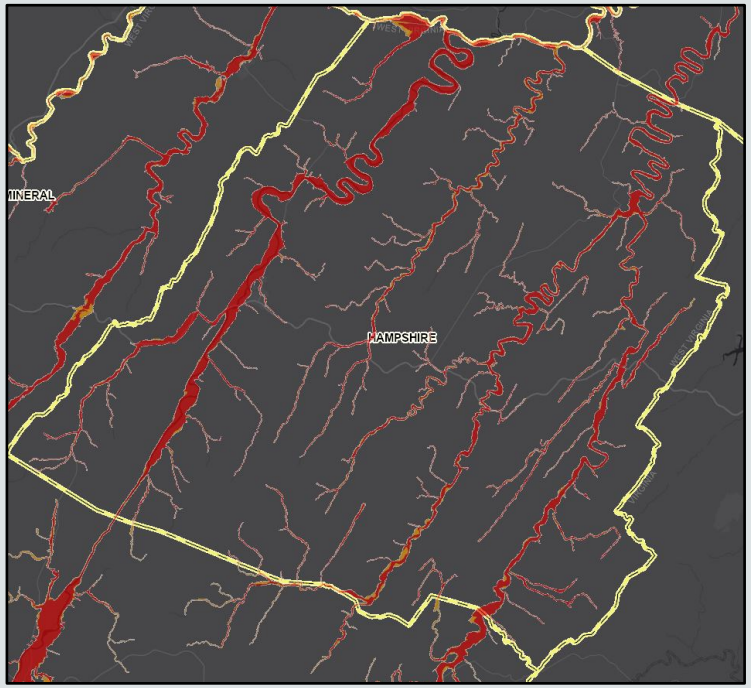
Top 20% Rankings for Floodplain Area

RANK	All Communities	Percent Rank	Unincorporated Areas	Percent Rank	Counties	Percent Rank	Regions	Percent Rank
1	Hampshire County*	100.0%	Hampshire County*	100.0%	HAMPSHIRE	100.0%	5	100%
2	Mason County*	99.6%	Mason County*	98.1%	KANAWHA	98.1%	8	90%
3	Kanawha County*	99.2%	Kanawha County*	96.2%	MASON	96.2%	2	80%
4	Greenbrier County*	98.9%	Greenbrier County*	94.4%	GREENBRIER	94.4%		
5	Randolph County*	98.5%	Randolph County*	92.5%	RANDOLPH	92.5%		
6	Webster County*	98.2%	Webster County*	90.7%	WOOD	90.7%		
7	Wood County*	97.8%	Wood County*	88.8%	WEBSTER	88.8%		
8	Hardy County*	97.5%	Hardy County*	87.0%	HARDY	87.0%		
9	Jackson County*	97.1%	Jackson County*	85.1%	JACKSON	85.1%		
10	Pendleton County*	96.8%	Pendleton County*	83.3%	WAYNE	83.3%		
11	Wayne County*	96.4%	Wayne County*	81.4%	PENDLETON	81.4%		
12	Lincoln County*	96.1%						
13	Berkeley County*	95.7%						
14	Cabell County*	95.4%						
15	Pocahontas County*	95.0%						
16	Preston County*	94.6%						
17	Putnam County*	94.3%						
18	Nicholas County*	93.9%						
19	Mineral County*	93.6%						
20	Raleigh County*	93.2%						
21	Jefferson County*	92.9%						
22	Morgan County*	92.5%						
23	Harrison County*	92.2%						
24	Wirt County*	91.8%						
25	Tyler County*	91.5%						
26	Ritchie County*	91.1%						
27	Braxton County*	90.8%						
28	Boone County*	90.4%						
29	Monroe County*	90.1%						
30	Tucker County*	89.7%						
31	Mercer County*	89.3%						
32	Grant County*	89.0%						
33	Lewis County*	88.6%						
34	Roane County*	88.3%						
35	Gilmer County*	87.9%						
36	Wetzel County*	87.6%						
37	Calhoun County*	87.2%						
38	Barbour County*	86.9%						
39	Upshur County*	86.5%						
40	Clay County*	86.2%						
41	Doddridge County*	85.8%						
42	Mingo County*	85.5%						
43	Marshall County*	85.1%						
44	Logan County*	84.8%						
45	Marion County*	84.4%						
46	Wyoming County*	84.0%						
47	Monongalia County*	83.7%						
48	Fayette County*	83.3%						
49	Summers County*	83.0%						
50	Pleasants County*	82.6%						
51	McDowell County*	82.3%						
52	Taylor County*	81.9%						
53	Brooke County*	81.6%						
54	Wheeling**	81.2%						
55	Parkersburg	80.9%						
56	Ohio County*	80.5%						
57	Huntington**	80.2%						

Colors:
Black --> Incorporated areas
Brown --> Unincorporated areas
Green --> Counties (Total)
Red --> Split communities

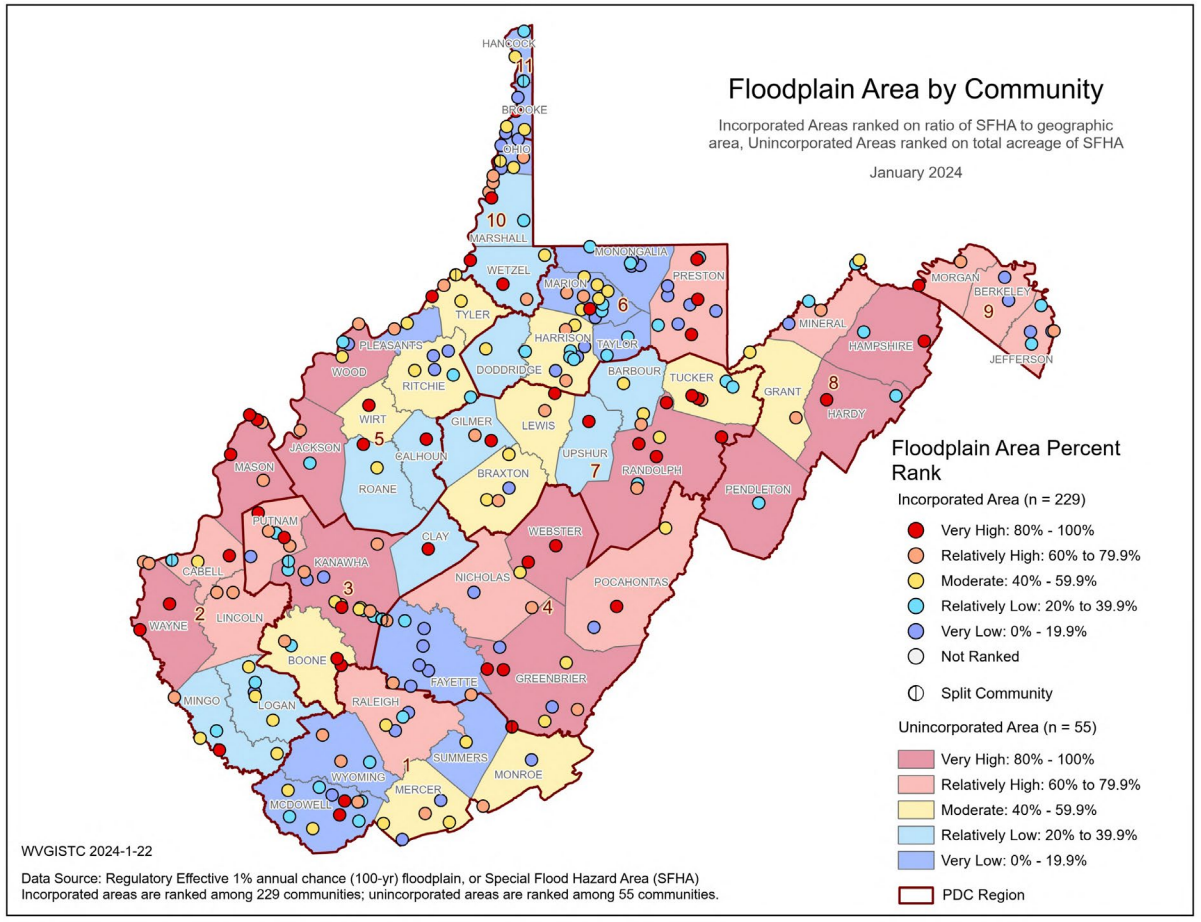


A WV Flood Tool Screenshot of the floodplains in Kanawha County (link)



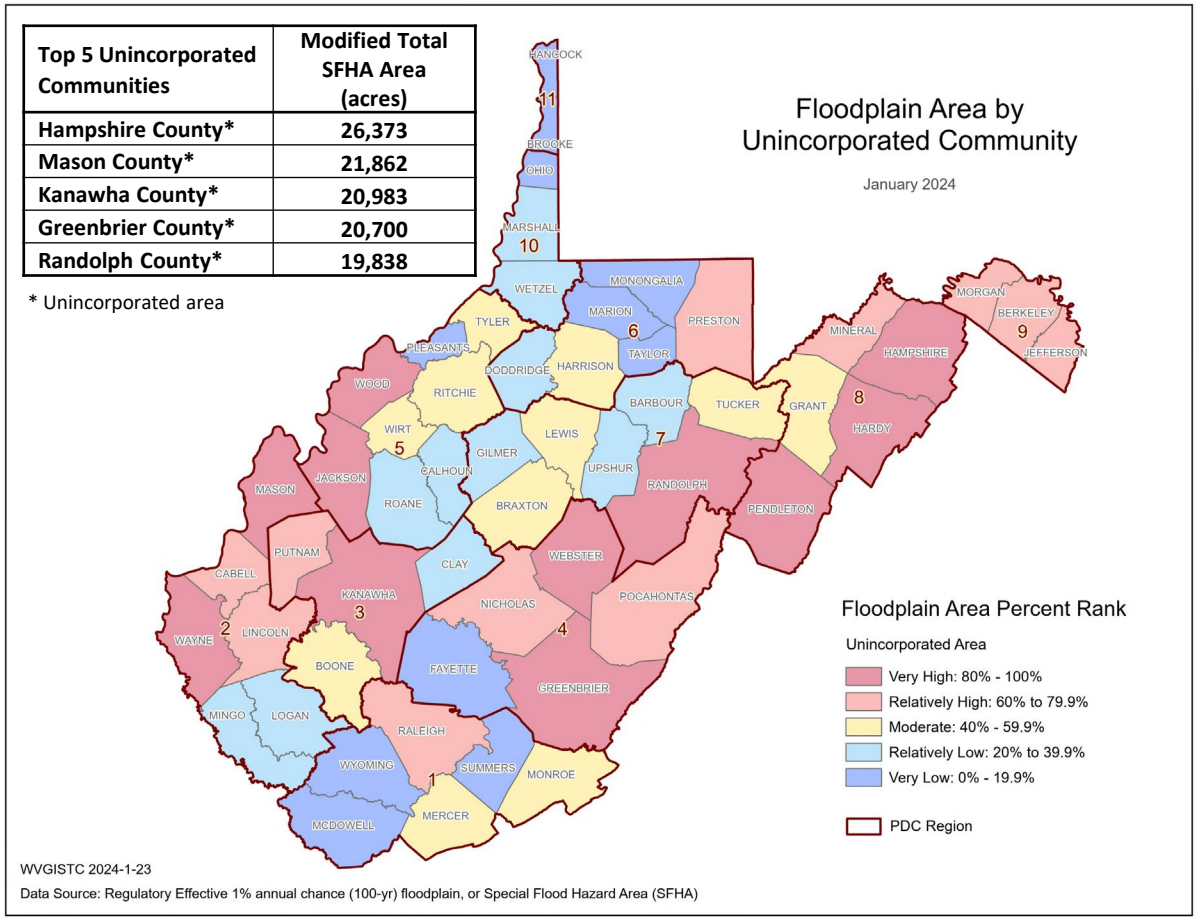
A WV Flood Tool Screenshot of the floodplains in Hampshire County (link)

Risk Factor Scores and Cumulative Index …



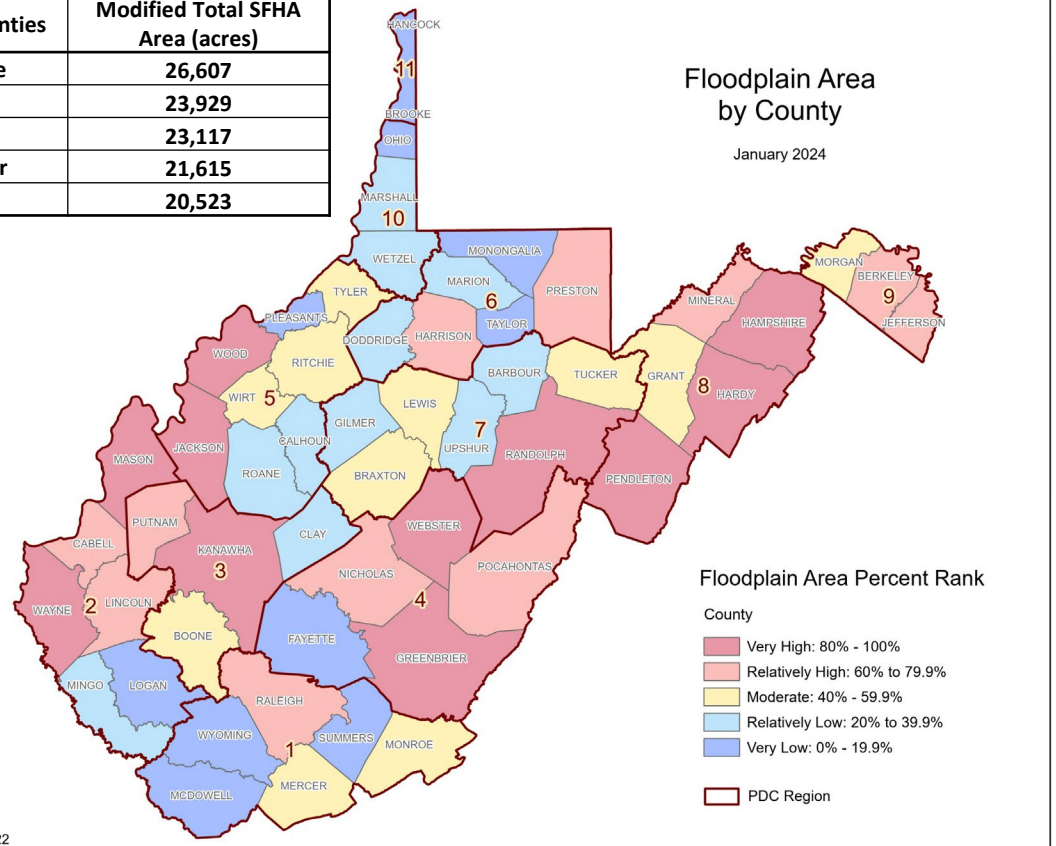
Top 5 Unincorporated Communities	Modified Total SFHA Area (acres)
Hampshire County*	26,373
Mason County*	21,862
Kanawha County*	20,983
Greenbrier County*	20,700
Randolph County*	19,838

* Unincorporated area



Risk Factor Scores and Cumulative Index …

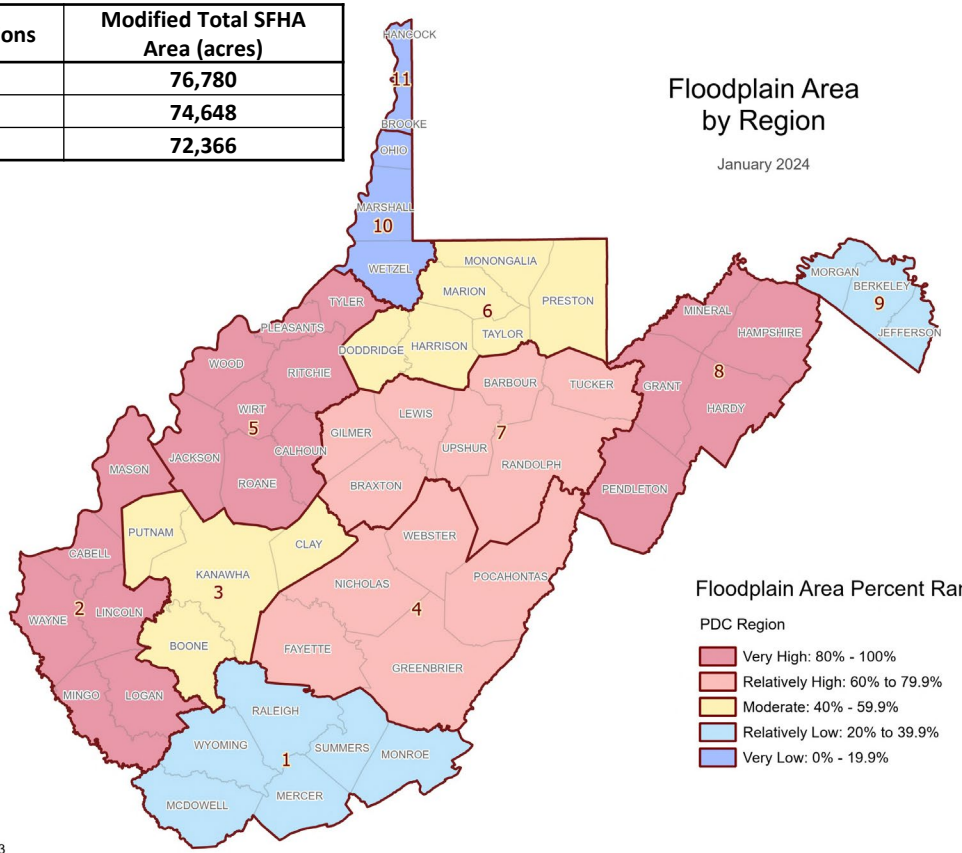
Top 5 Counties	Modified Total SFHA Area (acres)
Hampshire	26,607
Kanawha	23,929
Mason	23,117
Greenbrier	21,615
Randolph	20,523



WVGISTC 2024-1-22

Data Source: Regulatory Effective 1% annual chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA)

Top 3 Regions	Modified Total SFHA Area (acres)
5	76,780
8	74,648
2	72,366



WVGISTC 2024-1-23

Data Source: Regulatory Effective 1% annual chance (100-yr) floodplain, or Special Flood Hazard Area (SFHA)

Risk Factor Scores and Cumulative Index …

Indicator	White Sulphur Springs	Rainelle	Clendenin	Richwood	Marlinton	Camden-on-Gauley	Statewide Median
Total SFHA Area (acres)	267	223	235	247	494	35	77
Water Bodies > 10 acres & Wide Streams > 500 ft.	0	0	0	0	0	0	0
Federal Lands (> 10 acres)	0	0	0	0	0	0	0
Modified Total SFHA Area (acres) (Minus large water bodies and federal lands)	**267**	**223**	**235**	**247**	**494**	**35**	**74**
Total Community Area (acres)	1,214	714	974	1,068	1,566	214	559
Ratio of aSFHA to Community Area	**22.0%**	**31.2%**	**24.1%**	**23.1%**	**31.5%**	**16.4%**	13.8%
Floodplain Area Ratio Percent Rank	**74.2% (Relatively High)**	**87.7% (Very High)**	**78.6% (Relatively High)**	**77.7% (Relatively High)**	**89.0% (Very High)**	**58.5% (Moderate)**	-

Percent Rank Legend:

- **Very High: 80% to 100%** (**Red: 90% to 100%**)
- **Relatively High: 60% to 79.9%**
- **Moderate: 40% to 59.9%**
- **Relatively Low: 20% to 39.9%**
- **Very Low: 0% to 19.9%**

Risk Factor Scores and Cumulative Index …

Major Category	Detailed Category	Code	Indicator	Short Description	Unit
Flood Hazard Risk	Declared Disasters	**DCL_DSTR**	**Declared Flood Disasters**	Number of federally-declared flood disasters in the county since 1953	#

Rationale	Recommendations	Data Source
Previous disasters indicate potential for future risk. In addition, the recentness of a flood disaster has proven to increase communities' willingness to seek/accept change/mitigation. In West Virginia, many flood control structures (e.g., dams, levees, flood walls) built in the 20th Century have decreased the number of major flood disasters.	A major disaster declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work. Historical flooding including high water marks should be incorporated into communities' flood reduction efforts to include areas of mitigation interest.	Open FEMA

Risk Factor Scores and Cumulative Index …

Top 20% Ranking:

Name	RPDC Region	Federally-Declared Flood Disasters	Last Disaster Date	Percent Rank	Class
Mingo County	2	11	3/4/2021	100.0%	Very High
Lincoln County	2	10	3/4/2021	96.3%	Very High
Logan County	2	10	3/4/2021	96.3%	Very High
Wayne County	2	9	3/4/2021	92.6%	Very High
Greenbrier County	4	9	6/29/2016	92.6%	Very High
Kanawha County	3	8	3/4/2021	88.9%	Very High
Jackson County	5	8	6/29/2016	88.9%	Very High
Raleigh County	1	7	6/10/1996	81.5%	Very High
Wyoming County	1	7	6/29/2010	81.5%	Very High
Cabell County	2	7	3/4/2021	81.5%	Very High
Randolph County	7	7	6/30/2019	81.5%	Very High

Bottom 20% Ranking:

Clay County	3	3	6/29/2016	1.9%	Very Low
Pleasants County	5	3	4/15/2015	1.9%	Very Low
Wood County	5	3	3/15/1997	1.9%	Very Low
Taylor County	6	3	2/22/2000	1.9%	Very Low
Grant County	8	3	6/30/2019	1.9%	Very Low
Mineral County	8	3	2/2/1996	1.9%	Very Low
Berkeley County	9	3	2/2/1996	1.9%	Very Low
Jefferson County	9	3	2/2/1996	1.9%	Very Low
Morgan County	9	3	2/2/1996	1.9%	Very Low
Brooke County	11	3	4/11/2015	1.9%	Very Low
Hancock County	11	3	2/2/1996	1.9%	Very Low
Ritchie County	5	2	4/11/2015	0.0%	Very Low

Total federally-declared flood disasters in West Virginia: **32**

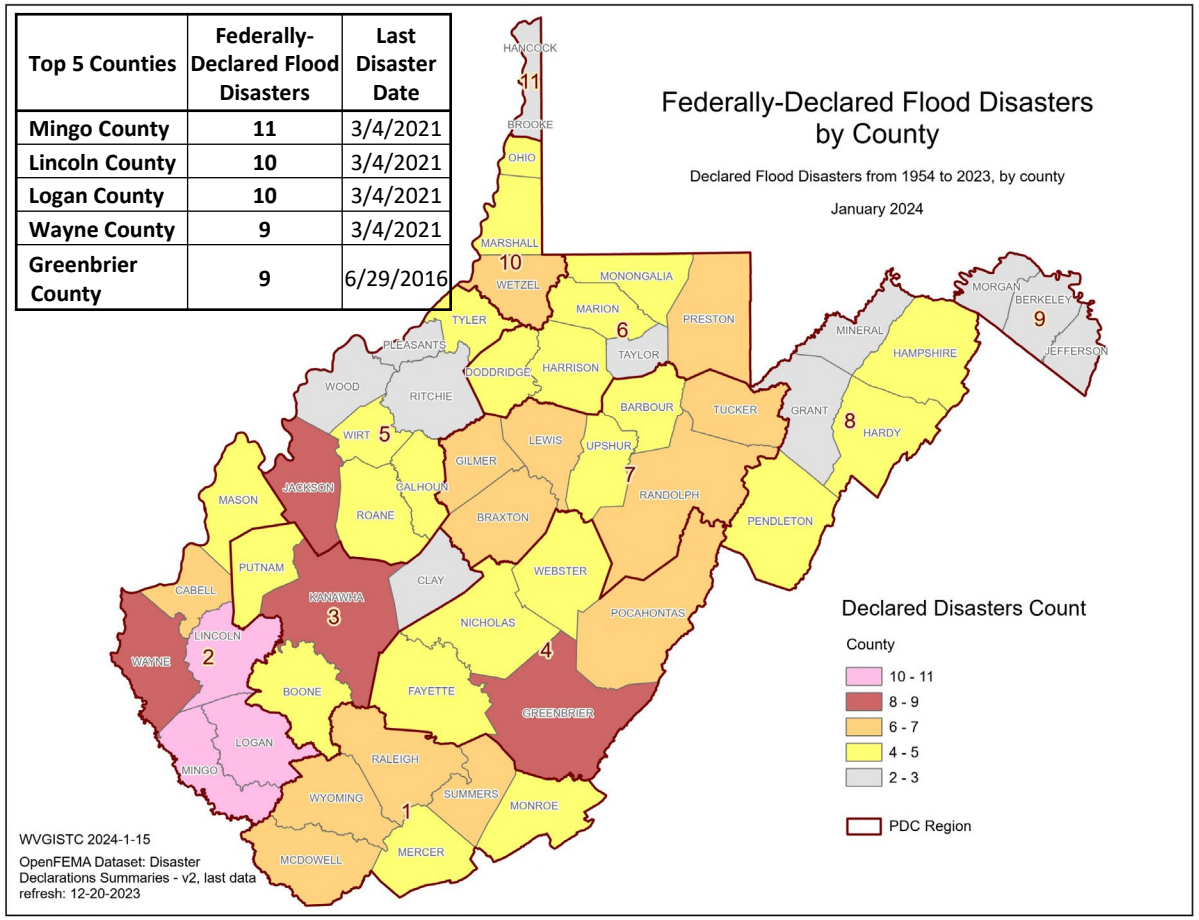
Total in USA: **880**

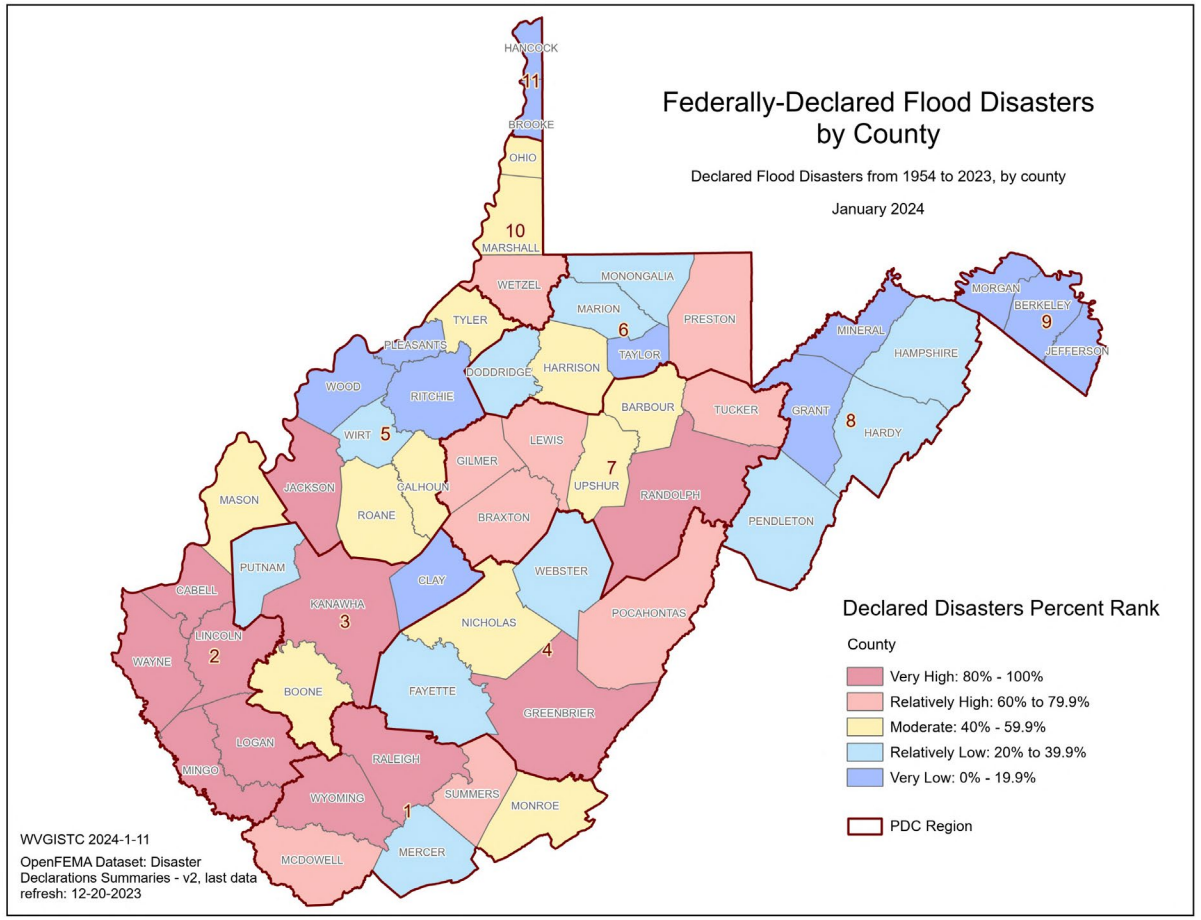
Scores Legend:

80 to 100	Very High	Red text: 90 to 100 Very High
60 to 79.9	Relatively High	
40 to 59.9	Moderate	
20 to 39.9	Relatively Low	
0 to 19.9	Very Low	

Risk Factor Scores and Cumulative Index …

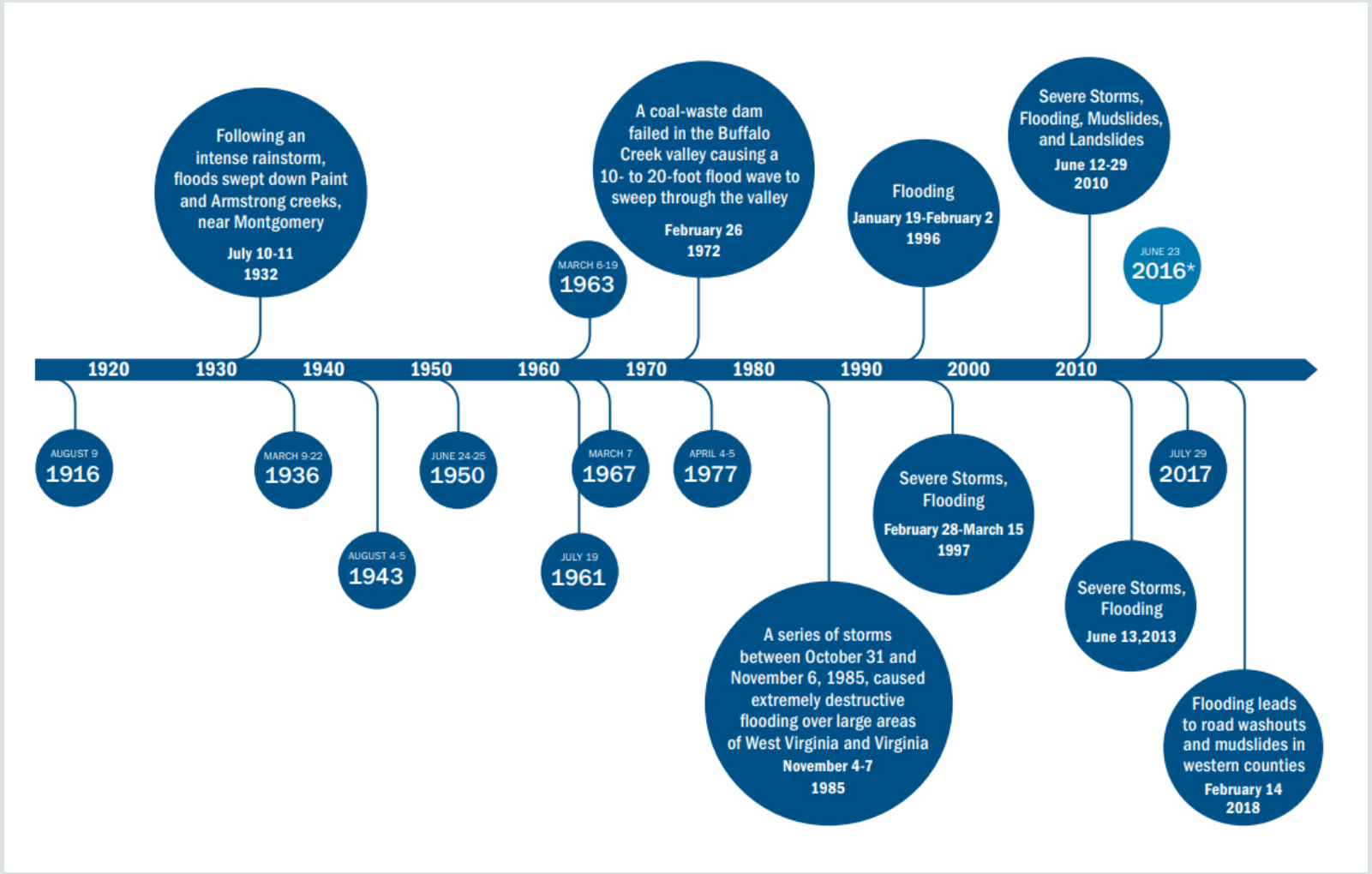
Top 5 Counties	Federally-Declared Flood Disasters	Last Disaster Date
Mingo County	11	3/4/2021
Lincoln County	10	3/4/2021
Logan County	10	3/4/2021
Wayne County	9	3/4/2021
Greenbrier County	9	6/29/2016





Risk Factor Scores and Cumulative Index …

Timeline of notable flood events in WV (1916 – 2018)



Qualitative Component

Source:
Federal Emergency Management Agency (FEMA). *Understanding flood dangers in central West Virginia: Lessons learned from the June 2016 flood.* https://www.fema.gov/sites/default/files/documents/Region_III_WV_FloodReport.pdf

Risk Factor Scores and Cumulative Index …

July 1961 (22 + 2 landslide fatalities)
Image: **Kanawha County** (Image link)

February 1972 (125 fatalities including 4 missing)
Image: **Huntington** (Image link)

November 1985 (47 fatalities in WV)
Image: **Moorefield** (Image link)

June 2016 (23 fatalities)
Image: **Rainelle** (Image link)

Fatalities data source: https://www.wvencyclopedia.org/assets/0003/4074/Deadliest_Floods_in_WestVirginia_History.pdf

Risk Factor Scores and Cumulative Index …

2) Structure Risk

Major Category	Detailed Category	Code	Indicator	Short Description	Unit
Structure Risk	Building Counts / Ratios	**BLDG_SFHA**	**Building Count in SFHA**	All primary insurable structures in the effective 100-year Floodplain or Special Flood Hazard Area (SFHA)	#

Rationale	Recommendations	Data Source
The higher number of buildings in the floodplain indicates higher physical and human exposure to riverine flooding. If a building owner has a mortgage from a federally regulated lender and the property is in the Special Flood Hazard Area, then the building owner is required by Federal law to carry flood insurance. The building count in the SFHA is a programming variable required for those communities participating in FEMA's Community Rating System (CRS) program.	Communities with a high floodplain building count should actively engage property owners about flood insurance and minimizing flood losses of property owners. See Floodsmart.gov for more information. Communities can become more resilient to flooding by exceeding the minimum NFIP requirements. Higher building standards adopted by local communities may include increasing the freeboard of the base flood elevation; or encourage property owners to build to the higher 500-year flood elevation or historical high-water mark. Floodplain managers and emergency planners should pre-load at-risk structures into substantial damage estimator software. Local officials should review early warning systems as well as short-term shelters located outside the floodplain and away from inundated roads. State and county leaders should prioritize pre-disaster planning for communities with many flood-prone buildings.	All political scales: FEMA Special Flood Hazard Area (SFHA) for effective 1%-Annual-Chance Floodplains; Watershed and Stream scales: Effective and Advisory Floodplains for 1% Annual-Chance event; BLRA

Risk Factor Scores and Cumulative Index …

Top 20% Rankings for Building Count in SFHA

RANK	All Communities	Percent_Rank	Incorporated Communities	Percent_Rank	Unincorporated Areas	Percent_Rank	Counties	Percent_Rank	Regions	Percent_Rank
1	Kanawha County*	100.0%	Wheeling**	100.0%	Kanawha County*	100.0%	KANAWHA	100.0%	3	100%
2	Logan County*	99.6%	Charleston	99.5%	Logan County*	98.1%	LOGAN	98.1%	2	90%
3	Wheeling**	99.2%	Dunbar	99.0%	Mingo County*	96.2%	OHIO	96.2%	1	80%
4	Mingo County*	98.8%	Wellsburg	98.5%	Boone County*	94.4%	BOONE	94.4%		
5	Boone County*	98.4%	New Martinsville	98.0%	Lincoln County*	92.5%	MINGO	92.5%		
6	Lincoln County*	98.1%	Huntington**	97.6%	Mercer County*	90.7%	CABELL	90.7%		
7	Mercer County*	97.7%	Buckhannon	97.1%	Raleigh County*	88.8%	MCDOWELL	88.8%		
8	Raleigh County*	97.3%	Milton	96.6%	Wayne County*	87.0%	WAYNE	87.0%		
9	Wayne County*	96.9%	Clarksburg	96.1%	Cabell County*	85.1%	LINCOLN	85.1%		
10	Cabell County*	96.6%	Marlinton	95.7%	Putnam County*	83.3%	MERCER	83.3%		
11	Charleston	96.2%	South Charleston	95.2%	Wood County*	81.4%	WOOD	81.4%		
12	Putnam County*	95.8%	Rainelle	94.7%						
13	Wood County*	95.4%	Weston	94.2%						
14	McDowell County*	95.1%	Moundsville	93.8%						
15	Wyoming County*	94.7%	Welch	93.3%						
16	Randolph County*	94.3%	Benwood	92.8%						
17	Hampshire County*	93.9%	Vienna	92.3%						
18	Dunbar	93.6%	White Sulphur Springs	91.4%						
19	Mason County*	93.2%	Clendenin	91.4%						
20	Marion County*	92.8%	Buffalo	90.9%						
21	Greenbrier County*	92.4%	Parkersburg	90.4%						
22	Fayette County*	92.1%	Madison	90.0%						
23	Clay County*	91.7%	Gary	89.5%						
24	Wetzel County*	91.3%	Keyser	89.0%						
25	Jackson County*	90.9%	Richwood	88.5%						
26	Webster County*	90.6%	Philippi	88.0%						
27	Harrison County*	90.2%	Parsons	87.6%						
28	Wellsburg	89.8%	Princeton	87.1%						
29	New Martinsville	89.4%	Elkins	86.6%						
30	Summers County*	89.0%	Wayne	86.1%						
31	Huntington**	88.7%	Spencer	85.7%						
32	Monongalia County*	88.3%	Hartford	85.2%						
33	Braxton County*	87.9%	Mannington	84.7%						
34	Doddridge County*	87.5%	Chesapeake	84.2%						
35	Lewis County*	87.2%	St. Albans	83.8%						
36	Nicholas County*	86.8%	Oceana	83.3%						
37	Upshur County*	86.4%	Alderson**	82.8%						
38	Marshall County*	86.0%	New Cumberland	82.3%						
39	Roane County*	85.7%	Morgantown	81.9%						
40	Mineral County*	85.3%	Weirton**	81.4%						
41	Buckhannon	84.9%	Man	80.9%						
42	Tyler County*	84.5%	Ravenswood	80.4%						
43	Berkeley County*	84.2%	Bridgeport	80.0%						
44	Jefferson County*	83.8%								
45	Calhoun County*	83.4%								
46	Wirt County*	83.0%								
47	Morgan County*	82.7%								
48	Milton	82.3%								
49	Pocahontas County*	81.9%								
50	Clarksburg	81.5%								
51	Preston County*	81.2%								
52	Hardy County*	80.8%								
53	Marlinton	80.0%								
54	Monroe County*	80.0%								

Colors:

Black --> Incorporated areas

Brown --> Unincorporated areas

Green --> Counties (Total)

Red --> Split communities

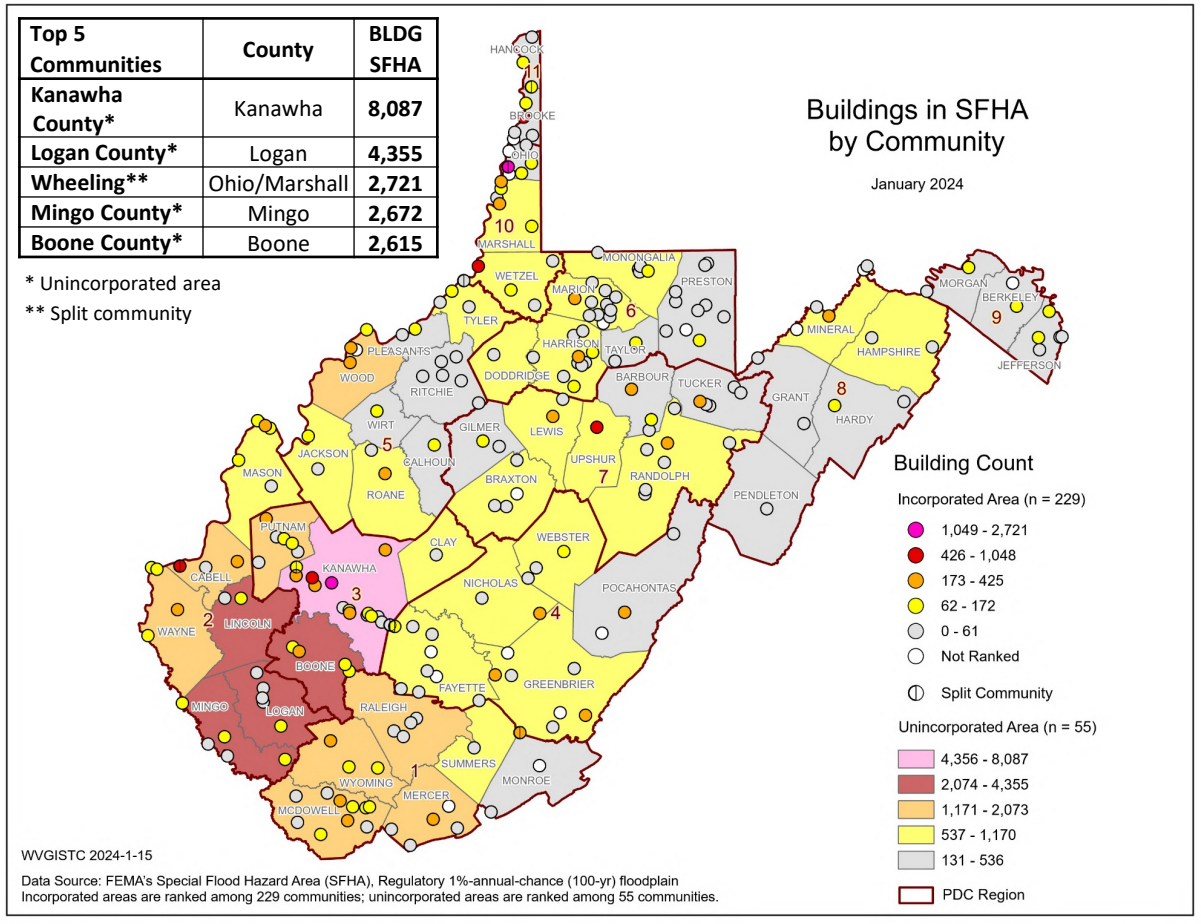
Black on blue: Six incorporated communities included in the detailed risk study (Camden-on-Gauley, Clendenin, Rainelle, Richwood, White Sulphur Springs, and Marlinton)

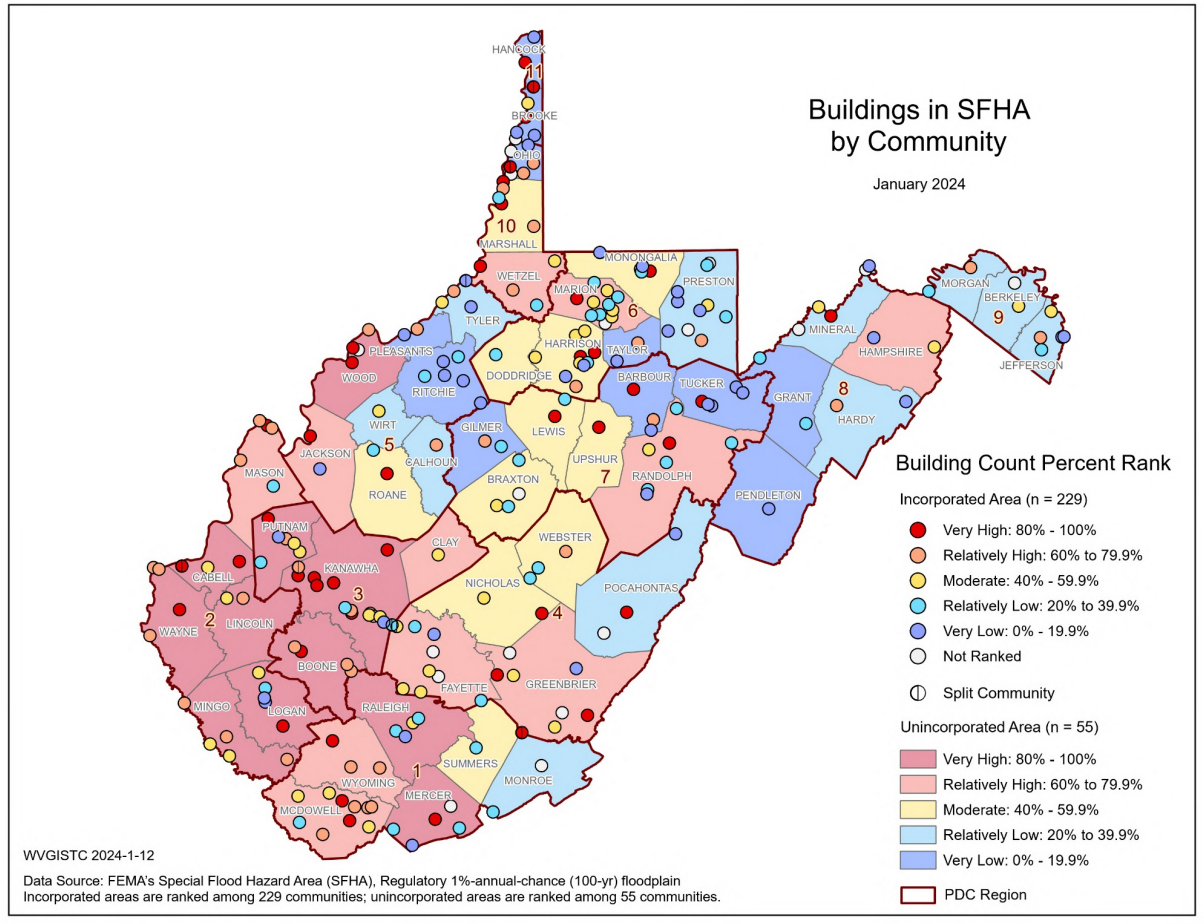
Risk Factor Scores and Cumulative Index …

Top 5 Communities	County	BLDG SFHA
Kanawha County*	Kanawha	**8,087**
Logan County*	Logan	**4,355**
Wheeling**	Ohio/Marshall	**2,721**
Mingo County*	Mingo	**2,672**
Boone County*	Boone	**2,615**

* Unincorporated area

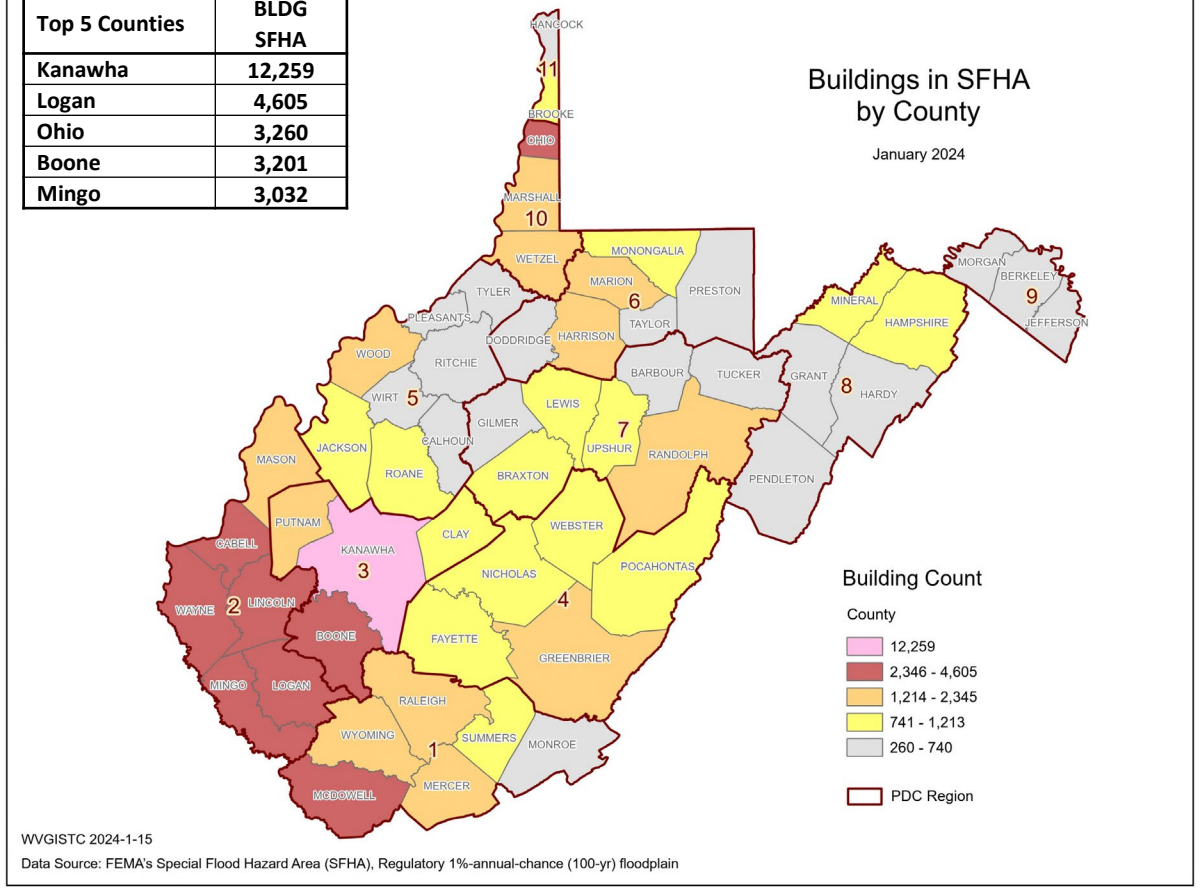
** Split community





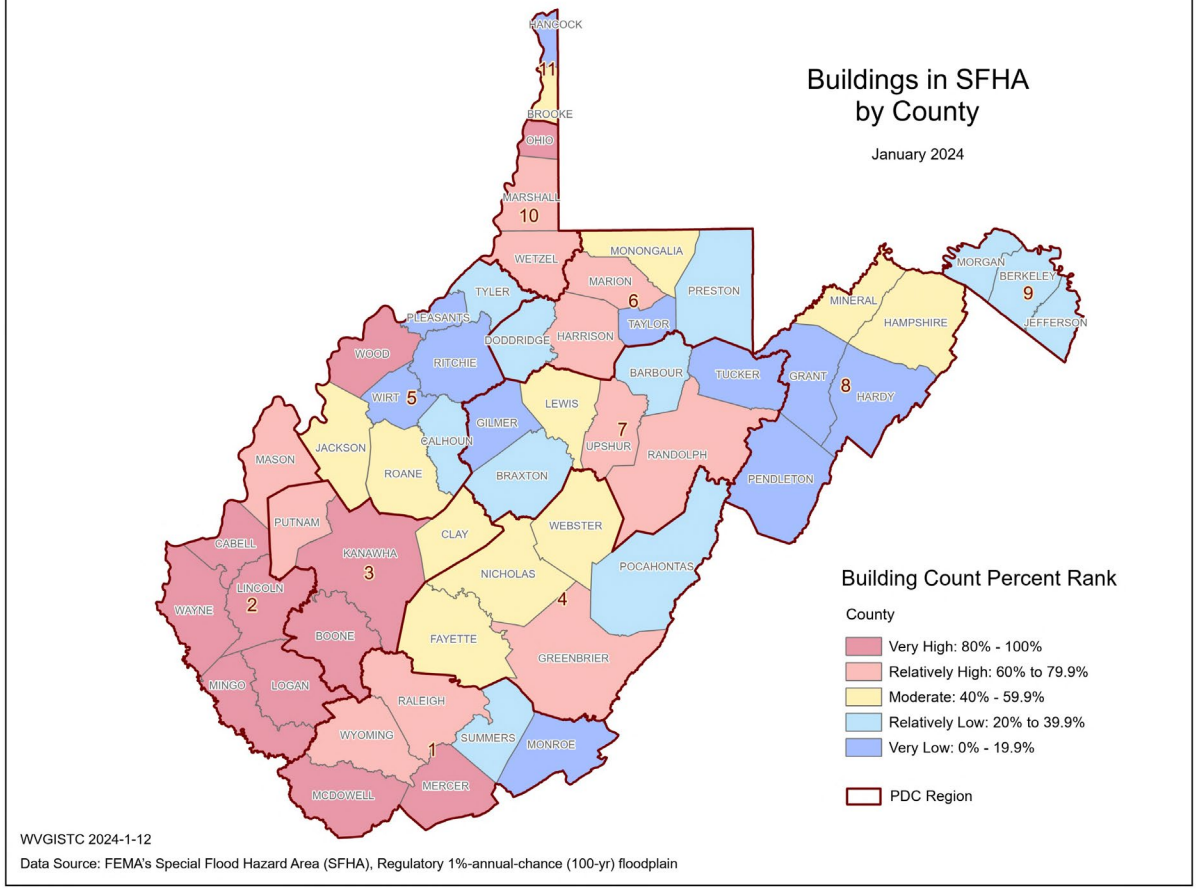
Risk Factor Scores and Cumulative Index …

Top 5 Counties	BLDG SFHA
Kanawha	12,259
Logan	4,605
Ohio	3,260
Boone	3,201
Mingo	3,032



WVGISTC 2024-1-15

Data Source: FEMA's Special Flood Hazard Area (SFHA), Regulatory 1%-annual-chance (100-yr) floodplain

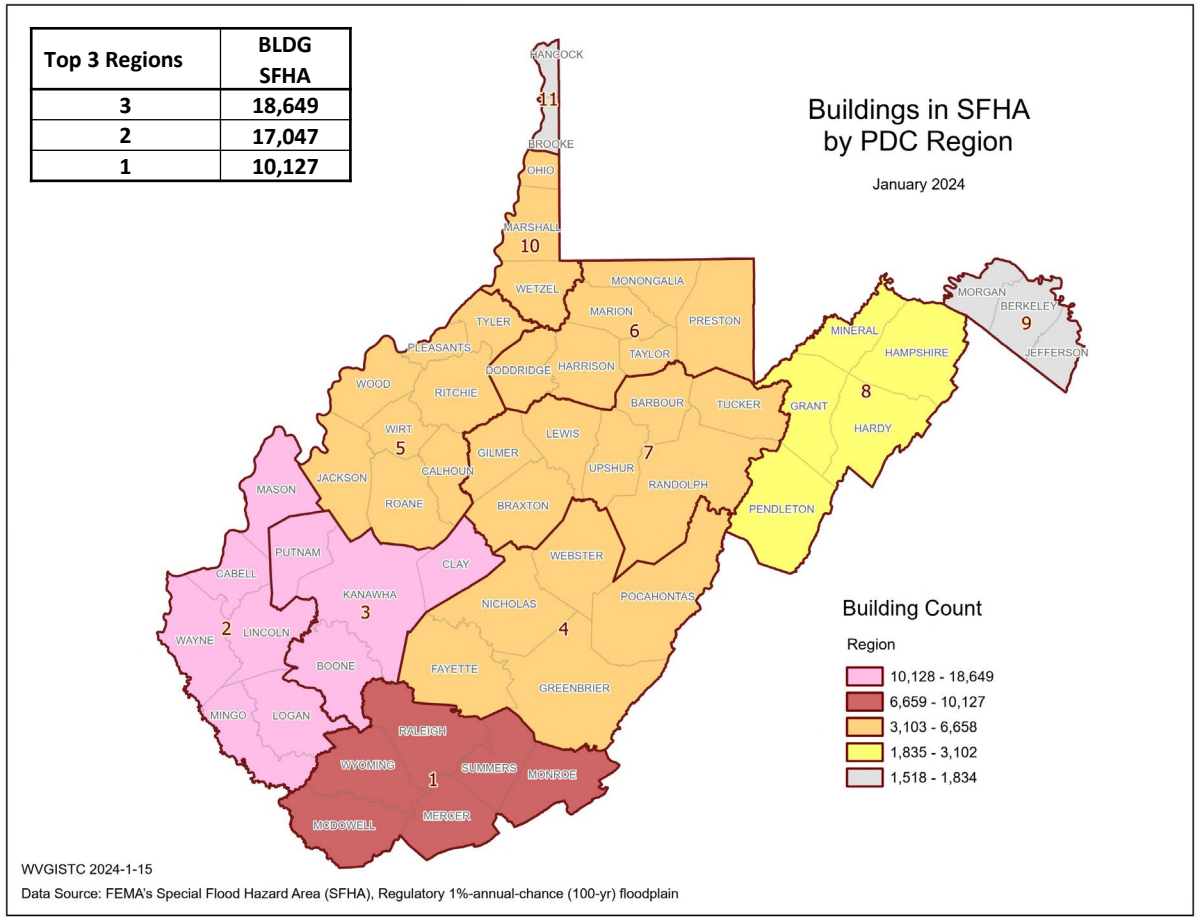


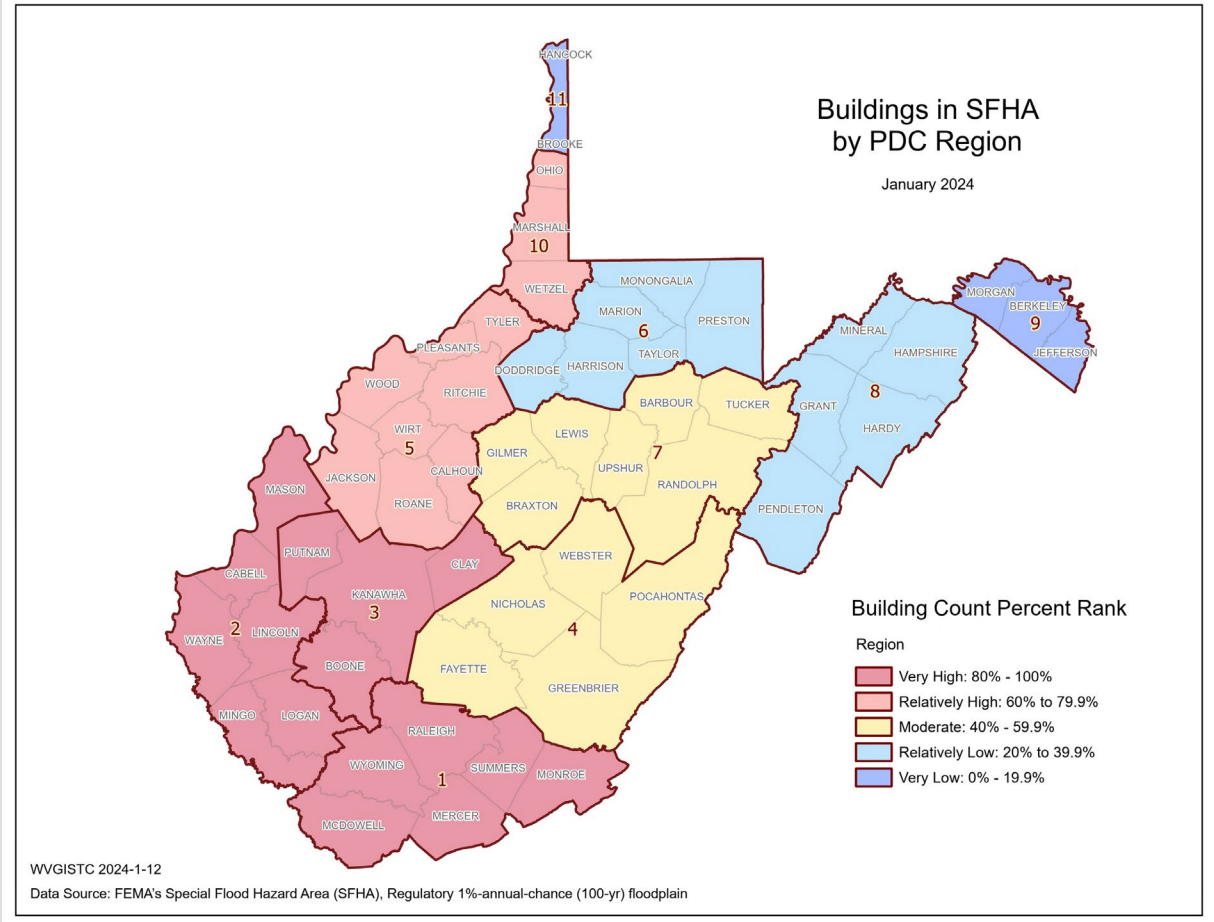
WVGISTC 2024-1-12

Data Source: FEMA's Special Flood Hazard Area (SFHA), Regulatory 1%-annual-chance (100-yr) floodplain

Risk Factor Scores and Cumulative Index …

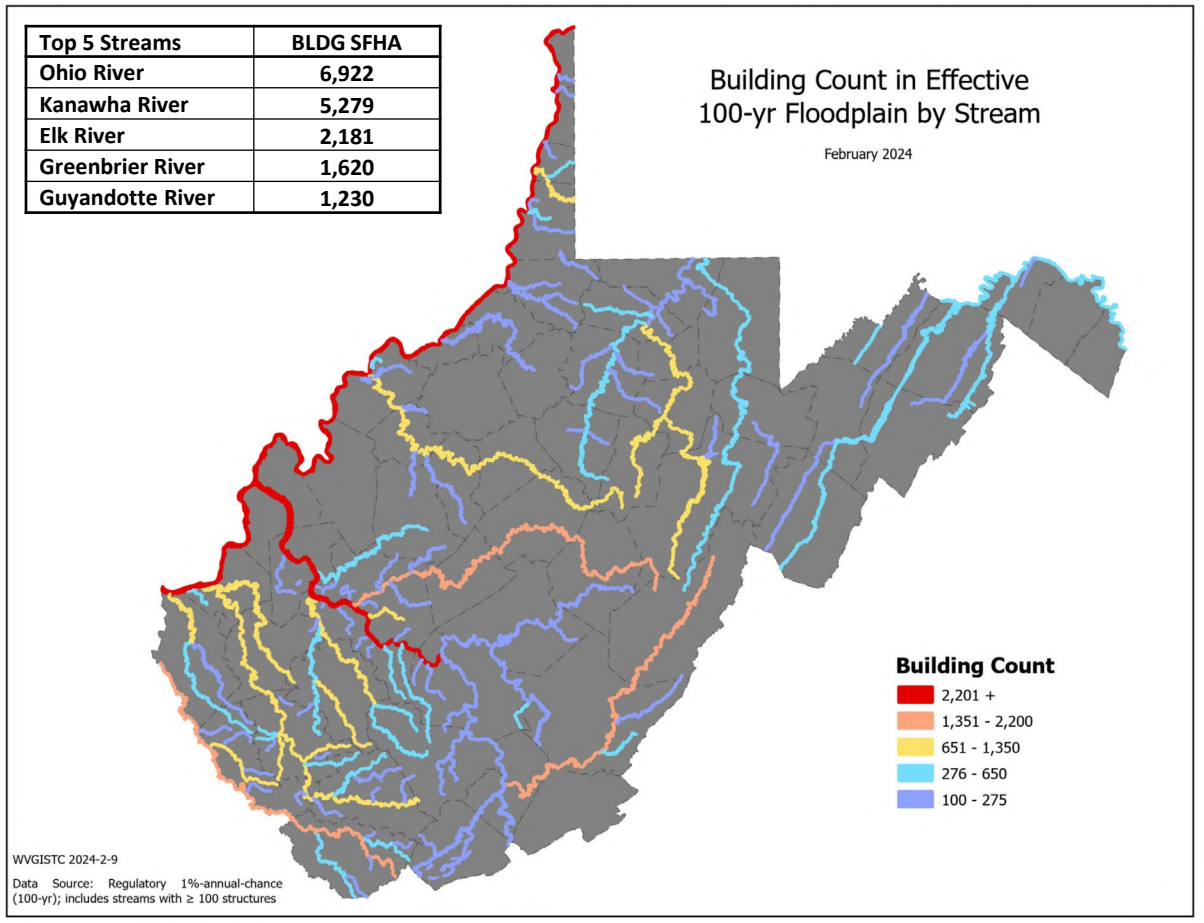
Top 3 Regions	BLDG SFHA
3	18,649
2	17,047
1	10,127

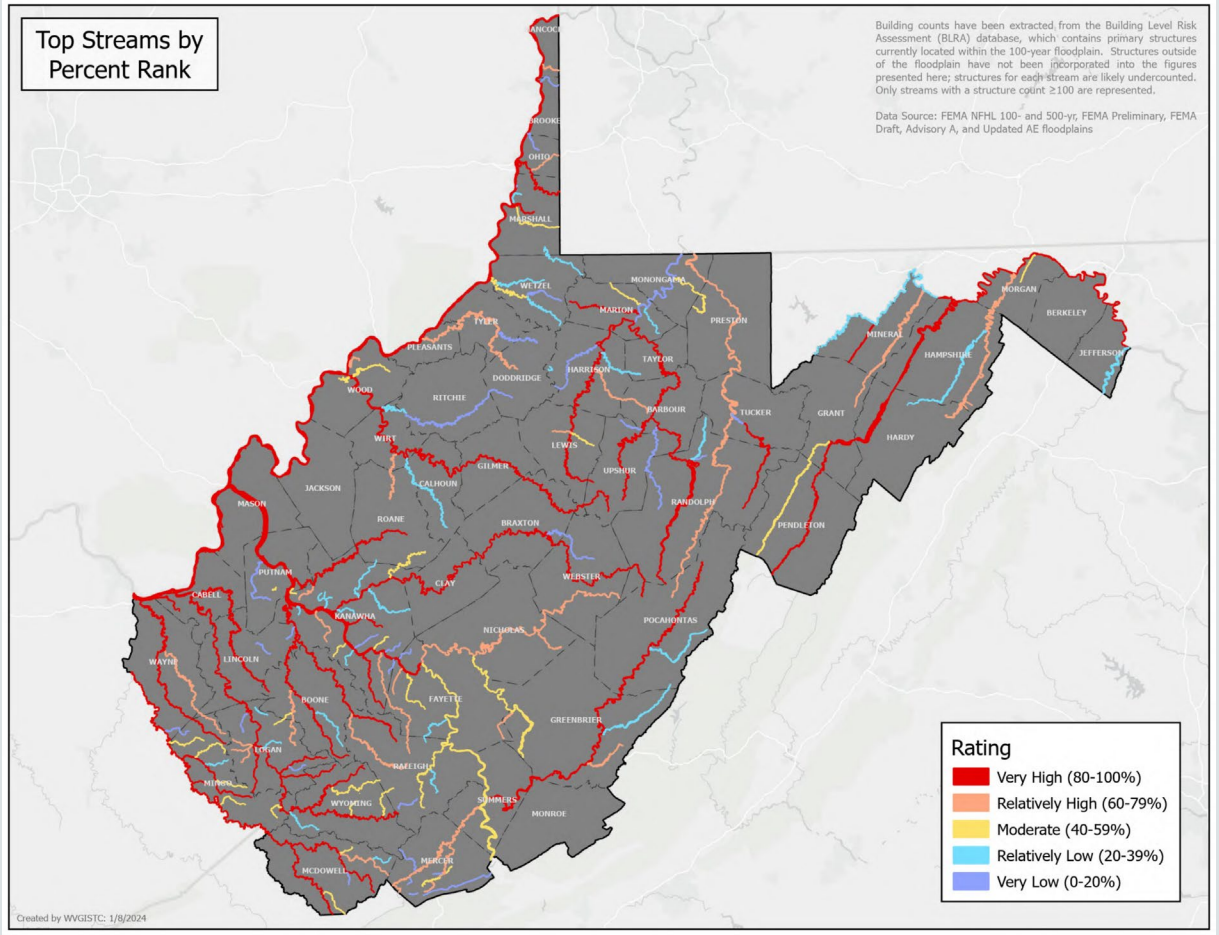




Risk Factor Scores and Cumulative Index …

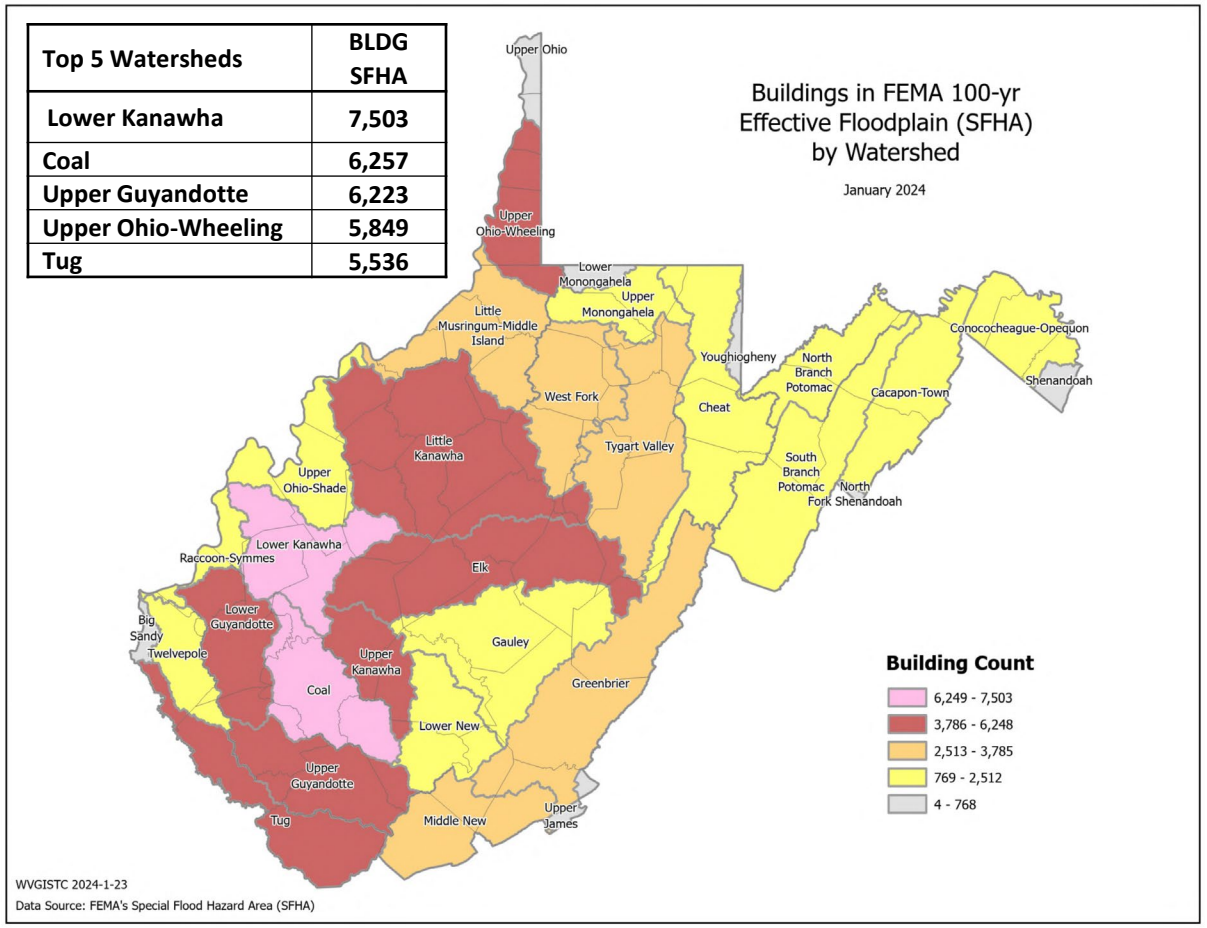
Top 5 Streams	BLDG SFHA
Ohio River	6,922
Kanawha River	5,279
Elk River	2,181
Greenbrier River	1,620
Guyandotte River	1,230

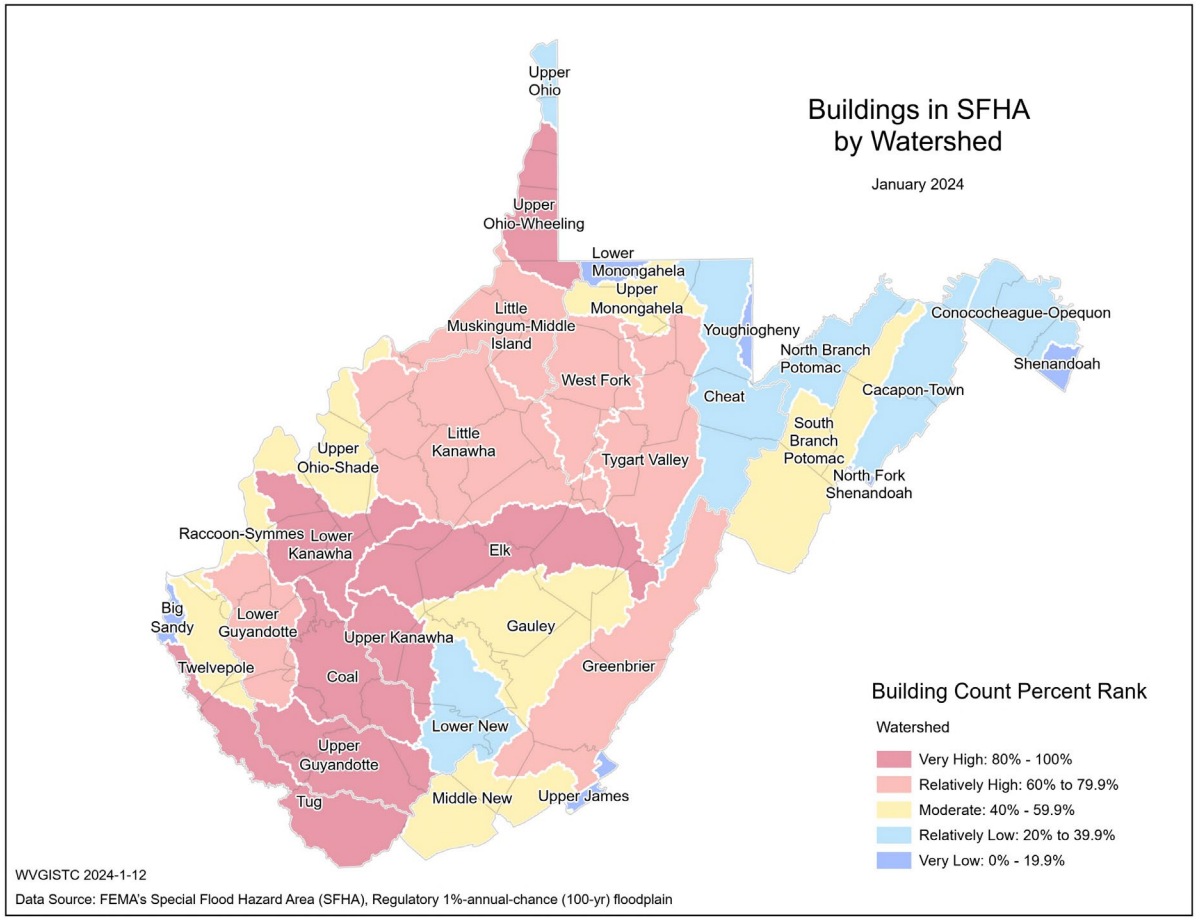




Risk Factor Scores and Cumulative Index …

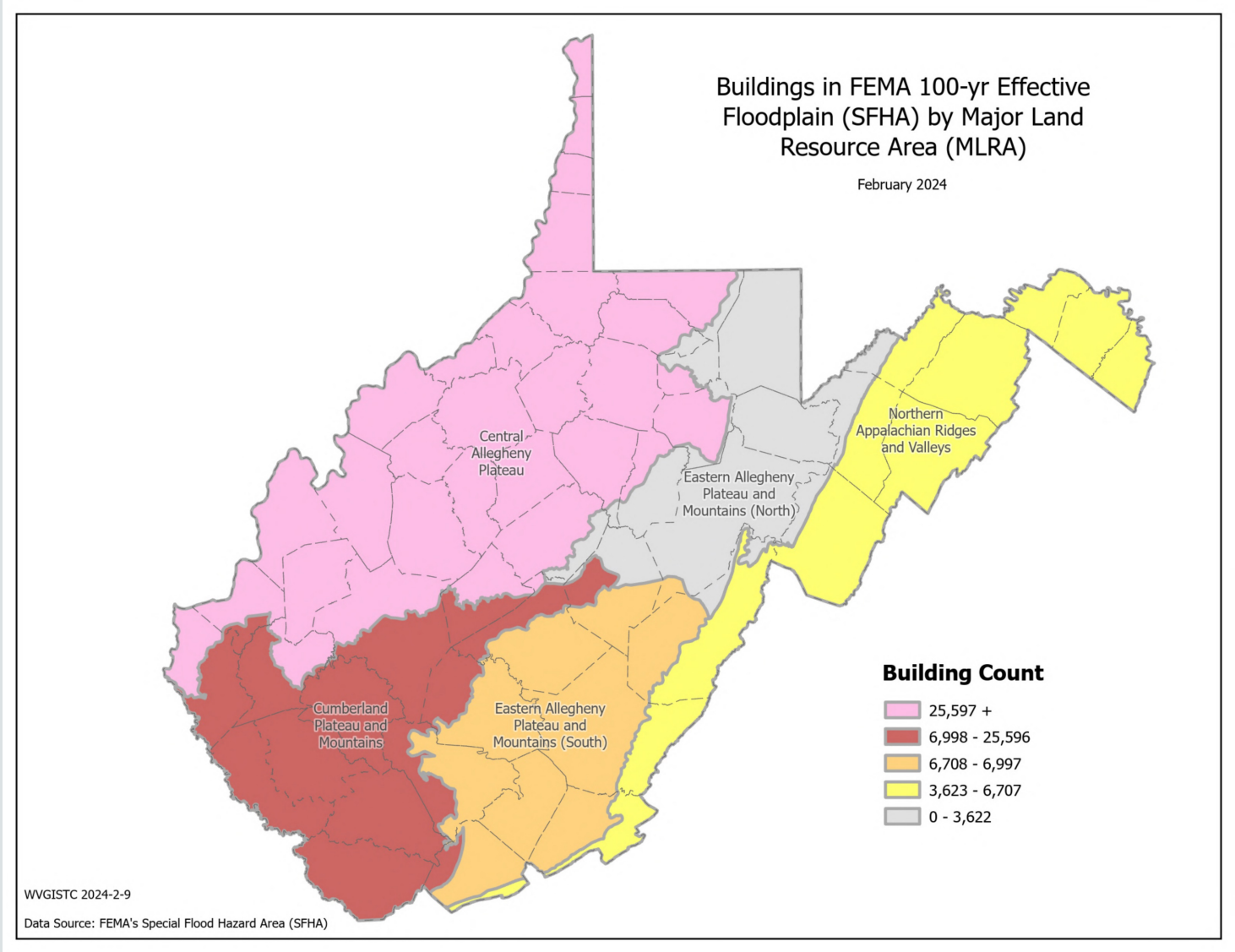
Top 5 Watersheds	BLDG SFHA
Lower Kanawha	7,503
Coal	6,257
Upper Guyandotte	6,223
Upper Ohio-Wheeling	5,849
Tug	5,536





Risk Factor Scores and Cumulative Index …

Building Counts in SFHA and Physiographic Provinces
NRCS Major Land Resource Areas (MLRAs)



Complementary Analyses

Source: https://www.nrcs.usda.gov/sites/default/files/2022-10/AgHandbook296_text_low-res.pdf

Risk Factor Scores and Cumulative Index …

Indicator	White Sulphur Springs	Rainelle	Clendenin	Richwood	Marlinton	Camden-on-Gauley	Statewide Median
Count in Approx. A	0	0	0	0	68	4	0
Count in AE	219	293	301	137	275	17	32
Count in AE Floodway	83	43	1	124	14	0	0
Count in AO	0	0	0	0	0	0	0
Count in AH	0	0	0	0	0	0	0
Count in Detailed Sum	302	336	302	261	289	17	39
Building Count in SFHA	**302**	**336**	**302**	**261**	**357**	**21**	49
Building Count in SFHA Percent Ranks	**91.4% (Very High)**	**94.7% (Very High)**	**91.4% (Very High)**	**88.5% (Very High)**	**95.7% (Very High)**	**23.8% (Relatively Low)**	-

Clendenin, June 2016 (Image link)

Rainelle, June 2016 (Image link)

Percent Rank Legend:

Very High: 80% to 100%
Red: 90% to 100%

Relatively High: 60% to 79.9%

Moderate: 40% to 59.9%

Relatively Low: 20% to 39.9%

Very Low: 0% to 19.9%

Risk Factor Scores and Cumulative Index …

3) People/Social Risk

Major Category	Detailed Category	Code	Indicator	Short Description	Unit
People/ Social Risk	Social Vulnerability	**WV_SVI**	**WV Social Vulnerability Index**	Social vulnerability index developed for West Virginia based on eight socioeconomic and demographic indicators	%

Rationale	Recommendations	Data Source
A community with a higher social vulnerability is less likely to be able to recover from a flood disaster quickly and fully. The WV Socioeconomic Index is a combination of eight social and economic indicators to measure a population's vulnerability to flood hazards. The select indicators are economic factors (Poverty Rate Unemployment Rate), population characteristics (Vulnerable Ages Rate, Disability Rate, Population without a High School Diploma, Population Change), and housing (Median Housing Unit Value, Mobile Homes as Percentage of Housing).	Flood disaster planning and preparedness should evaluate socioeconomic and individual factors such as age, disability, education, employment, and housing can influence the risk of flood deaths and damage loss. Source: NIH. A wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work, are available for disadvantaged populations and communities.	Census Bureau's American Community Survey (ACS) 5-year estimate of 2021; Census Bureau's Decennial Census (DEC) of 2010 & 2020 (For population change)

Risk Factor Scores and Cumulative Index …

Vulnerability Indicator	Description	Rationale	Data Source
Poverty Rate	Percentage of households with incomes below poverty level	The poor are less likely to have the income or assets needed to prepare for a possible disaster or to recover after it occurs (Cutter et al., 2003; Flanagan et al., 2011; Morrow, 1999; Thomas, 2017).	Census 2021 ACS 5-Year Estimates
Unemployment Rate	Percentage of families (two or more people residing together and related by birth, marriage, or adoption) with no workers in the past 12 months (from 2021)	In addition to income problems, unemployed persons lack benefit plans providing health cost assistance when injuries or deaths occur due to disasters (Brodie et al., 2006; Flanagan et al., 2011).	Census 2021 ACS 5-Year Estimates
Vulnerable Ages Ratio	Percentage of population in two groups of "younger than 15" or "65 and older"	Children and the elderly are generally more vulnerable to disasters such as flooding due to the lack of experience or physical and cognitive limitations to protect themselves (Cutter et al., 2003; Flanagan et al., 2011; Morrow, 1999).	Census 2021 ACS 5-Year Estimates
Disability Ratio	Percentage of civilian noninstitutionalized population with disabilities of independent living, self-care, ambulatory, cognitive, vision, or hearing difficulties	Disabled people are more vulnerable to natural hazards such as flooding and may require special assistance to evacuate (Cutter et al., 2003; Flanagan et al., 2011; Morrow, 1999).	Census 2021 ACS 5-Year Estimates
No High School Diploma Ratio	Percentage of population 25 years and older with no high school diploma	Highly educated individuals and societies are reported to have better preparedness and response to disasters, suffered lower negative impacts, and can recover faster (Muttarak & Lutz, 2014).	Census 2021 ACS 5-Year Estimates
Population Growth Ratio	Percentage of population change from 2010 to 2020	Although rapid population growth in dense urban areas can contribute to the risk (Cutter et al., 2003) we believe population decrease can be a factor of social vulnerability in WV communities.	Decennial Census (DEC) of 2010 & 2020
Housing Median Value	Median dollar values of owner-occupied residential units	The value can be an indicator of building quality. Buildings of low quality cannot withstand flooding adequately and are more vulnerable. Residents in communities with higher median housing values may be more likely to carry flood insurance policies, as their properties represent substantial investments. This can enhance financial preparedness and resilience (Flanagan et al., 2011; Morrow, 1999; Thieken et al., 2008).	Census 2021 ACS 5-Year Estimates
Mobile Homes Ratio	Percentage of manufactured homes in the whole community	Light-weight manufactured homes are not designed for withstanding floods and are more vulnerable to flood damage. Communities with a higher prevalence of manufactured homes often encounter more obstacles in achieving resilience, as these structures typically do not offer the same level of security as traditionally constructed homes. Moreover, these homes are often situated in regions beyond the urban core, where access to major roadways and public transit systems may be less available.	Census 2021 ACS 5-Year Estimates

Risk Factor Scores and Cumulative Index …

Top 20% Rankings for WV Social Vulnerability index

RANK	All Communities	INDEX_SC	Incorporated Communities	INDEX_SC	Unincorporated Areas	INDEX_SC	Counties	INDEX_SC	Regions	INDEX_SC
1	Anawalt	100.0%	Anawalt	100.0%	McDowell County*	100.0%	McDowell County, West Virginia	100.0%	1	100%
2	War	99.6%	War	99.6%	Wyoming County*	98.1%	Wyoming County, West Virginia	98.1%	4	90%
3	McDowell County*	99.3%	Smithfield	99.1%	Mingo County*	96.3%	Mingo County, West Virginia	96.3%	2	80%
4	Smithfield	98.9%	Auburn	98.7%	Webster County*	94.4%	Clay County, West Virginia	94.4%		
5	Lester	98.6%	Lester	98.2%	Clay County*	92.6%	Webster County, West Virginia	92.6%		
6	Auburn	98.2%	Reedy	97.8%	Braxton County*	90.7%	Calhoun County, West Virginia	90.7%		
7	Reedy	97.9%	Matewan	97.4%	Logan County*	88.9%	Logan County, West Virginia	88.9%		
8	Matewan	97.5%	Clay	96.9%	Calhoun County*	87.0%	Braxton County, West Virginia	87.0%		
9	Wyoming County*	97.2%	Pax	96.5%	Boone County*	85.2%	Ritchie County, West Virginia	85.2%		
10	Mingo County*	96.8%	Delbarton	96.0%	Lincoln County*	83.3%	Lincoln County, West Virginia	83.3%		
11	Delbarton	96.5%	Keystone	95.6%	Roane County*	81.5%	Roane County, West Virginia	81.5%		
12	Clay	96.1%	Fort Gay	95.2%						
13	Fort Gay	95.7%	Northfork	94.7%						
14	Pax	95.4%	Quinwood	94.3%						
15	Keystone	95.0%	Iaeger	93.8%						
16	Northfork	94.7%	Harman	93.4%						
17	Quinwood	94.3%	Cowen	93.0%						
18	Iaeger	94.0%	Richwood	92.5%						
19	Webster County*	93.6%	Elizabeth	92.1%						
20	Harman	93.3%	Cameron	91.6%						
21	Richwood	92.9%	Grantsville	91.2%						
22	Logan County*	92.6%	Gary	90.7%						
23	Cowen	92.2%	Junior	90.3%						
24	Cameron	91.8%	Oceana	89.9%						
25	Clay County*	91.5%	West Hamlin	89.4%						
26	Grantsville	91.1%	Bradshaw	89.0%						
27	Elizabeth	90.8%	Anmoore	88.5%						
28	Oceana	90.4%	Kermit	88.1%						
29	Sophia	90.1%	Sophia	87.7%						
30	West Hamlin	89.7%	Gilbert	87.2%						
31	Gary	89.4%	Chesapeake	86.8%						
32	Braxton County*	89.0%	Hillsboro	86.3%						
33	Kermit	88.7%	Harrisville	85.9%						
34	Junior	88.3%	Danville	85.5%						
35	Calhoun County*	87.9%	Spencer	85.0%						
36	Hillsboro	87.6%	Rainelle	84.6%						
37	Gilbert	87.2%	Bramwell	84.1%						
38	Bradshaw	86.9%	Pennsboro	83.7%						
39	Anmoore	86.5%	Cairo	83.3%						
40	Spencer	86.2%	Womelsdorf (Coalton)	82.8%						
41	Chesapeake	85.8%	Pineville	82.4%						
42	Harrisville	85.5%	Hartford	81.9%						
43	Boone County*	85.1%	Hinton	81.5%						
44	Danville	84.8%	Rowlesburg	81.1%						
45	Pennsboro	84.4%	Ansted	80.6%						
46	Womelsdorf (Coalton)	84.0%	Alderson**	80.2%						
47	Pineville	83.7%								
48	Hartford	83.3%								
49	Rowlesburg	83.0%								
50	Hinton	82.6%								
51	Bramwell	82.3%								
52	Alderson**	81.9%								
53	Lincoln County*	81.6%								
54	Rainelle	81.2%								
55	Sutton	80.9%								
56	Davy	80.5%								
57	Beverly	80.1%								

Colors:

Black --> Incorporated areas

Brown --> Unincorporated areas

Green --> Counties (Total)

Red --> Split communities

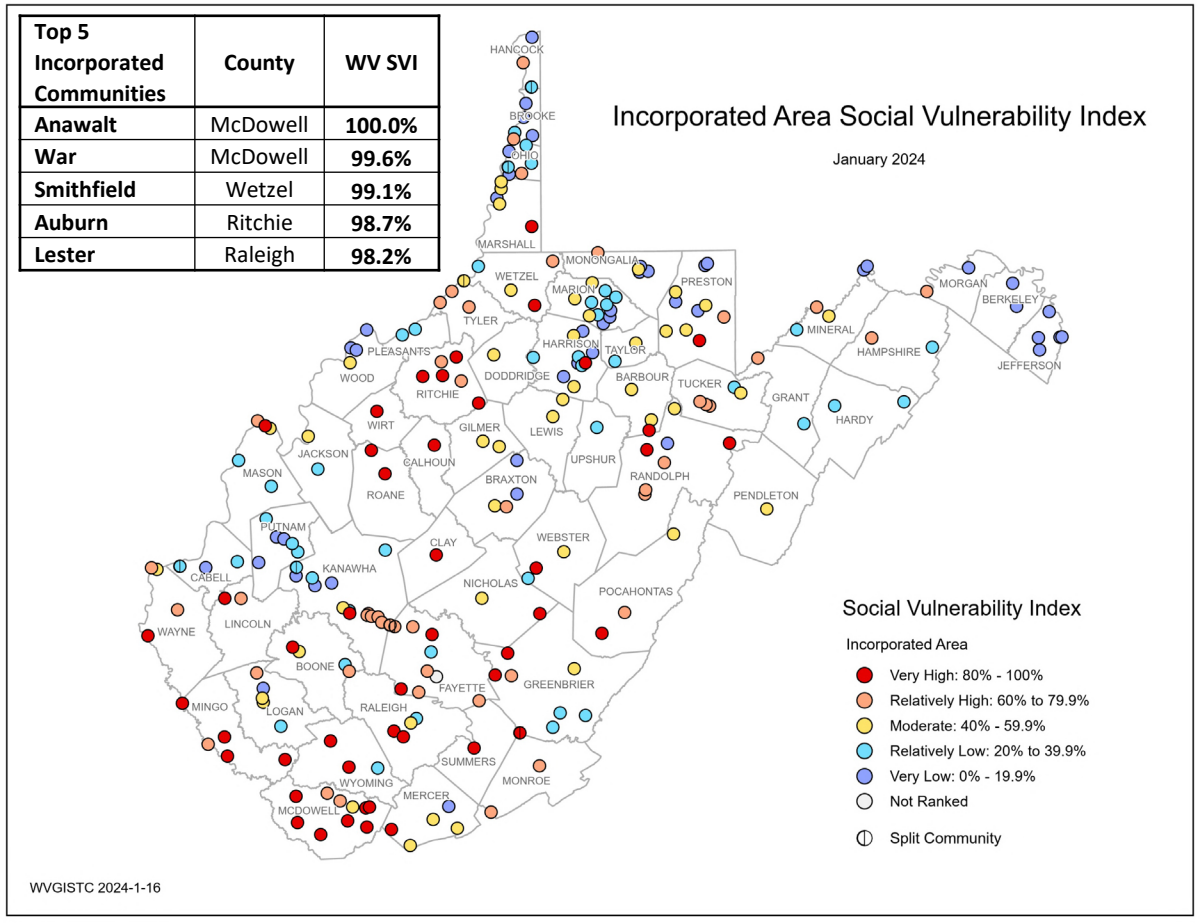
Blue --> Incorporated communities participating in the National Flood Insurance Program (NFIP) with no regulatory Special Flood Hazard Area (SFHA)

Purple --> Incorporated communities with no regulatory Special Flood Hazard Area (SFHA) not participating in the National Flood Insurance Program (NFIP) (not mentioned in the FEMA's Community Status Book Report)

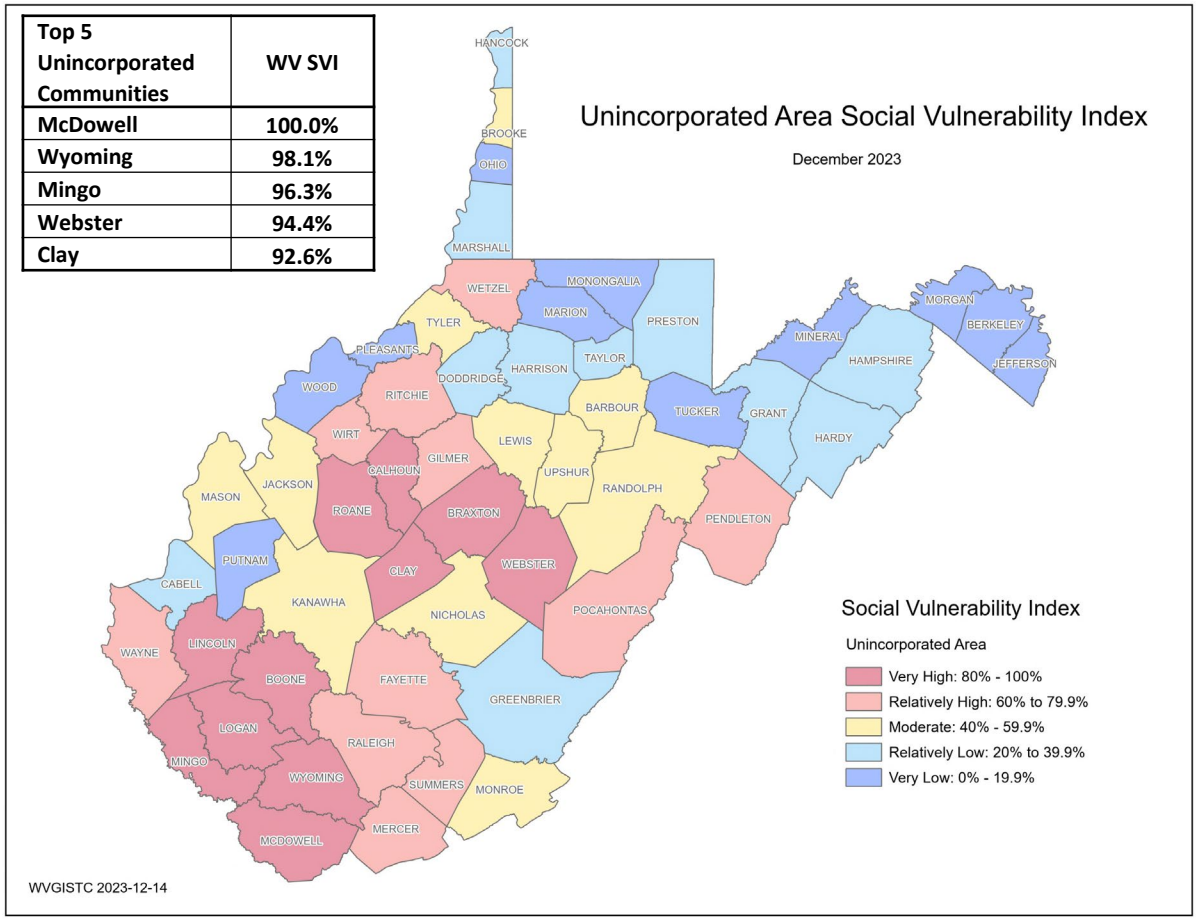
Black on blue: Six incorporated communities included in the detailed risk study (Camden-on-Gauley, Clendenin, Rainelle, Richwood, White Sulphur Springs, and Marlinton)

Risk Factor Scores and Cumulative Index …

Top 5 Incorporated Communities	County	WV SVI
Anawalt	McDowell	**100.0%**
War	McDowell	**99.6%**
Smithfield	Wetzel	**99.1%**
Auburn	Ritchie	**98.7%**
Lester	Raleigh	**98.2%**

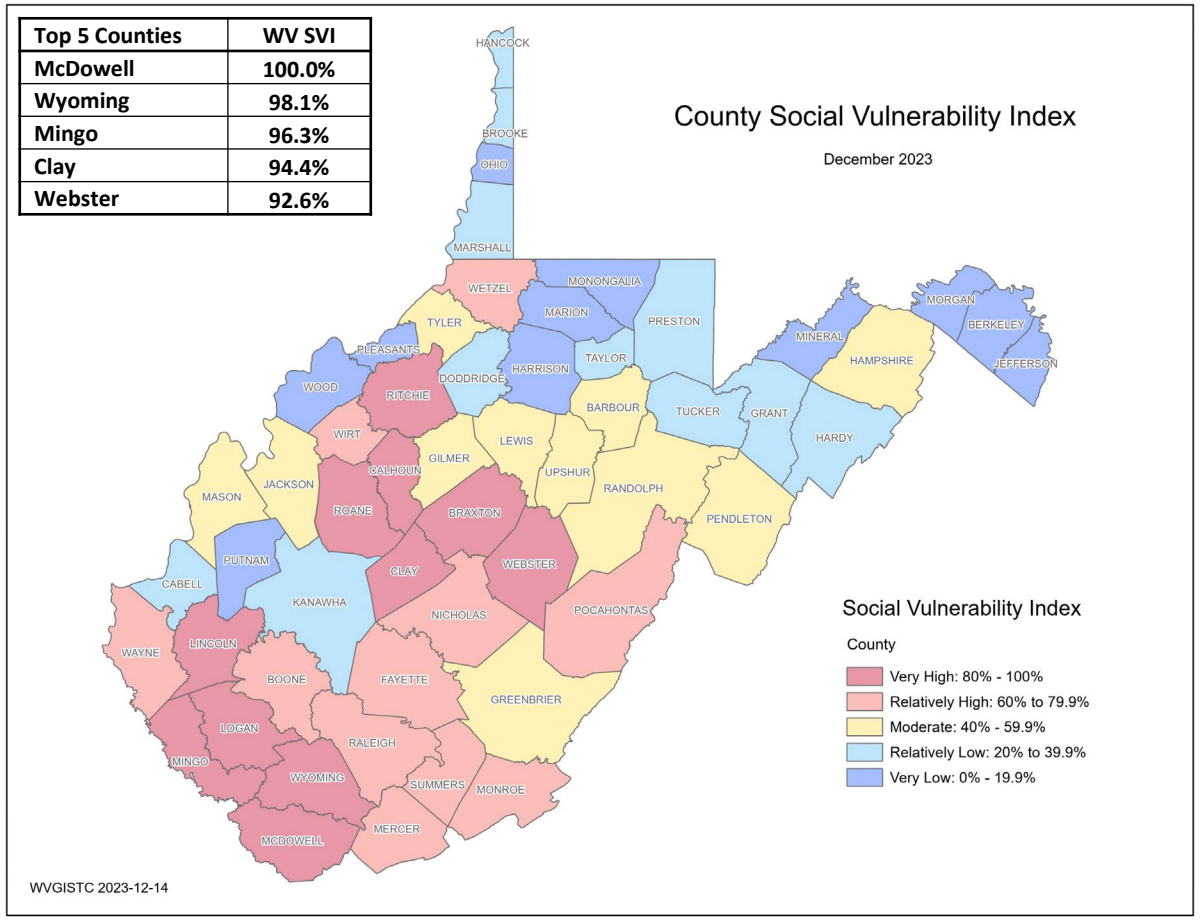


Top 5 Unincorporated Communities	WV SVI
McDowell	**100.0%**
Wyoming	**98.1%**
Mingo	**96.3%**
Webster	**94.4%**
Clay	**92.6%**

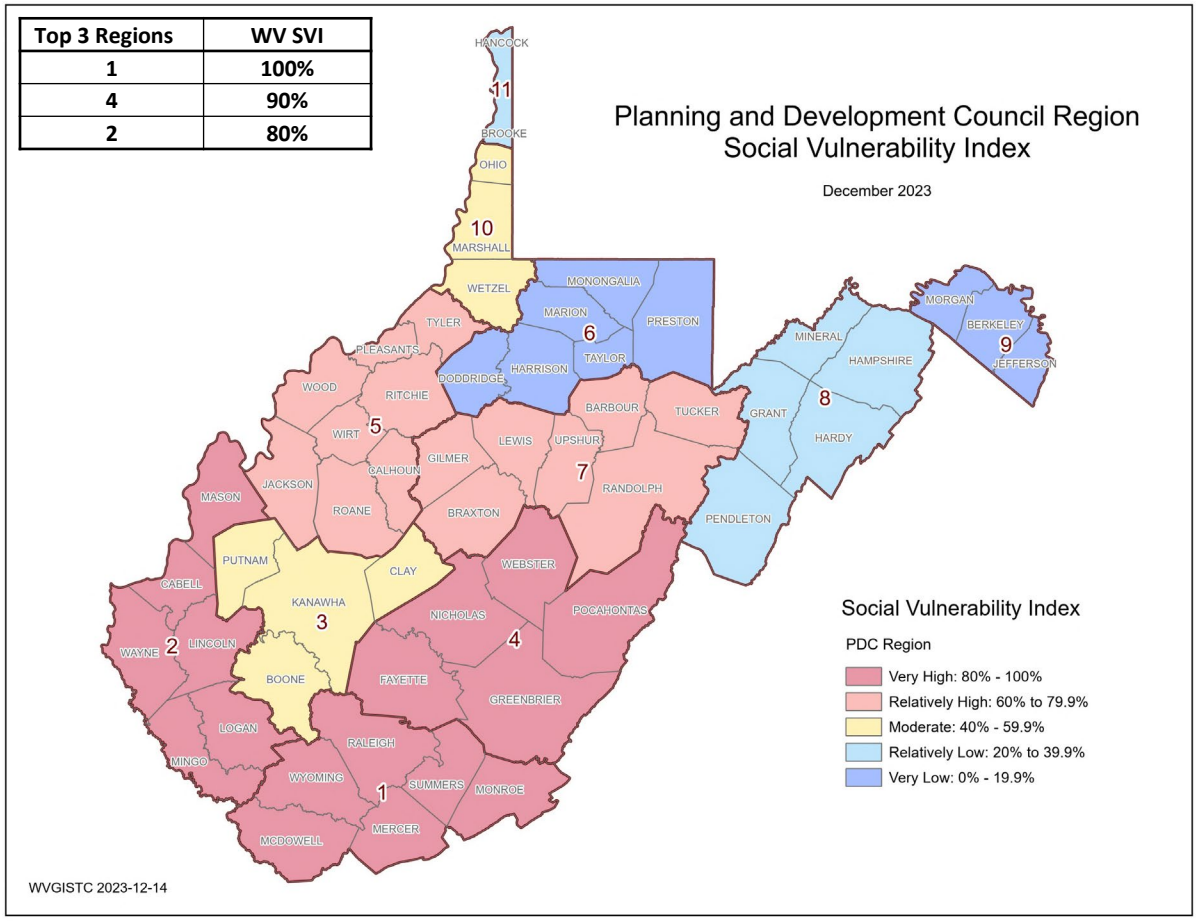


Risk Factor Scores and Cumulative Index …

Top 5 Counties	WV SVI
McDowell	100.0%
Wyoming	98.1%
Mingo	96.3%
Clay	94.4%
Webster	92.6%



Top 3 Regions	WV SVI
1	100%
4	90%
2	80%



Risk Factor Scores and Cumulative Index …

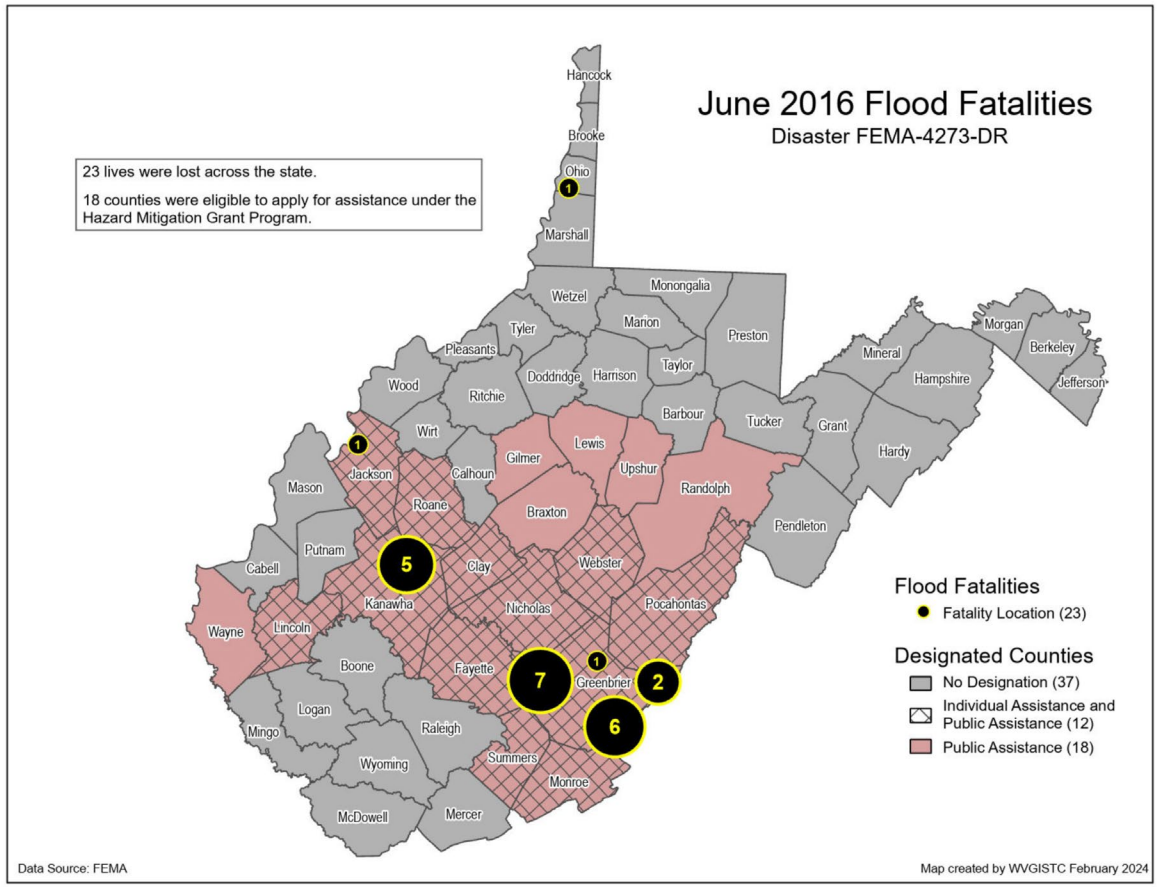
Vulnerability Indicators	White Sulphur Springs	Rainelle	Clendenin	Richwood	Marlinton	Camden-on-Gauley	State Ratio/Value	National Ratio/Value
Poverty Rate	21.9%	27.7%	9.2%	26.1%	25.7%	14.3%	17.0%	12.4%
Unemployment Rate	13.0%	22.1%	7.3%	39.8%	16.3%	8.3%	23.7%	14.6%
Vulnerable Ages Ratio	37.5%	36.0%	45.4%	43.1%	37.6%	33.0%	36.7%	34.6%
Disability Ratio	20.5%	31.9%	11.2%	29.9%	27.6%	9.7%	19.3%	12.6%
No High School Diploma Ratio	8.3%	15.4%	10.1%	13.2%	16.1%	4.8%	11.9%	11.1%
Population Change Ratio	-9.1%	-20.9%	-30.4%	-19.1%	-5.3%	-25.4%	-3.2%	7.4%
Median Housing Value	$121,000	$59,100	$70,300	$68,300	$79,700	$73,800	$128,800	$244,900
Mobile Homes Ratio	0.0%	9.3%	3.9%	7.5%	4.9%	11.1%	14.0%	5.9%
WV Social Vulnerability Index Score (Among incorporated communities)	**21.1% (Relatively Low)**	**84.6% (Very High)**	**36.6% (Relatively Low)**	**92.5% (Very High)**	**60.4% (Relatively High)**	**27.3% (Relatively Low)**	-	-

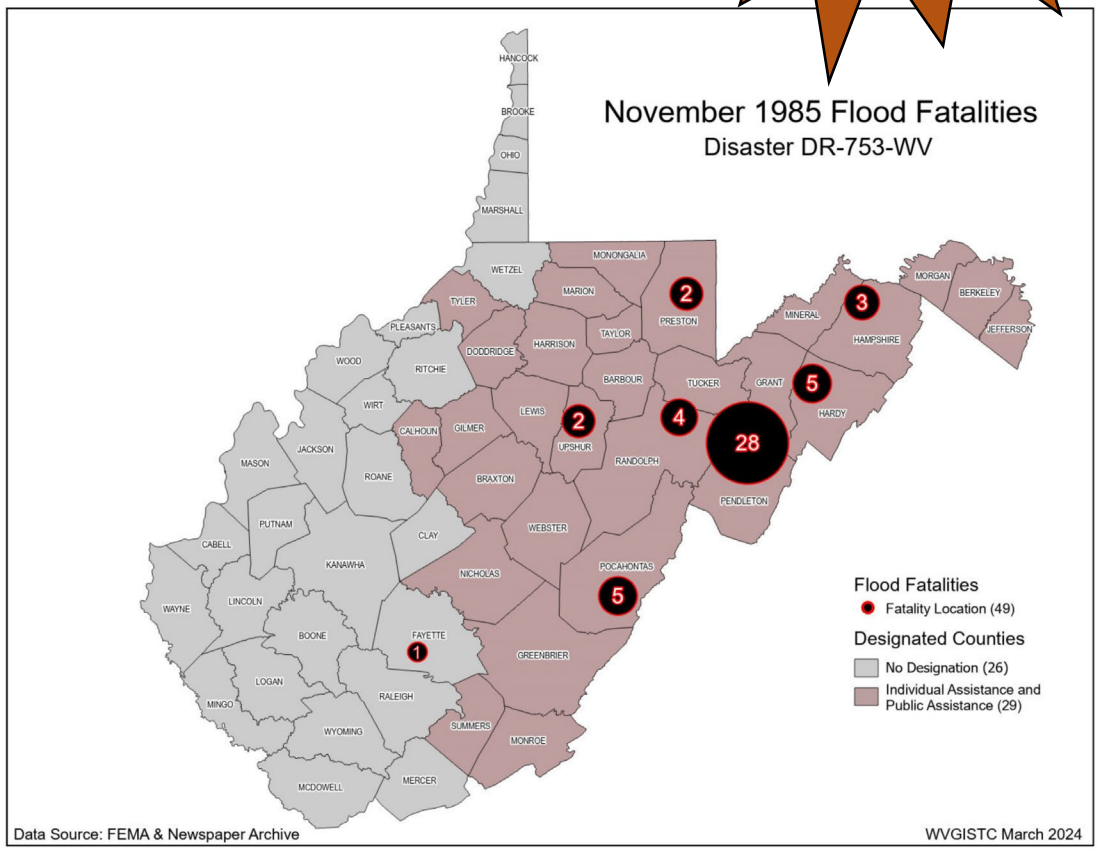
Index Legend: Very High: 80% to 100% (Red: 90% to 100%) | Relatively High: 60% to 79.9% | Moderate: 40% to 59.9% | Relatively Low: 20% to 39.9% | Very Low: 0% to 19.9%

Risk Factor Scores and Cumulative Index …

Complementary Analysis

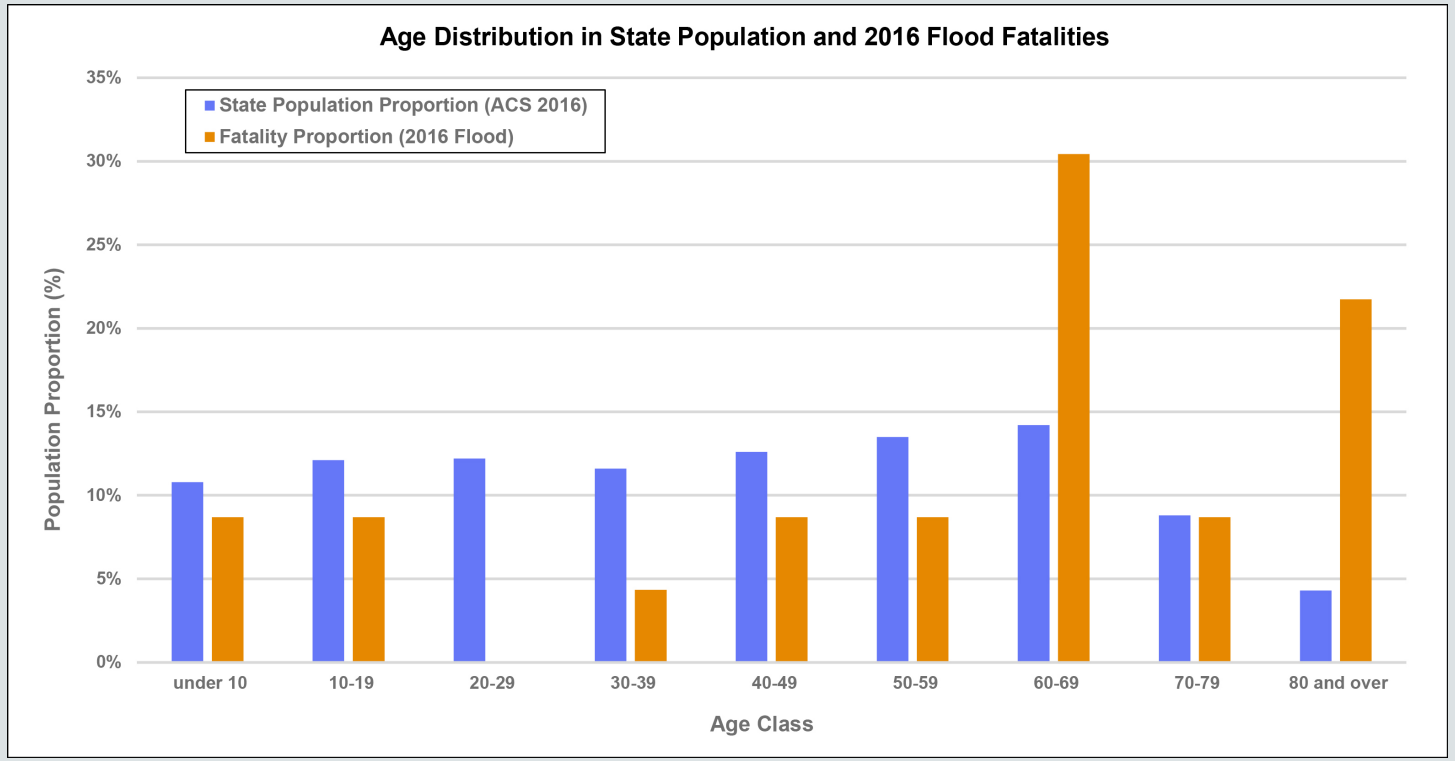
Spatial Analysis of Fatalities by Previous Floods

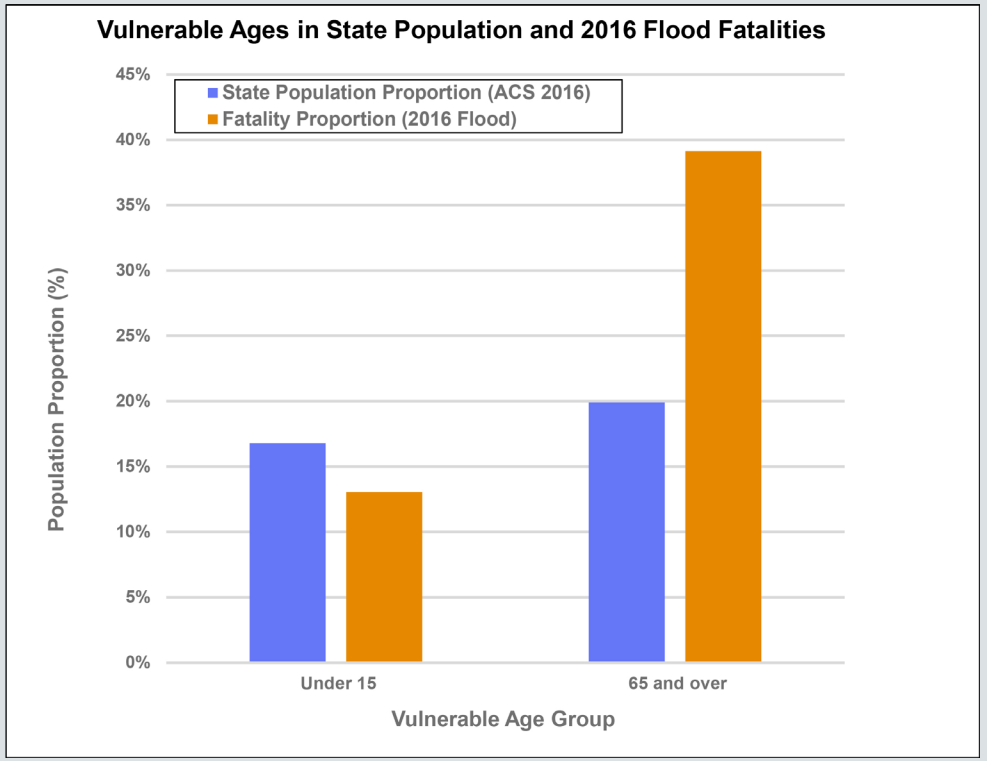




Risk Factor Scores and Cumulative Index …

Demographic Analysis of Fatalities by Previous Floods





Analysis of Risky Behavior and Evacuation Response Time

Qualitative Component

Complementary Analyses

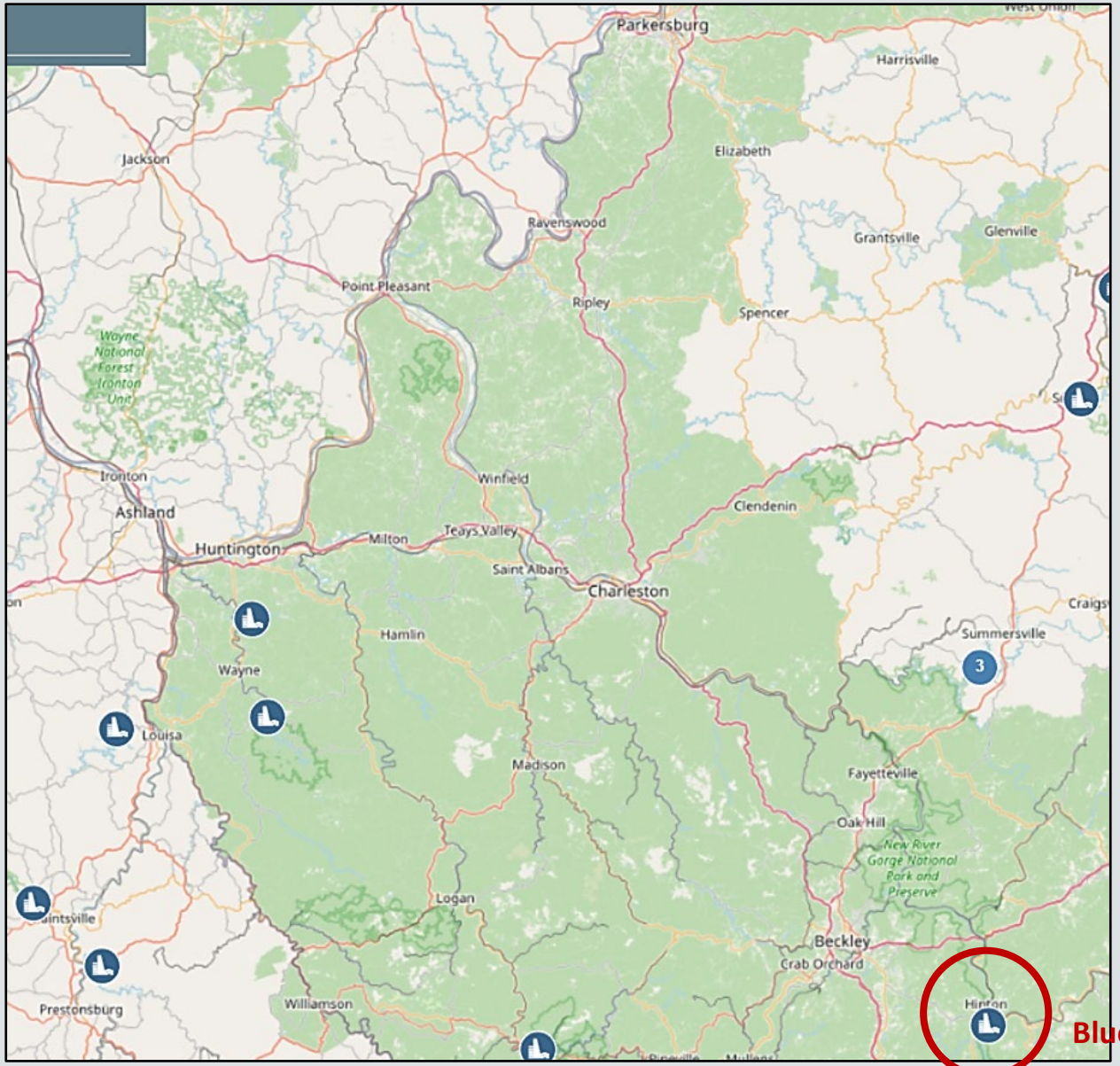
Risk Factor Scores and Cumulative Index …

4) Other Hazards

- **Dam Failure Risk** (Incorporated Places) (Y/N)
- **Number of High-Risk Dams** (Unincorporated Areas and larger scales)
- **Levee Failure Risk** (Y/N)
- **High-Susceptibility Landslide Area Ratio**

Example of a high-risk dam, Bluestone Dam, Hinton (link)

Risk Factor Scores and Cumulative Index …

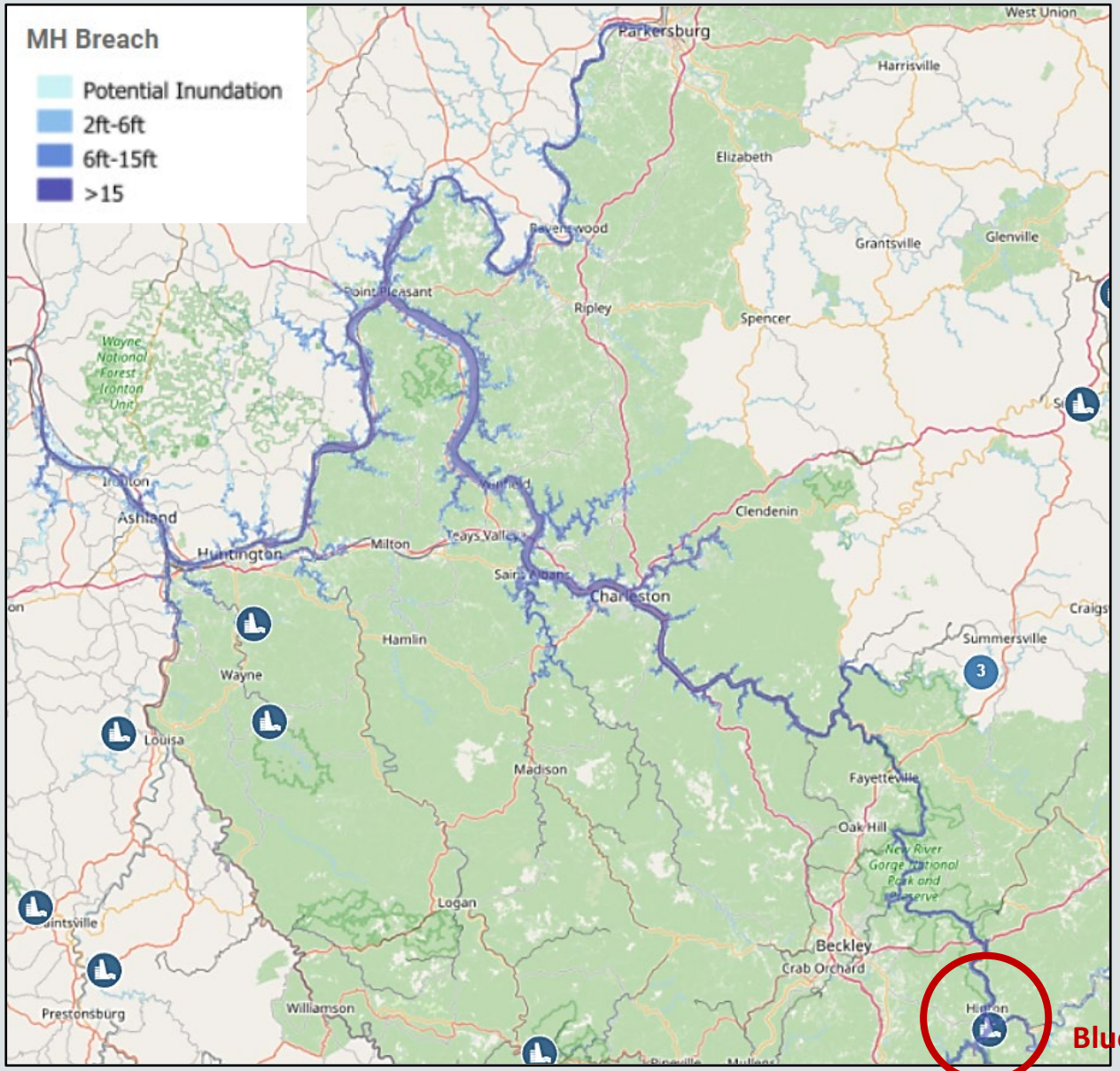


Bluestone Dam

A Maximum High (MH) breach scenario modeling for Bluestone Dam

Source: National Inventory of Dams

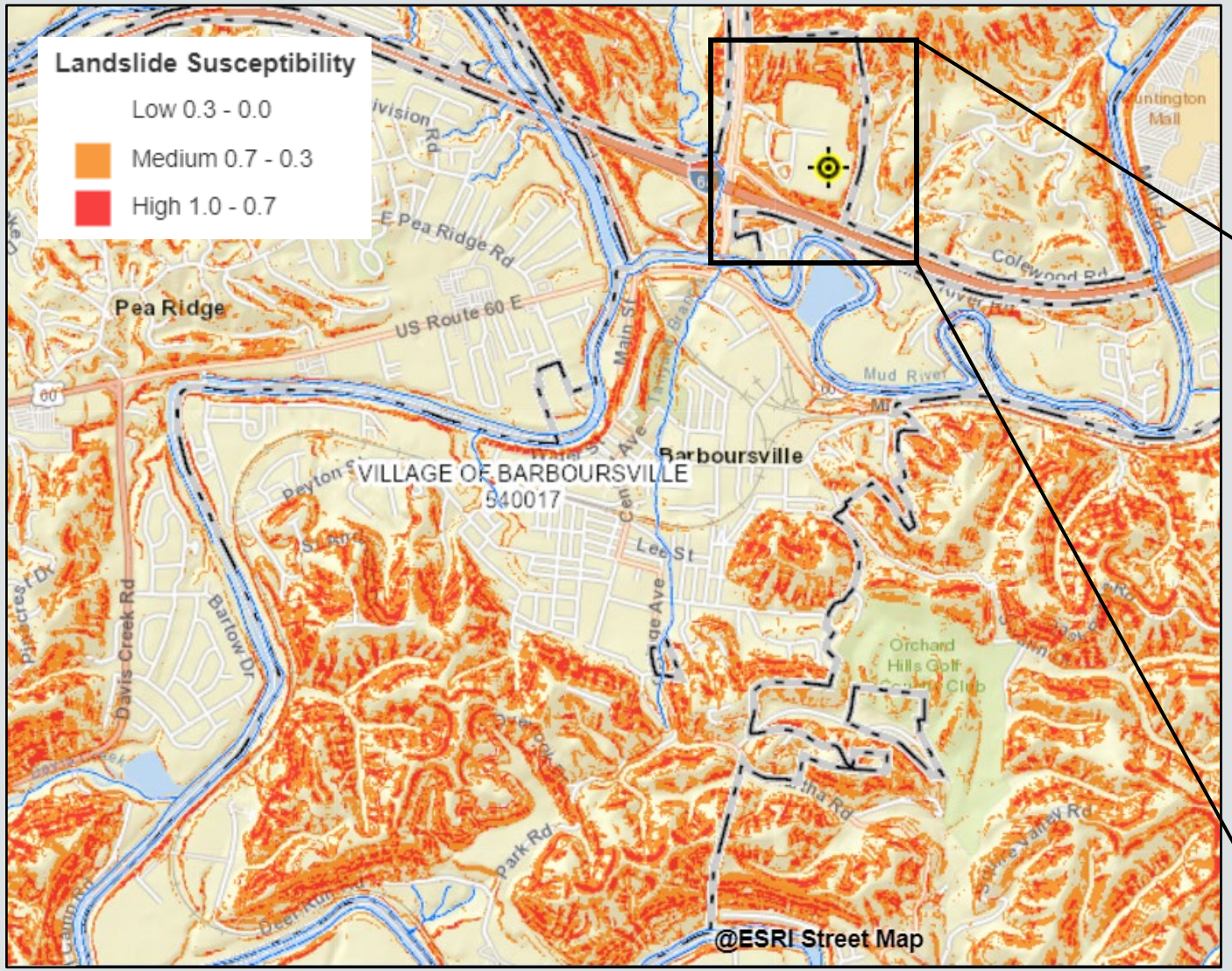
Risk Factor Scores and Cumulative Index …



A Maximum High (MH) breach scenario modeling for Bluestone Dam

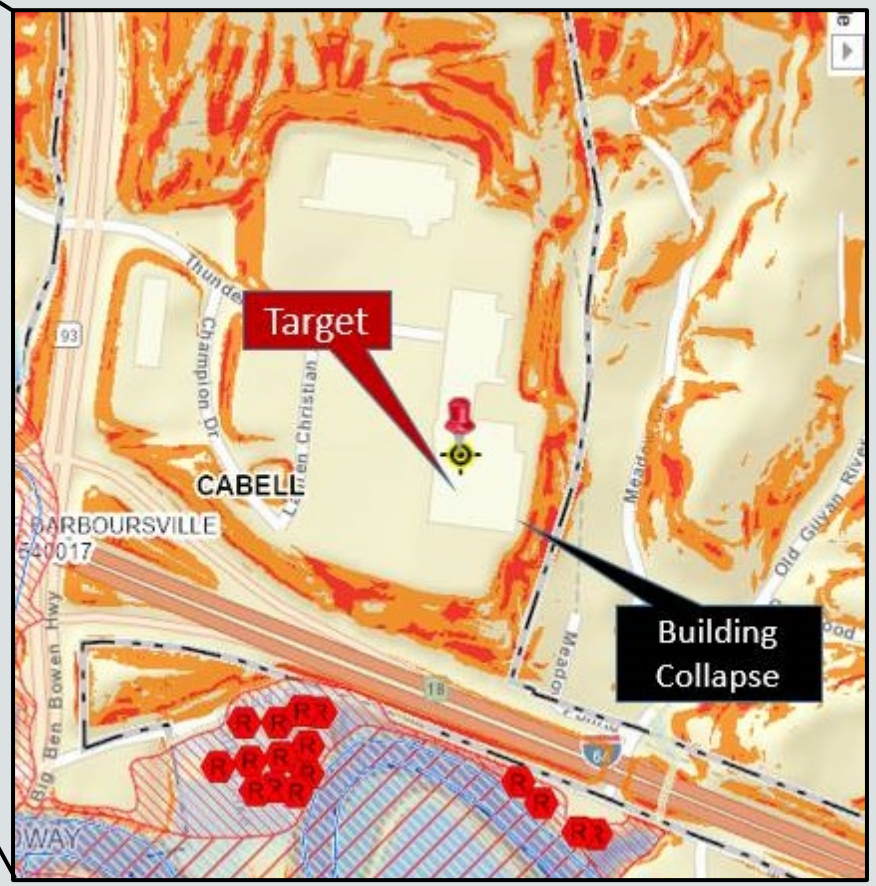
Source: National Inventory of Dams

Risk Factor Scores and Cumulative Index …



Landslide susceptibility in Barboursville, WV (link)

(Image link)



Risk Factor Scores and Cumulative Index …

5) Mitigation Measures

- **Structural Measures:** Such as ***Dams***, ***Levees***, ***Floodwalls***, and ***Chanel Widening*** focus on reducing the probability of flood hazard
  Related indicator:
  Dam Protection (Y/N)

- **Physical Non-Structural Measures:** Such as ***Building Elevation***, ***Floodproofing***, ***Acquisition and Relocation*** focus on mitigating the consequences of flooding instead of reducing the probability of flooding
  Related indicators:
  Mitigated Structures to Design Flood Elevation (DFE) (BFE + Freeboard)
  Buyout Parcels (#)
  Open Space Preservation (Area/Ratio)
  Wet/Dry Floodproofing Structures based on Building Adaptability Models (#)

- **Non-Physical Non-structural Measures**
  - ***Flood Insurance Policies in Force***
  - ***Higher Standards*** (CRS, Ordinances, Flood Disclosure Laws)
    - Community Rating System (CRS) Participation
    - Floodplain Management Ordinances
      - Higher Freeboard
      - Building Above Code
      - Land Use
    - Higher Regulatory Mapping Standards
      - Increased Regulatory Floodplain
      - Increased BFE
  - ***Flood Emergency and Evacuation Plans***
  - ***Risk Communications***
  - ***Flood Disclosure Laws***

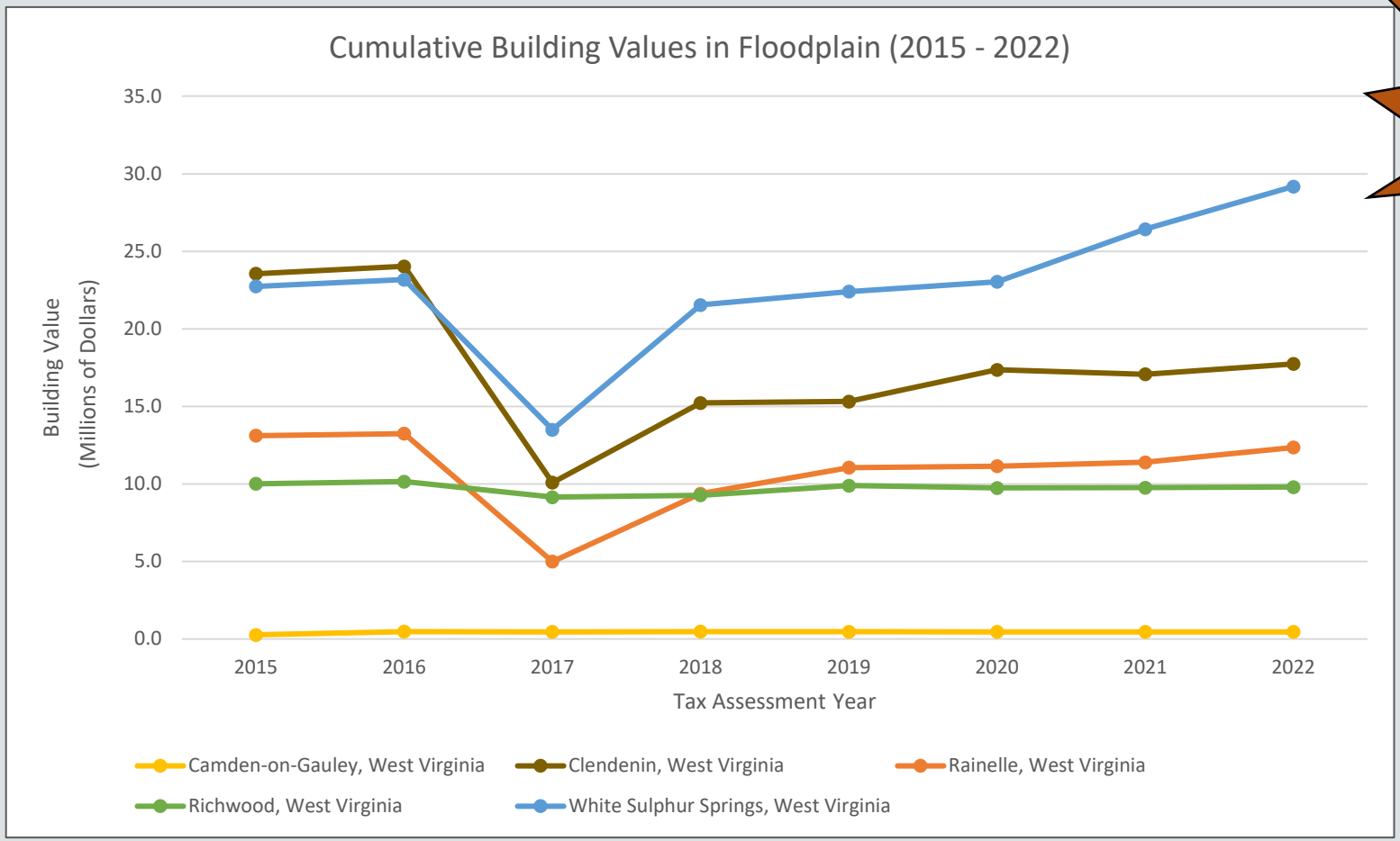
Related indicators:
Community Rating System (CRS) Class
Freeboard (ft)
Flood Disclosure Laws (Y/N)
Flood Insurance Ratio

Source: USACE

Risk Factor Scores and Cumulative Index …

Floodplain Building Value Recovery

Source: Tax assessment database. May not include values for tax exempt properties.



Complementary Analyses

Community	2015	2016	2017	2018	2019	2020	2021	2022
Camden-on-Gauley	0.3 Million	**0.5 Million**	0.5 Million	0.5 Million	0.5 Million	0.5 Million	0.5 Million	0.5 Million
Clendenin	23.6 Million	**24.0 Million**	10.1 Million	15.2 Million	15.3 Million	17.4 Million	17.1 Million	17.7 Million
Rainelle	13.1 Million	**13.2 Million**	5.0 Million	9.4 Million	11.1 Million	11.1 Million	11.4 Million	12.4 Million
Richwood	10.0 Million	**10.1 Million**	9.1 Million	9.3 Million	9.9 Million	9.7 Million	9.8 Million	9.8 Million
White Sulphur Springs	22.7 Million	**23.2 Million**	13.5 Million	21.5 Million	22.4 Million	23.0 Million	26.4 Million	29.2 Million

Risk Factor Scores and Cumulative Index …

Example of risk index development methodology among the detailed study (6) communities with 31 risk indicators

Flood Hazard Indicators
Regulatory Floodplain Area Ratio
Federally-Declared Flood Disasters (in County) since 1953
Maximum Estimated Flood Depth

Building Counts / Ratios
Structures in All High-Risk Floodplains Ratio in All Bldgs.
Buildings in High-Risk Floodway Ratio in SFHA Bldgs.
Structures in Estimated Depths of Greater than 10 ft

Building Types / Values
Total Building Value in Floodplain
Median Building Value in Floodplain
Residential Value in Floodplain
Non-Residential Value in Floodplain

Building Year / New Construction
Pre-FIRM in Floodplain Ratio

Vulnerable Structures
Ratio of Manufactured Homes in High-Risk Floodplain Bldgs.
Floodplain Buildings with Basements Ratio
One-Story Floodplain Residential Buildings Ratio
Renter-Occupied Housing in Floodplain Ratio
Low-Value (< $10K) Floodplain Buildings Ratio

Significant Structures
Floodplain Essential Facilities
Most Vulnerable Essential Facilities
Floodplain Non-Hist. Community Assets
Most Vulnerable Non-Historical Community Assets
Floodplain Historical Community Assets
Most Vulnerable Historical Community Assets

Most Vulnerable Essential Facilities: [School, Hospital, Nursing Home] OR [In Floodway] OR [Flood Depth >= 3 ft. Flood]

Most Vulnerable Community Assets: [In Floodway] OR [Flood Depth >= 3 ft. Flood]

Physical Damage
Building Flood Loss Ratio
Substantial Damage Ratio
Previous Flood Claims (since 1978)
Previous Paid Losses (since 1978)
Repetitive Loss Structures

Transportation Infrastructure
Inundated Roads Ratio

People/Social
WV Social Vulnerability Index
Floodplain Population Ratio
Displaced Population Ratio

Risk Factor Scores and Cumulative Index …

	Floodplain Area (Modified aSFHA) Ratio	Percent Rank Floodplain Area (Modified aSFHA) Ratio	Declared Flood Disasters in County since 1953	Percent Rank Declared Flood Disasters in County since 1953	Maximum Estimated Flood Depth	Percent Rank Maximum Estimated Flood Depth	High-Risk Floodplain Buildings to Total Buildings Ratio	Percent Rank High-Risk Floodplain Buildings to Total Buildings Ratio	Floodway Buildings to SFHA Buildings Ratio	Percent Rank Floodway Buildings to SFHA Buildings Ratio
White Sulphur Springs	22.0%	20.0%	9	80.0%	5	0.0%	18.7%	0.0%	27.4%	80.0%
Rainelle	31.2%	80.0%	9	80.0%	6	20.0%	33.7%	60.0%	12.8%	60.0%
Clendenin	24.1%	60.0%	8	60.0%	28	100.0%	47.0%	80.0%	0.3%	20.0%
Richwood	23.1%	40.0%	5	20.0%	8	40.0%	22.9%	20.0%	47.5%	100.0%
Marlinton	31.5%	100.0%	6	40.0%	9	60.0%	61.4%	100.0%	3.9%	40.0%
Camden-on-Gauley	16.4%	0.0%	4	0.0%	13	80.0%	30.0%	40.0%	0.0%	0.0%

	Buildings in FEMA Depth > 10 ft	Percent Rank Buildings in FEMA Depth > 10 ft	Total Building Value in Floodplain	Percent Rank Total Building Value in Floodplain	Median Floodplain Building Value	Percent Rank Median Floodplain Building Value	Residential Value in Floodplain	Percent Rank Residential Value in Floodplain	Non-Residential Value in Floodplain	Percent Rank Non-Residential Value in Floodplain	Pre-FIRM in Floodplain Ratio	Percent Rank Pre-FIRM in Floodplain Ratio
White Sulphur Springs	0	0.0%	$24,475,000	80.0%	$54,100	100.0%	$15,489,000	100.0%	$8,986,000	80.0%	86.7%	40.0%
Rainelle	0	0.0%	$17,261,000	40.0%	$38,500	60.0%	$9,488,000	40.0%	$7,773,000	60.0%	77.2%	0.0%
Clendenin	34	100.0%	$19,351,000	60.0%	$48,600	80.0%	$12,851,000	80.0%	$6,500,000	40.0%	83.8%	20.0%
Richwood	0	0.0%	$11,754,000	20.0%	$19,100	20.0%	$6,447,000	20.0%	5,307,000	20.0%	92.0%	100.0%
Marlinton	0	0.0%	$44,762,000	100.0%	$19,100	20.0%	$10,840,000	60.0%	33,922,000	100.0%	88.0%	60.0%
Camden-on-Gauley	2	80.0%	$574,000	0.0%	$16,700	0.0%	$263,000	0.0%	$311,000	0.0%	90.5%	80.0%

Risk Factor Scores and Cumulative Index …

	Floodplain Manufactured Homes Ratio	Percent Rank Floodplain Manufactured Homes Ratio	Floodplain Buildings with Basements Ratio	Percent Rank Floodplain Buildings with Basements Ratio	One-Story Residential Buildings Ratio	Percent Rank One-Story Residential Buildings Ratio	Renter-Occupied Housing in Floodplain Ratio	Percent Rank Renter-Occupied Housing in Floodplain Ratio	Low-Value (< $10K) Floodplain Buildings Ratio	Percent Rank Low-Value (< $10K) Floodplain Buildings Ratio
White Sulphur Springs	0.6%	0.0%	21.1%	40.0%	82.0%	80.0%	39.8%	60.0%	6.2%	0.0%
Rainelle	4.2%	20.0%	7.1%	0.0%	93.5%	100.0%	40.3%	80.0%	15.7%	60.0%
Clendenin	4.6%	40.0%	40.4%	100.0%	79.5%	60.0%	27.7%	40.0%	8.6%	40.0%
Richwood	13.5%	80.0%	13.5%	20.0%	77.9%	40.0%	24.7%	20.0%	23.2%	80.0%
Marlinton	5.8%	60.0%	24.3%	60.0%	68.4%	20.0%	55.8%	100.0%	7.3%	20.0%
Camden-on-Gauley	19.0%	100.0%	30.7%	80.0%	61.5%	0.0%	23.1%	0.0%	33.3%	100.0%

	Floodplain Essential Facilities	Percent Rank Floodplain Essential Facilities	Most Vulnerable Essential Facilities	Percent Rank Most Vulnerable Essential Facilities	Floodplain Non-Hist. Community Assets	Percent Rank Floodplain Non-Hist. Community Assets	Most Vulnerable Non-Historical Community Assets	Percent Rank Most Vulnerable Non-Historical Community Assets	Floodplain Historical Community Assets	Percent Rank Floodplain Historical Community Assets	Most Vulnerable Historical Community Assets	Percent Rank Most Vulnerable Historical Community Assets
White Sulphur Springs	1	0.0%	0	0.0%	7	40.0%	2	20.0%	0	0.0%	0	0.0%
Rainelle	2	40.0%	0	0.0%	6	20.0%	2	20.0%	0	0.0%	0	0.0%
Clendenin	2	40.0%	2	80.0%	15	100.0%	15	100.0%	121	100.0%	52	100.0%
Richwood	3	80.0%	0	0.0%	8	60.0%	3	60.0%	10	80.0%	4	60.0%
Marlinton	6	100.0%	4	100.0%	13	80.0%	6	80.0%	5	60.0%	4	60.0%
Camden-on-Gauley	1	0.0%	1	60.0%	1	0.0%	0	0.0%	0	0.0%	0	0.0%

Risk Factor Scores and Cumulative Index …

	Building Flood Loss Ratio	Percent Rank Building Flood Loss Ratio	Substantial Damage Ratio	Percent Rank Substantial Damage Ratio	Previous Flood Claims (since 1978)	Percent Rank Previous Flood Claims (since 1978)	Previous Paid Losses (since 1978)	Percent Rank Previous Paid Losses (since 1978)	Repetitive Loss Structures	Percent Rank Repetitive Loss Structures	Inundated Roads Ratio	Percent Rank Inundated Roads Ratio
White Sulphur Springs	5.5%	20.0%	0.0%	0.0%	89	20.0%	$3,005,000	20.0%	2	0.0%	17.2%	0.0%
Rainelle	5.9%	40.0%	0.3%	20.0%	154	80.0%	$3,721,000	40.0%	35	60.0%	36.1%	80.0%
Clendenin	25.7%	100.0%	15.2%	80.0%	122	40.0%	$6,582,000	60.0%	24	40.0%	57.1%	100.0%
Richwood	4.8%	0.0%	0.3%	20.0%	144	60.0%	$6,750,000	80.0%	66	80.0%	21.4%	40.0%
Marlinton	7.6%	60.0%	4.0%	60.0%	585	100.0%	$13,448,000	100.0%	252	100.0%	20.4%	20.0%
Camden-on-Gauley	19.5%	80.0%	19.1%	100.0%	21	0.0%	$358,000	0.0%	11	20.0%	35.0%	60.0%

	WV Social Vulnerability Index	Percent Rank WV Social Vulnerability Index	Floodplain Population Ratio	Percent Rank Floodplain Population Ratio	Displaced Population Ratio	Percent Rank Displaced Population Ratio
White Sulphur Springs	21.1%	0.0%	25.8%	40.0%	17.5%	40.0%
Rainelle	84.6%	80.0%	45.6%	60.0%	38.3%	60.0%
Clendenin	36.6%	40.0%	67.5%	80.0%	63.2%	80.0%
Richwood	92.5%	100.0%	23.8%	20.0%	16.9%	20.0%
Marlinton	60.4%	60.0%	85.6%	100.0%	76.0%	100.0%
Camden-on-Gauley	27.3%	20.0%	23.3%	0.0%	15.9%	0.0%

SUM of all Percent Rank Values	Percent Rank on the SUM: Risk Index Score for 6 Communities
960.0%	20.0%
1360.0%	40.0%
2120.0%	100.0%
1400.0%	60.0%
2120.0%	80.0%
900.0%	0.0%

Risk Factor Scores and Cumulative Index …

Risk Index (Selected Indicators for only 6 Communities)		
Rank	Community	Index Score
1	Clendenin	100%
2	Marlinton	80%
3	Richwood	60%
4	Rainelle	40%
5	White Sulphur Springs	20%
6	Camden-on-Gauley	0%

Flood Risk Indicator Dashboard

- Interactively explore indicators

Flood hazards

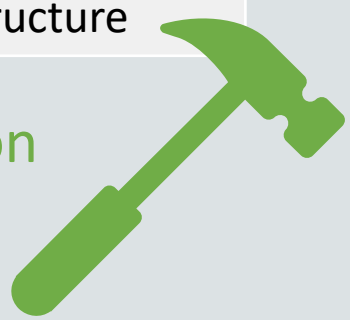
Floodplain area
Floodplain length
Declared disasters
Flood depth

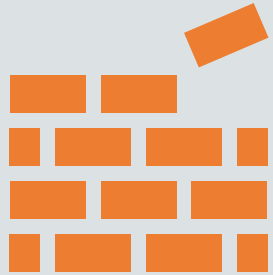
People/Social

Social vulnerability
Population exposure
Population displacement & shelter needs

Mitigation

Floodplain management
Flood insurance
Mitigated structures
Green infrastructure



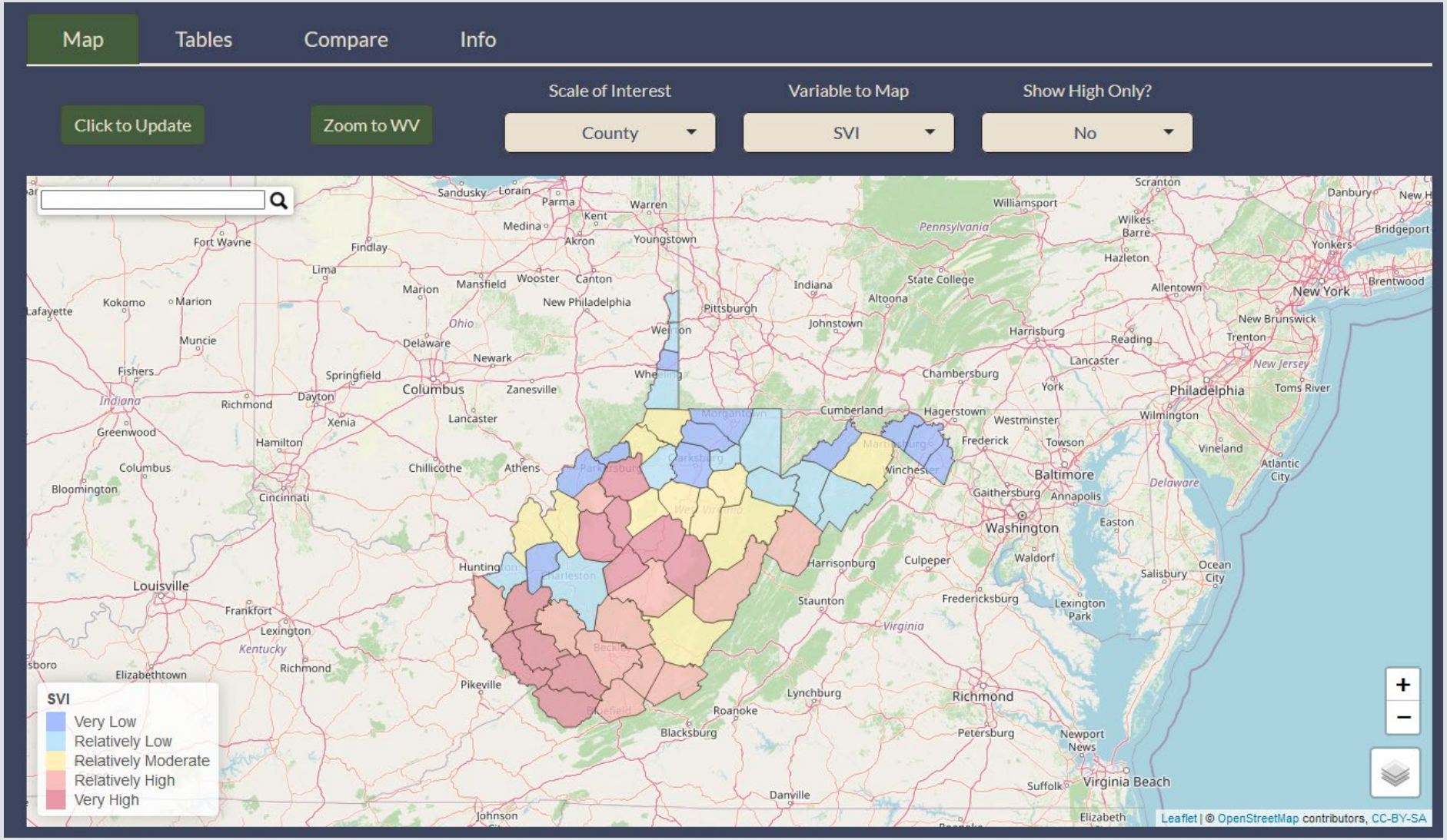


Structures

Building counts/ratios
Building types & values
Vulnerable structures
FIRM status
Building year/new construction
Significant structures
Physical damage estimates
Recorded building damage losses
Transportation infrastructure

Flood Risk Indicator Dashboard

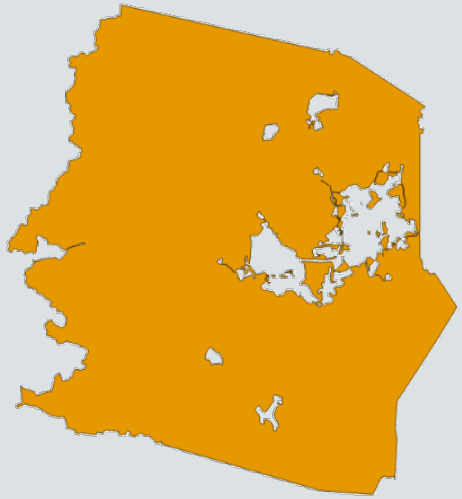
- Interactively explore indicators



Flood Risk Indicator Dashboard

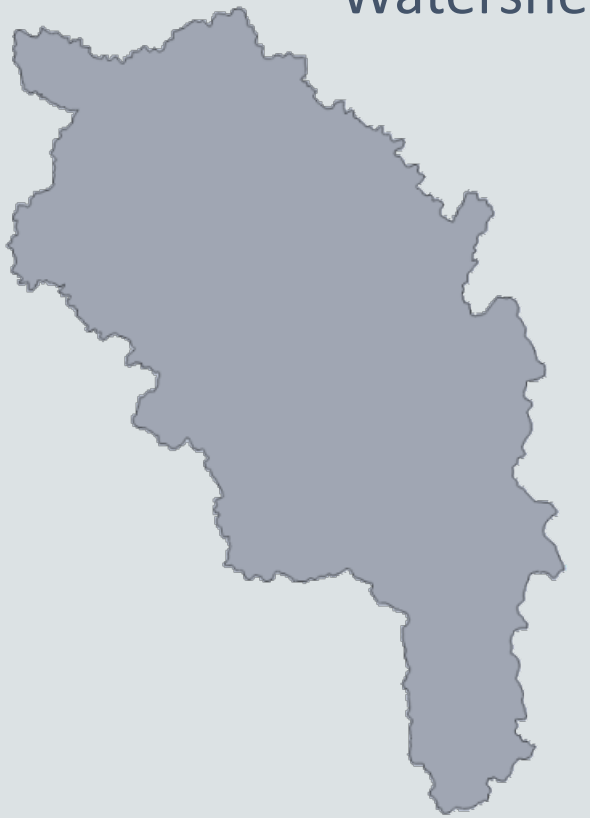
- Visualize and explore data at different scales

Unincorporated



Regions

Watersheds



Incorporated

Counties

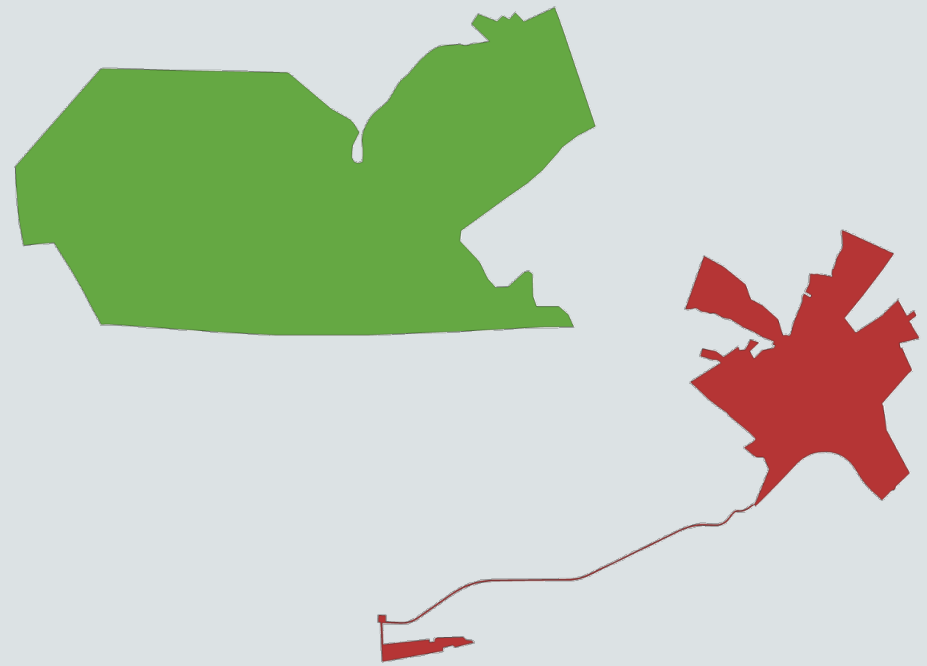
Flood Risk Indicator Dashboard

Social Vulnerability Indices

	Mean	Median	Selection1	Selection2	Rank1	Rank2
Poverty Rate	20.2%	18.3%	27.7%	21.9%	0.79	0.61
Unemployment Rate	24.9%	23.1%	22.1%	13.0%	0.45	0.14
Vulnerable Age Rate	37.5%	37.8%	36.0%	37.5%	0.38	0.45
Disability Rate	21.9%	20.2%	31.9%	20.5%	0.84	0.52
No Highschool Diploma Rate	13.3%	11.9%	15.4%	8.3%	0.69	0.29
Population Change Rate	−9.7%	−8.2%	−20.9%	−9.1%	0.80	0.53
Median House Value	$100,092	$92,400	$59,100	$121,000	0.86	0.22
Mobile Home Rate	9.5%	6.3%	9.3%	0.0%	0.65	0.00
Social Vulnerability Index					0.84	0.21

Click here for documentation.

- Make comparisons



Map | Tables | Compare | Info

Click to Update

Scale of Interest: Incorporated

Selct First Unit: Rainelle

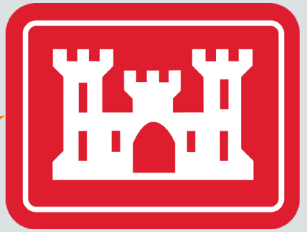
Select Second Unit: White Sulphur Springs

Show High Only: No

Flood Risk Index Tool Demo: Within WRF

- Link to documentation and resources

FEMA



WVU LAW
Land Use and Sustainable Development Law Clinic

USGS
science for a changing world

WV Flood Tool
Remember: When In Doubt, It's Not Out!

Flood Risk Indicator Dashboard: Status

Completed

- Basic UI design
- People/social indicators

In-Progress

- Additional indicators
- Documentation

To do

- App refinement
- Integration with WRF

```
server <- function(input, output, session) {

observeEvent(input$mapAgg2,
             {

               if(input$mapAgg2 == "rData"){
                 theChoices = rDataUN
               }else if(input$mapAgg2 == "unData"){
                 theChoices = unDataUN
               }else if(input$mapAgg2 == "incData"){
                 theChoices = incDataUN
               }else{
                 theChoices = cDataUN
               }

             updateSelectInput(session,
                               "sample1",
                               choices=theChoices)
```

Beta version by July 2024/Version 1.0 by Oct. 2024

FLOOD RISK VISUALIZATIONS

Flood Risk Visualization Overview

A collection of movies, animations, story maps, and other flood visualization tools available at the building and community levels for communicating and understanding flood risk in West Virginia.

Animation (3D Movies)

3D movies have been created using two distinct approaches:

- The first approach illustrates the percentage of damage during a 100-year flood event for Bolivar, Shepherdstown, Charlestown, and Harpers Ferry in Jefferson County.
- The second approach showcases mitigated buildings, as well as community assets and essential facilities situated within the 100-year flood zone for White Sulphur Springs and Rainelle in Greenbrier County, as well as Clendenin in Kanawha County.

Story Maps

Story Maps can serve as educational tools by providing detailed information about floods, their causes, impacts, and mitigation strategies. They can include multimedia elements such as videos, images, and infographics to explain complex concepts in an accessible manner.

Key Concepts of Flood Risk Visualization

Visualization Content

- Flood Frequency Probability and Magnitude
- Damage Loss Estimates
- Mitigated and unmitigated properties

Levels of Visualization

Building-Level Visualizations

- Building Flood Profiles for different sized storms

(includes High Water Marks)

- Building Flood Depth and Damage Assessment

(WV Flood Tool)

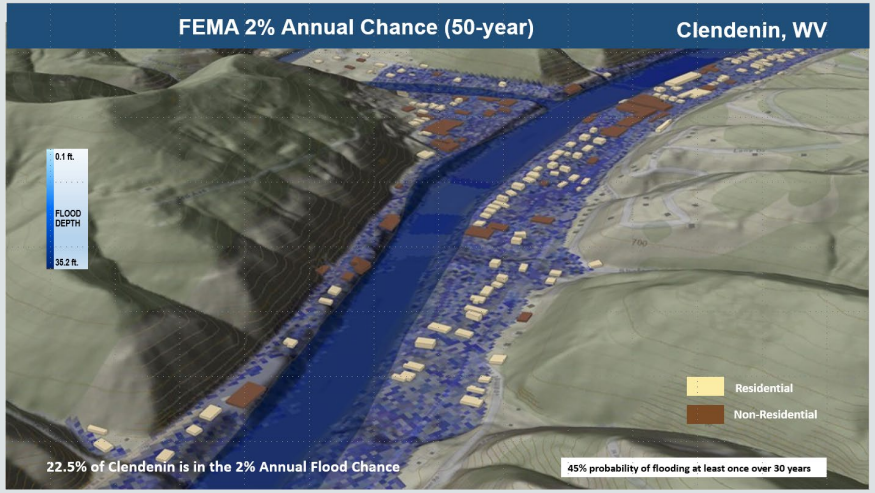
Community-Level Visualizations

- Movies
- Viewsheds
- Story Maps

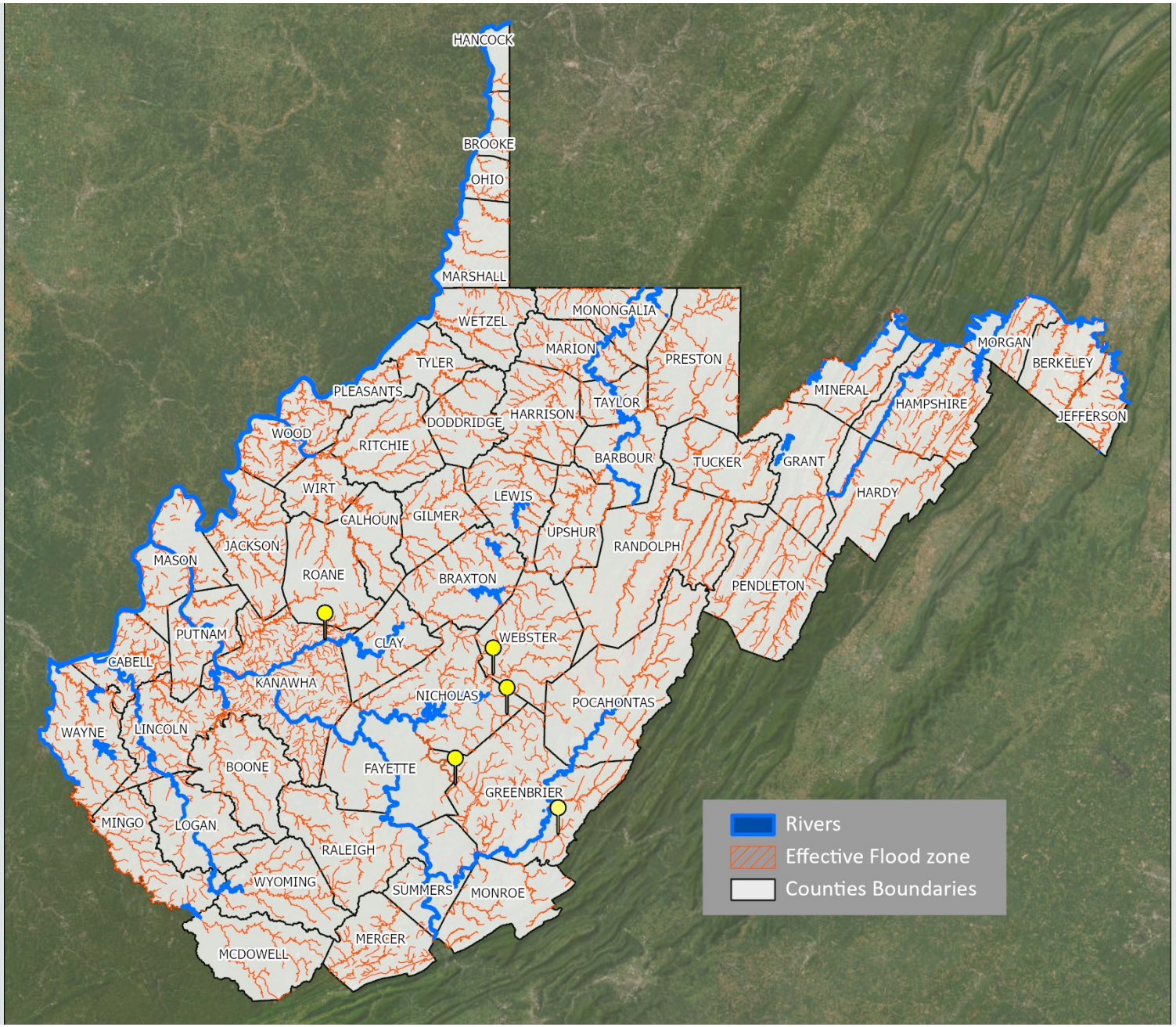
Visualization Products

A map index provides a spatial gateway to flood visualizations and videos.

5-, 10-, 20-, 25-, 50-, 100-, and 500-year flood elevations (above sea level) refer to expected water levels of the 20%, 10%, 5%, 4%, 2%, 1%, and 0.2% annual chance flood events.



Map Index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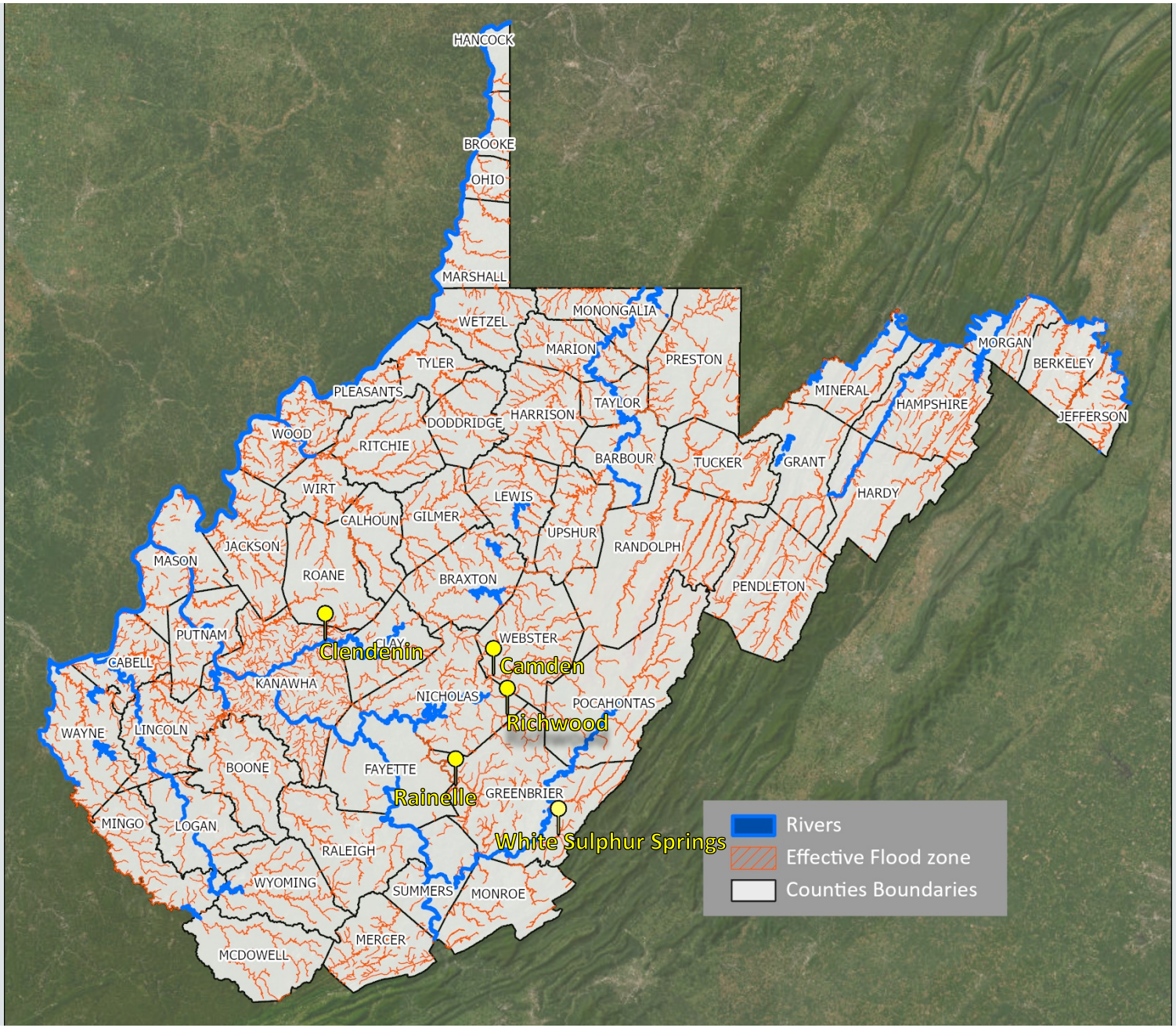
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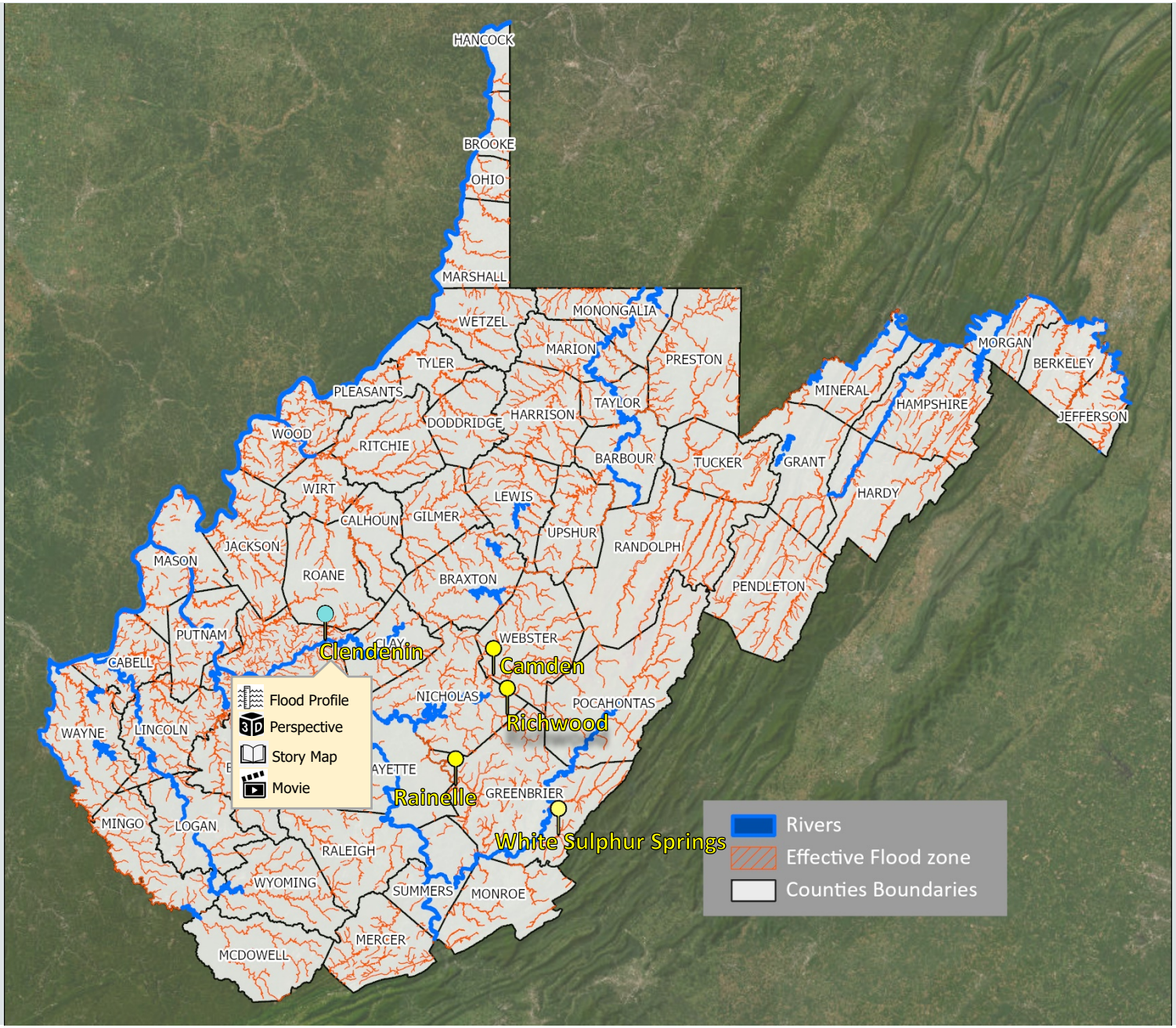
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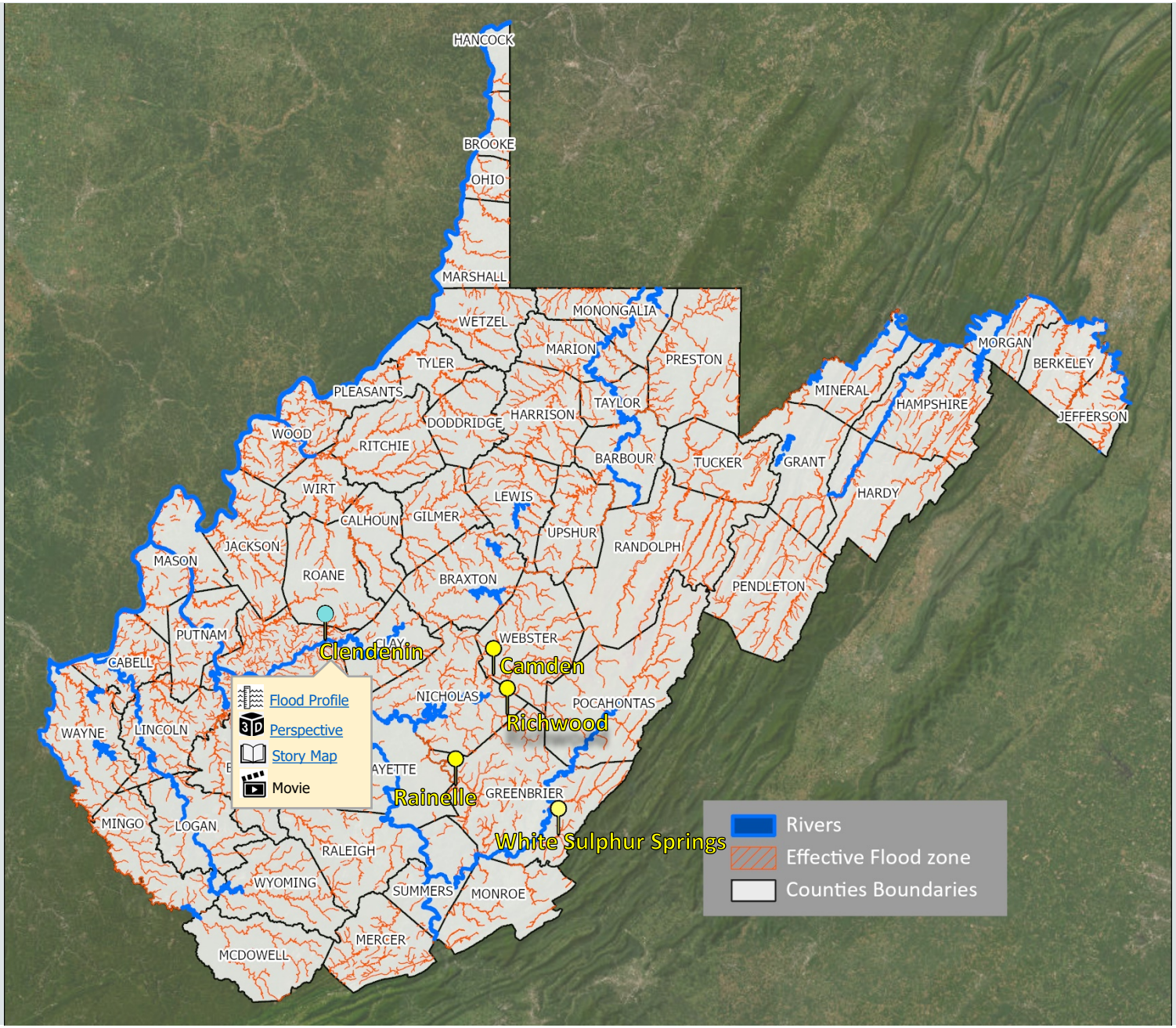
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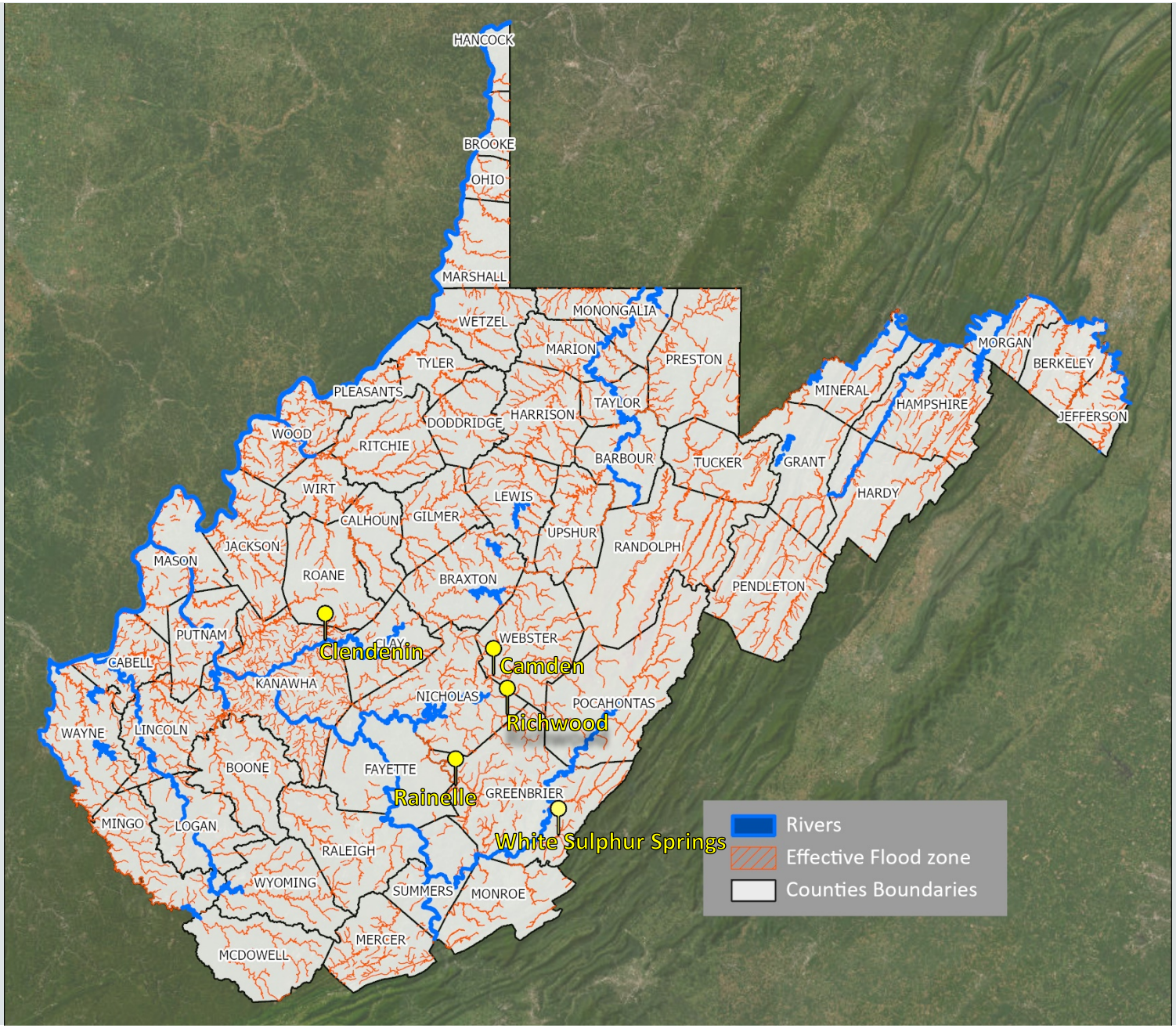
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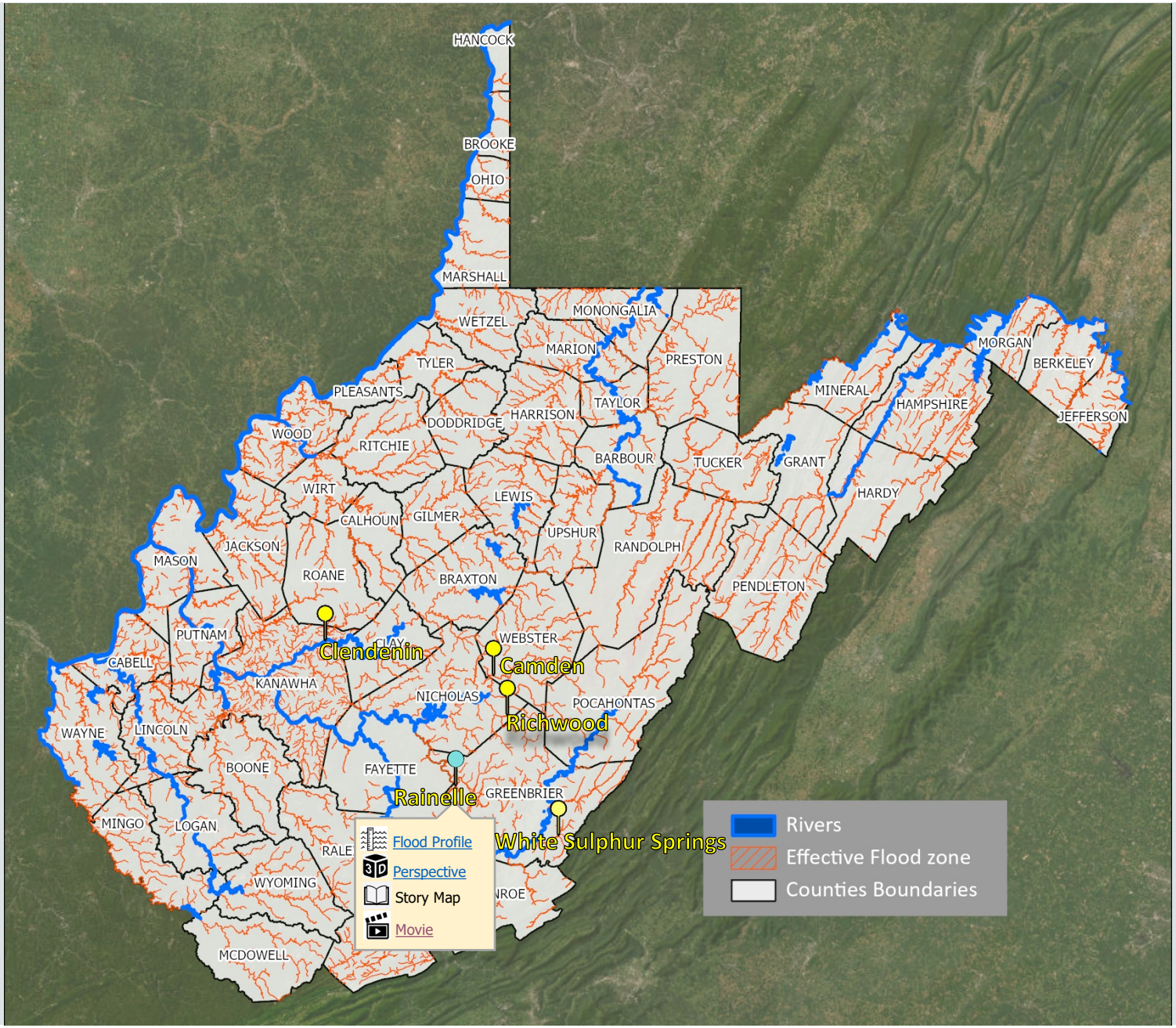
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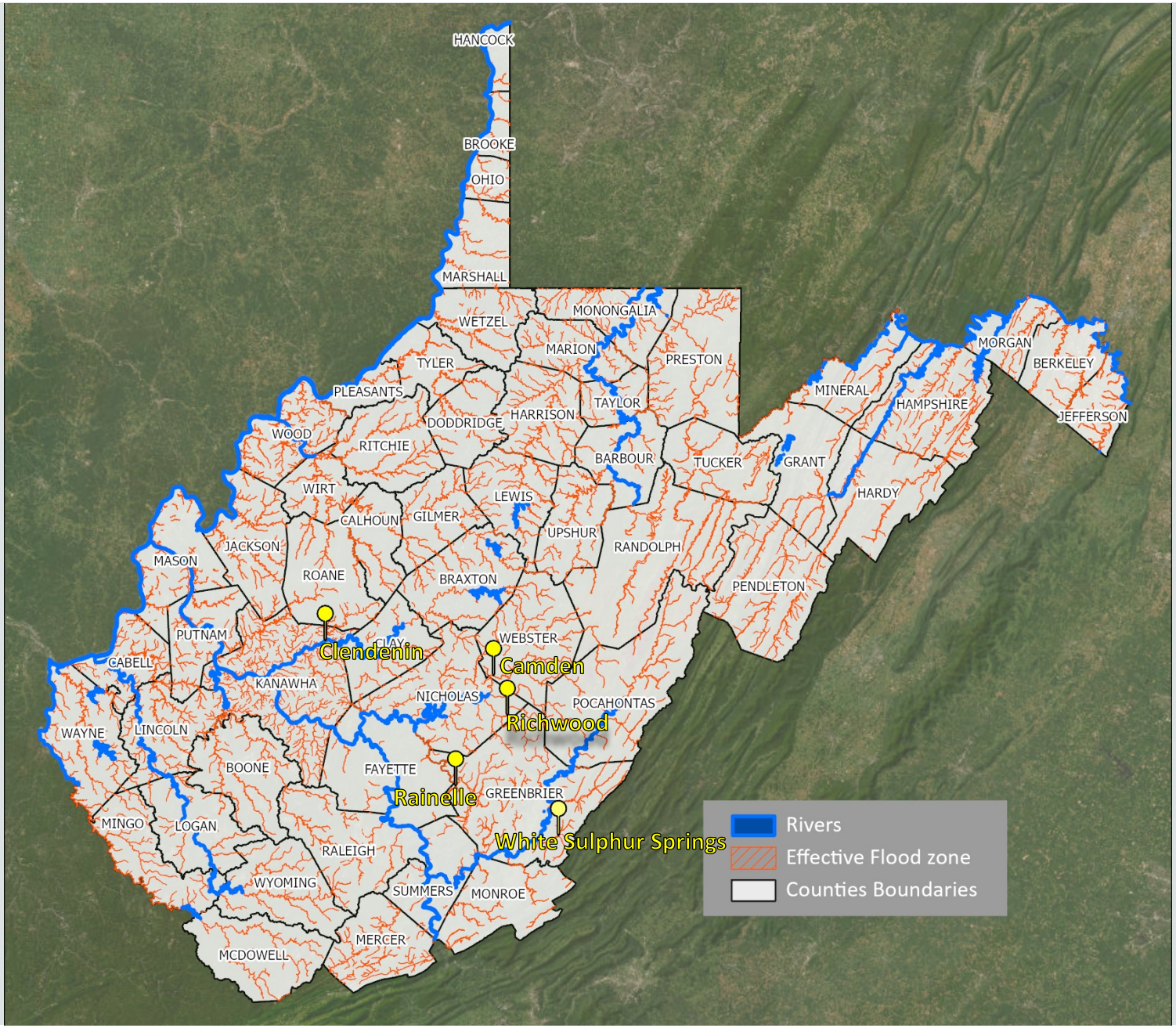
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QUESTIONS? COMMENTS?

LINKED SLIDES

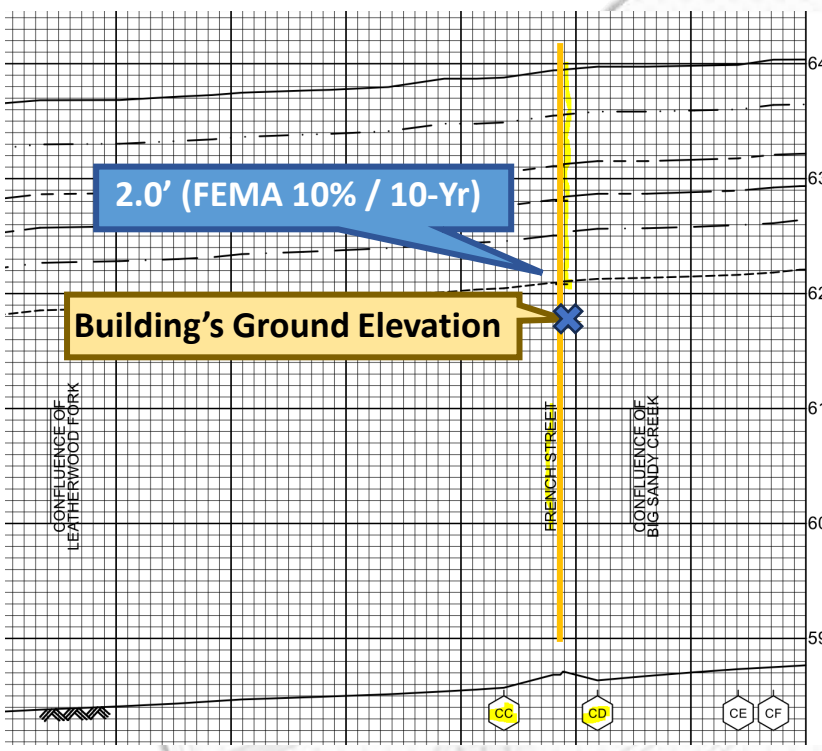
Building Flood Profile

Clendenin

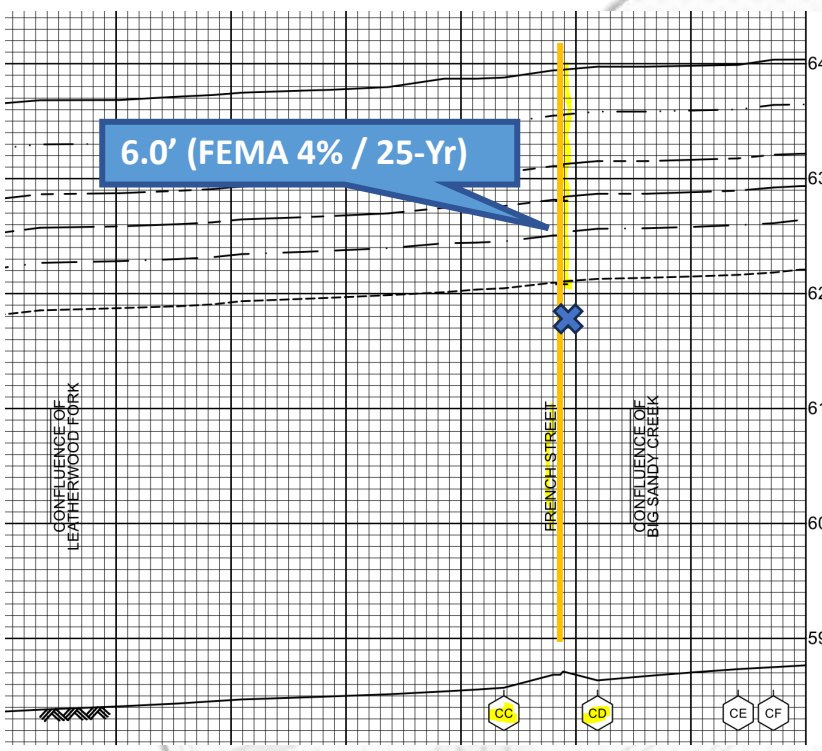
20-02-0006-0044-0000_306

306 Maywood Ave., Clendenin, WV, 25045

10% Probability of Flood in a year (10-year flood)

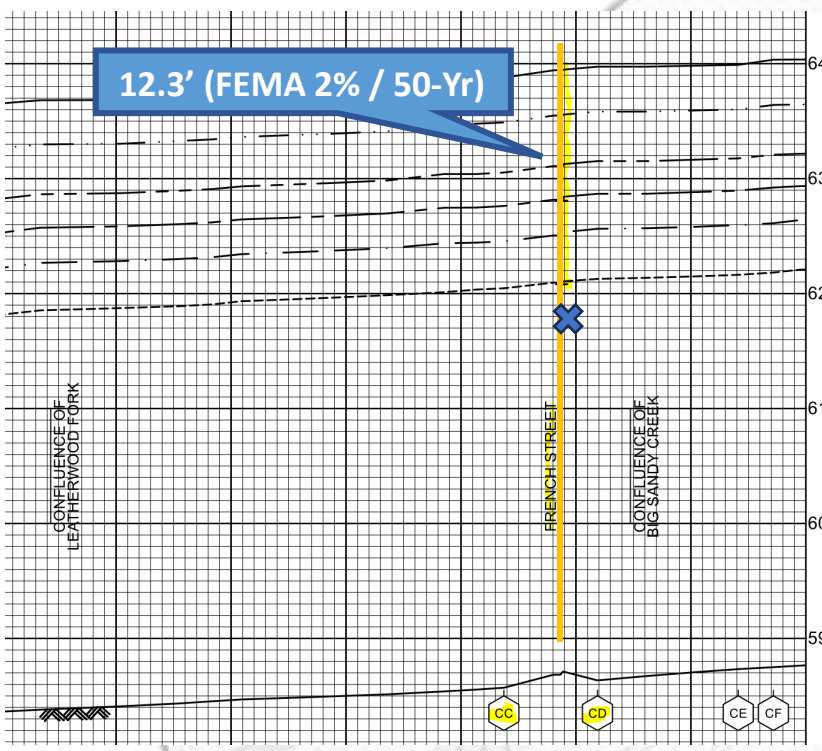


4% Probability of Flood in a year (25-year flood)

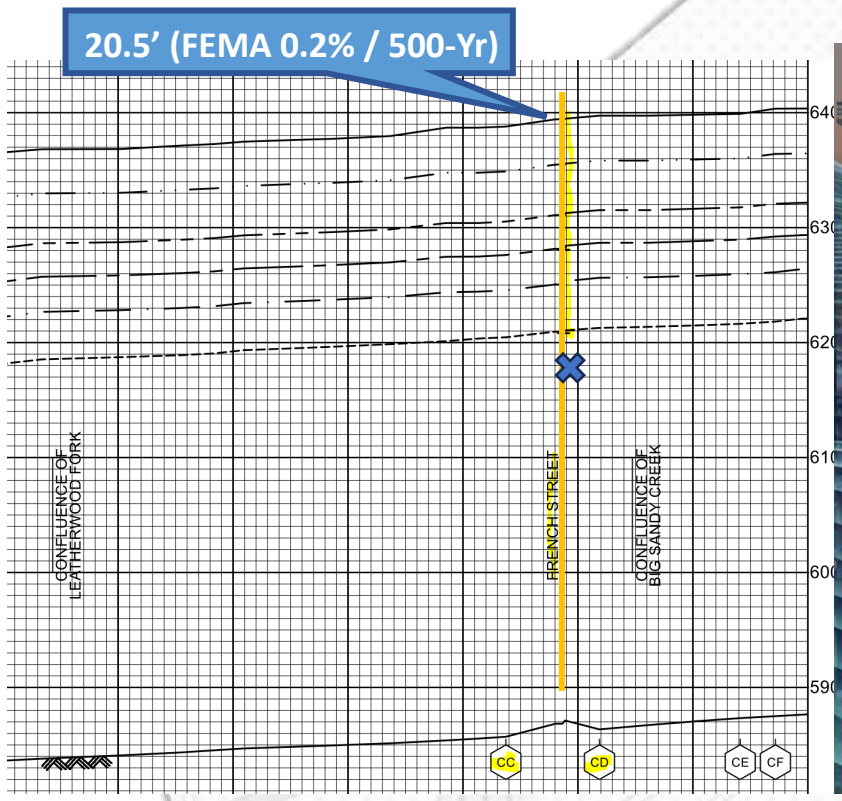


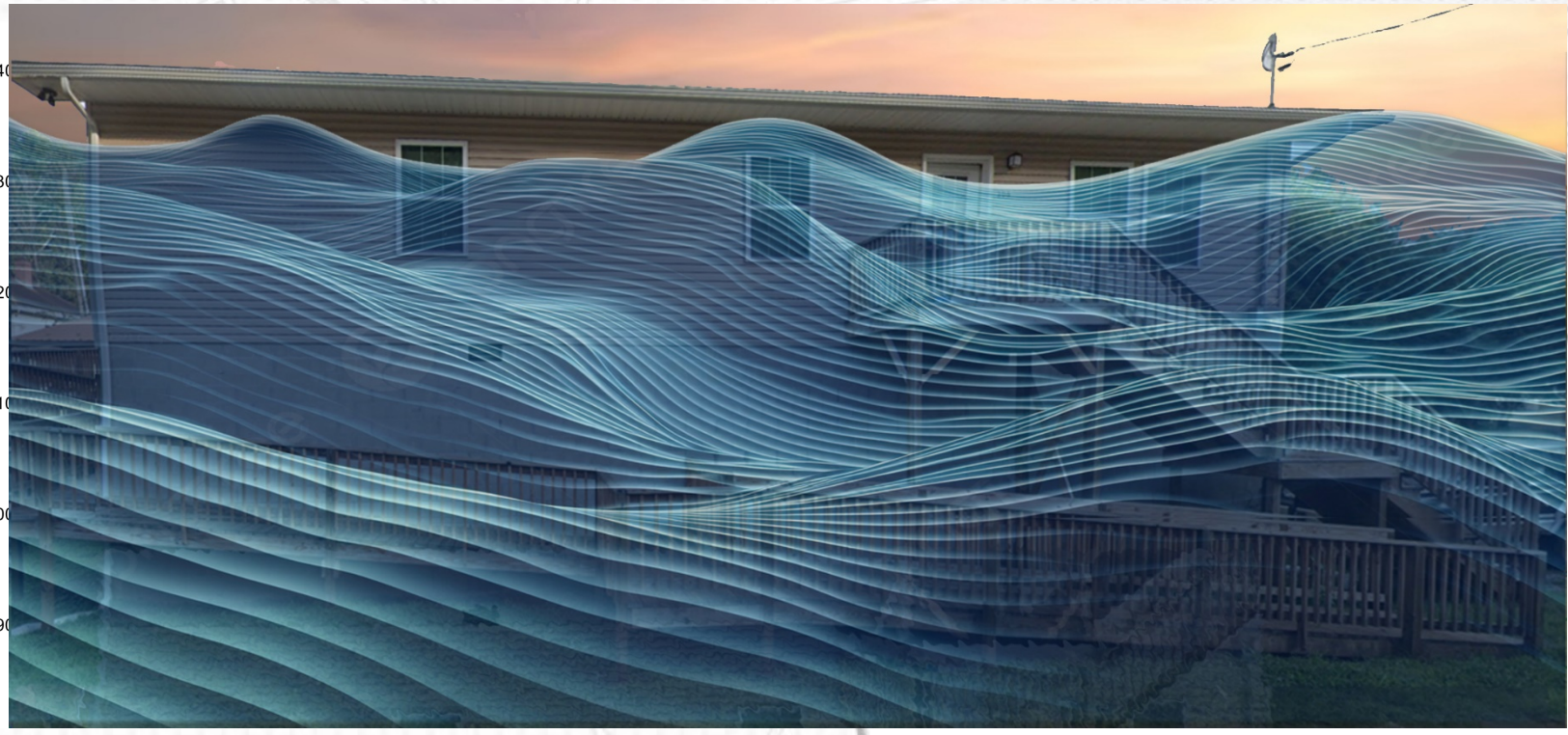
2% Probability of Flood in a year (50-year flood)

1% Probability of Flood in a year (100-year flood)



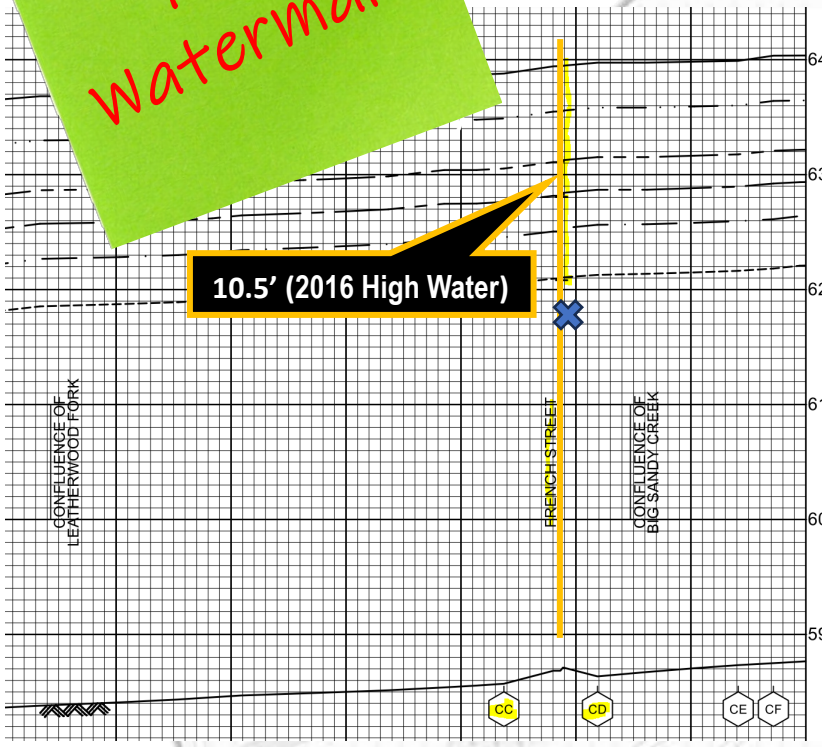
0.2% Probability of Flood in a year (500-year flood)





2016 High Watermark

High Watermark



The Design Flood Elevation (DFE) should be the BFE plus 2 feet of freeboard. The DFE should also be above the high-water marks of the 2016 flood plus freeboard.

306 Maywood Ave., Clendenin, WV, 25045

	HEIGHT (ft.)
BUILDING	
First Floor Height	12.0
Freeboard (FBD)	2.0
FLOOD DEPTH	
FEMA 10% (10-Yr)	2.0
FEMA 4% (25-Yr)	
FEMA 2% (50-Yr)	
2016 Flood HWM	
FEMA 1% (100-Yr)	
FEMA 100-Yr + FBD	
FEMA 1%+	
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building 20-02-0006-0044-0000_306

FLOOD DEPTHS: FEMA First Street Foundation (FSF) USGS 2016 Flood High Water Mark

The Design Flood Elevation (DFE) should be the BFE plus 2 feet of freeboard. The DFE should also be above the high-water marks of the 2016 flood plus freeboard.

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2016 Flood HWM	
FEMA 1% (100-Yr)	
FEMA 100-Yr + FBD	
FEMA 1%+	
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building 20-02-0006-0044-0000_306

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FEMA 2% (50-Yr)	9.5
2016 Flood HWM	
FEMA 1% (100-Yr)	
FEMA 100-Yr + FBD	
FEMA 1%+	
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building 20-02-0006-0044-0000_306

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

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FEMA 2% (50-Yr)	9.5
2016 Flood HWM	10.5
FEMA 1% (100-Yr)	
FEMA 100-Yr + FBD	
FEMA 1%+	
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building 20-02-0006-0044-0000_306

FLOOD DEPTHS: FEMA First Street Foundation (FSF) USGS 2016 Flood High Water Mark

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FLOOD DEPTH	
FEMA 10% (10-Yr)	2.0
FEMA 4% (25-Yr)	6.0
FEMA 2% (50-Yr)	9.5
2016 Flood HWM	10.5
FEMA 1% (100-Yr)	12.3
FEMA 100-Yr + FBD	14.3
FEMA 1%+	16.5
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building 20-02-0006-0044-0000_306

FLOOD DEPTHS: FEMA First Street Foundation (FSF) USGS 2016 Flood High Water Mark

The Design Flood Elevation (DFE) should be the BFE plus 2 feet of freeboard. The DFE should also be above the high-water marks of the 2016 flood plus freeboard.

306 Maywood Ave., Clendenin, WV, 25045

	HEIGHT (ft.)
BUILDING	
First Floor Height	12.0
Freeboard (FBD)	2.0
FLOOD DEPTH	
FEMA 10% (10-Yr)	2.0
FEMA 4% (25-Yr)	6.0
FEMA 2% (50-Yr)	9.5
2016 Flood HWM	10.5
FEMA 1% (100-Yr)	12.3
FEMA 100-Yr + FBD	14.3
FEMA 1%+	16.5
FEMA 0.2% (500-Yr)	20.5
FSF 0.2% (500-Yr)	

Building 20-02-0006-0044-0000_306

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

The Design Flood Elevation (DFE) should be the BFE plus 2 feet of freeboard. The DFE should also be above the high-water marks of the 2016 flood plus freeboard.

306 Maywood Ave., Clendenin, WV, 25045

	HEIGHT (ft.)
BUILDING	
First Floor Height	12.0
Freeboard (FBD)	2.0
FLOOD DEPTH	
FEMA 10% (10-Yr)	2.0
FEMA 4% (25-Yr)	6.0
FEMA 2% (50-Yr)	9.5
2016 Flood HWM	10.5
FEMA 1% (100-Yr)	12.3
FEMA 100-Yr + FBD	14.3
FEMA 1%+	16.5
FEMA 0.2% (500-Yr)	20.5
FSF 0.2% (500-Yr)	24.6

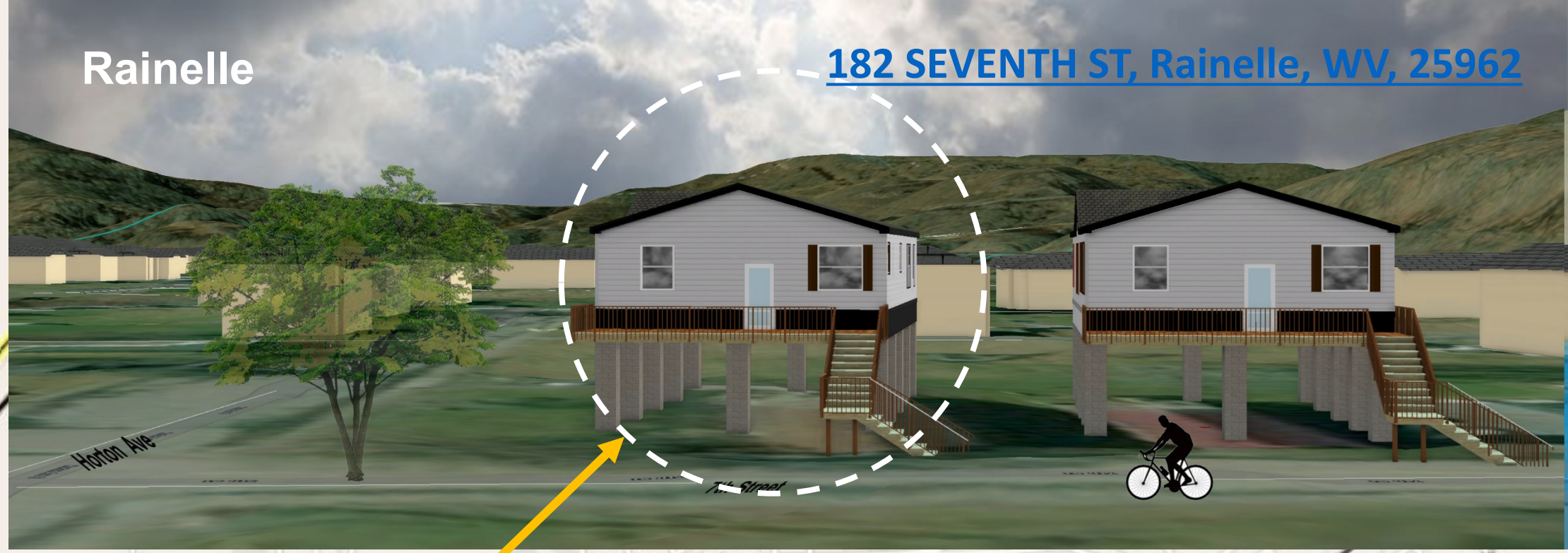
Building 20-02-0006-0044-0000_306

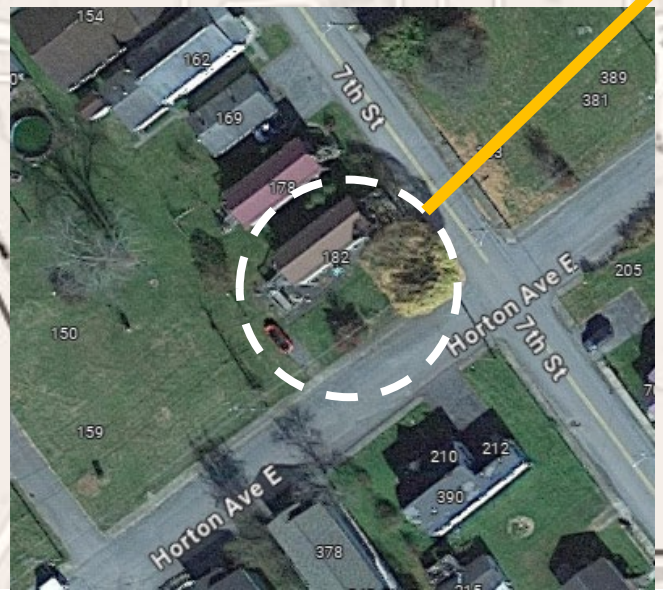
FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

Building Flood Profile

Rainelle

182 SEVENTH ST, Rainelle, WV, 25962

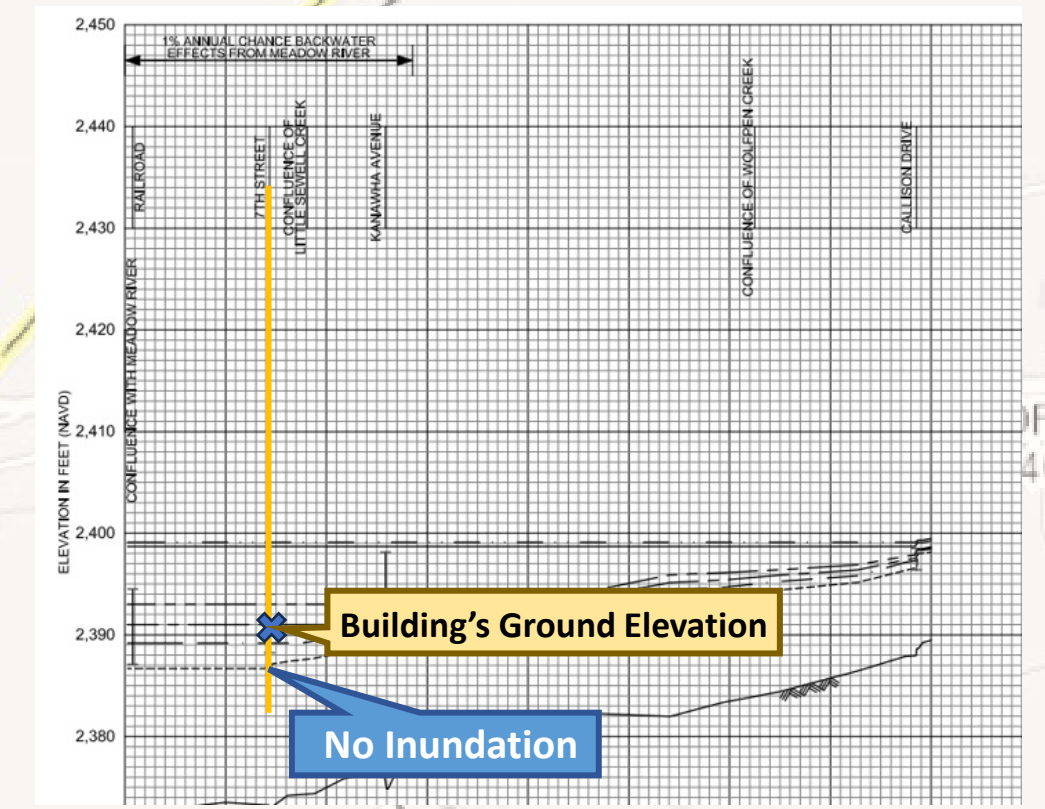


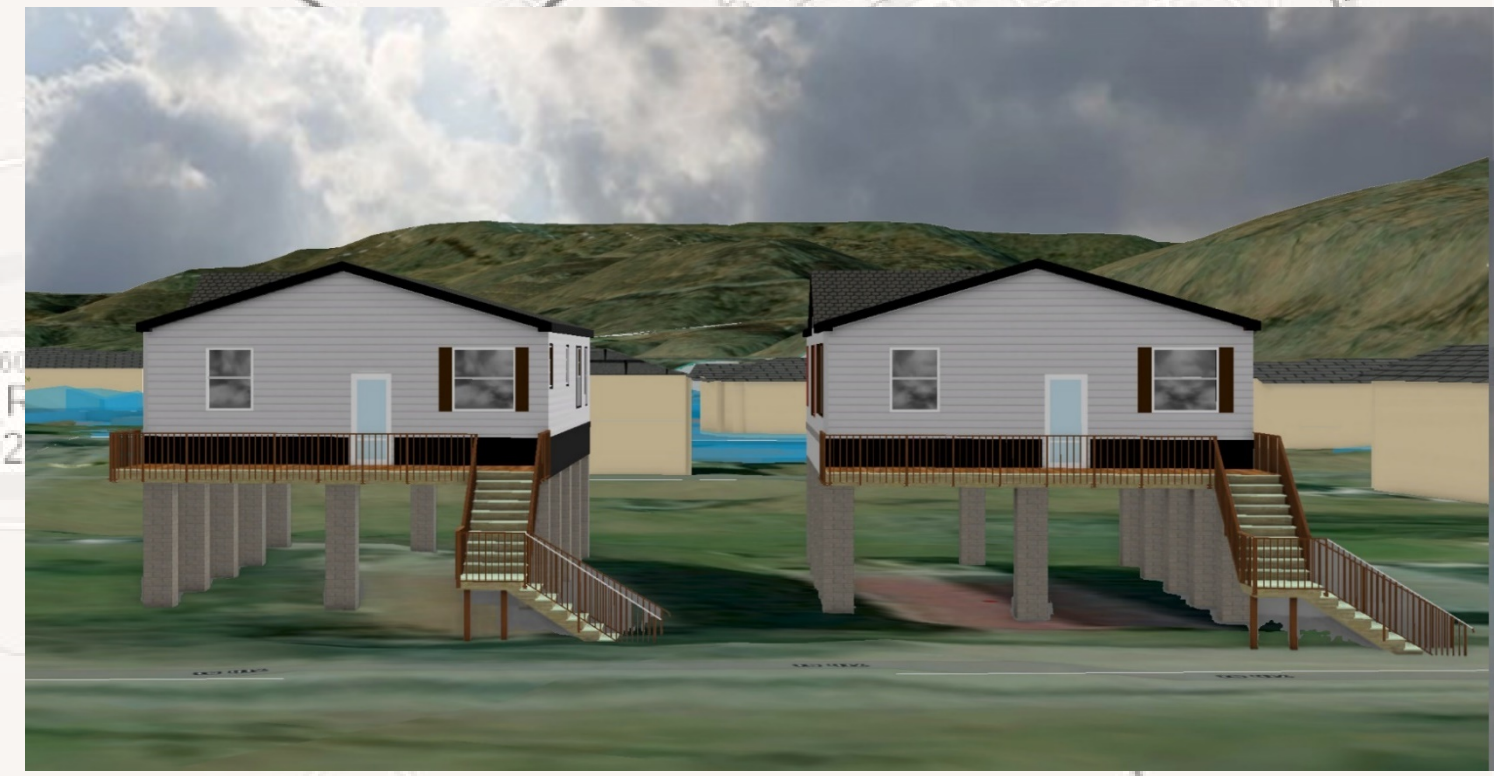


OF RAINELLE
540228

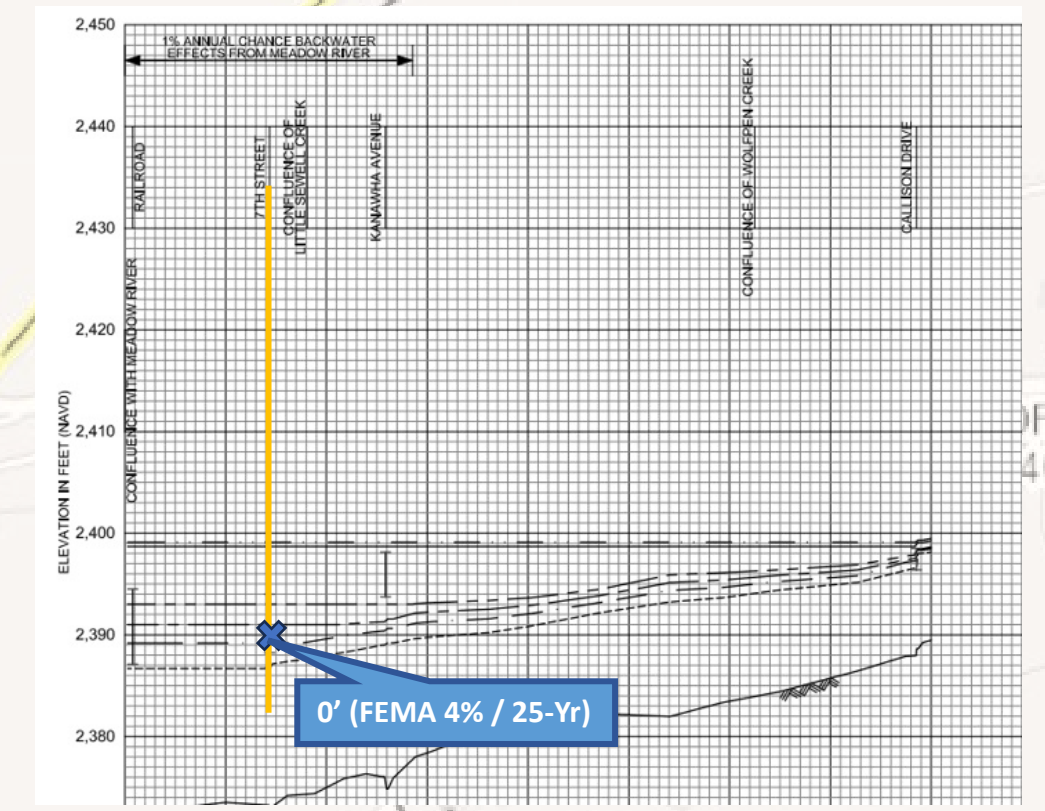
13-13-0001-0054-0000_182

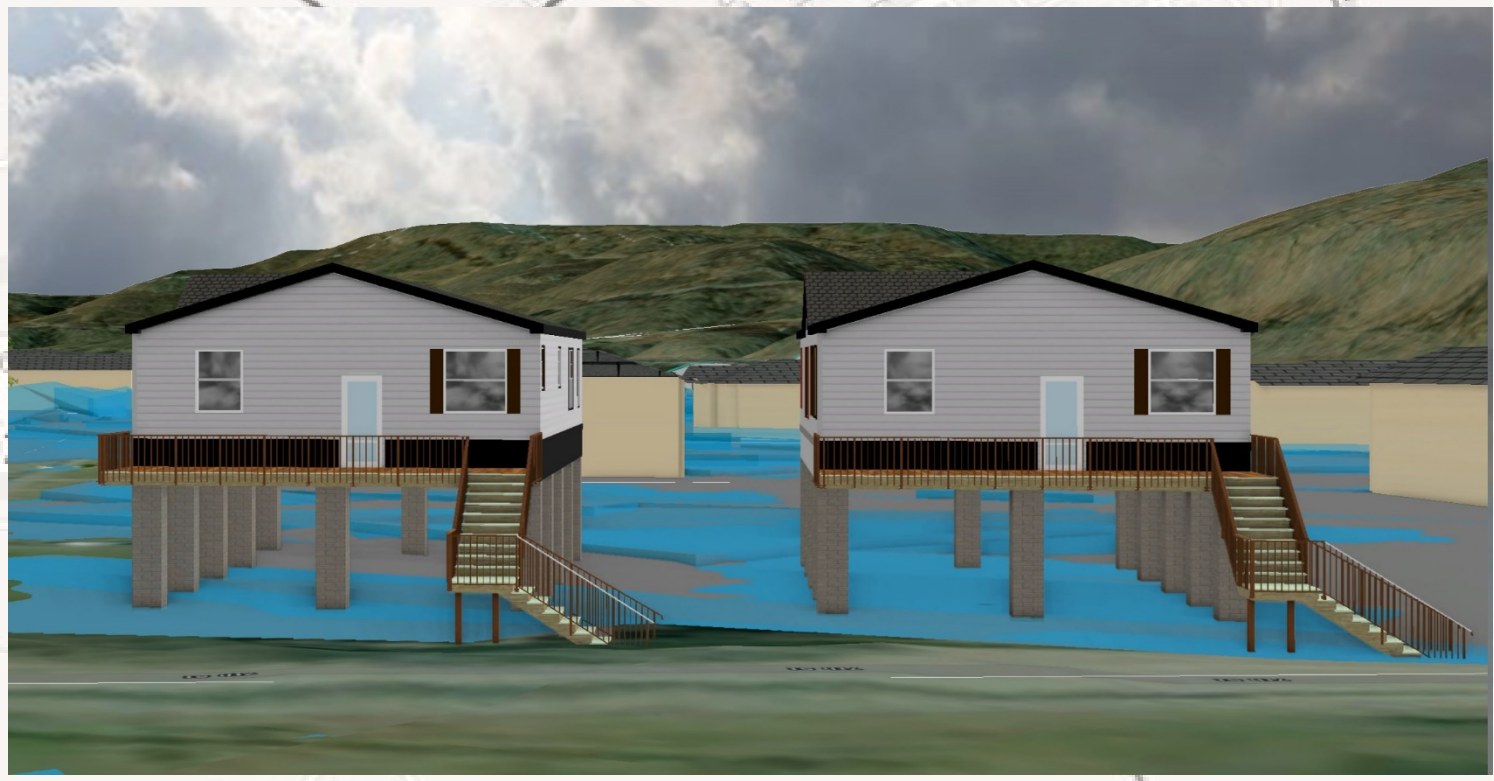
10% Probability of Flood in a year (10-year flood)



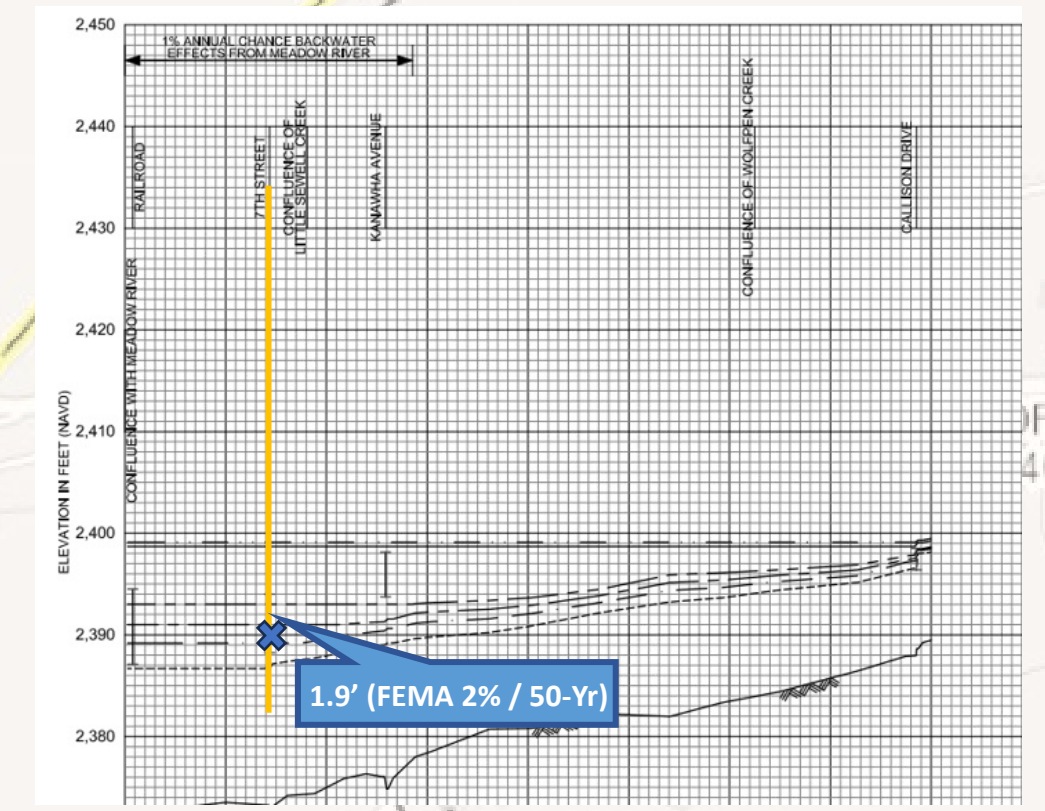


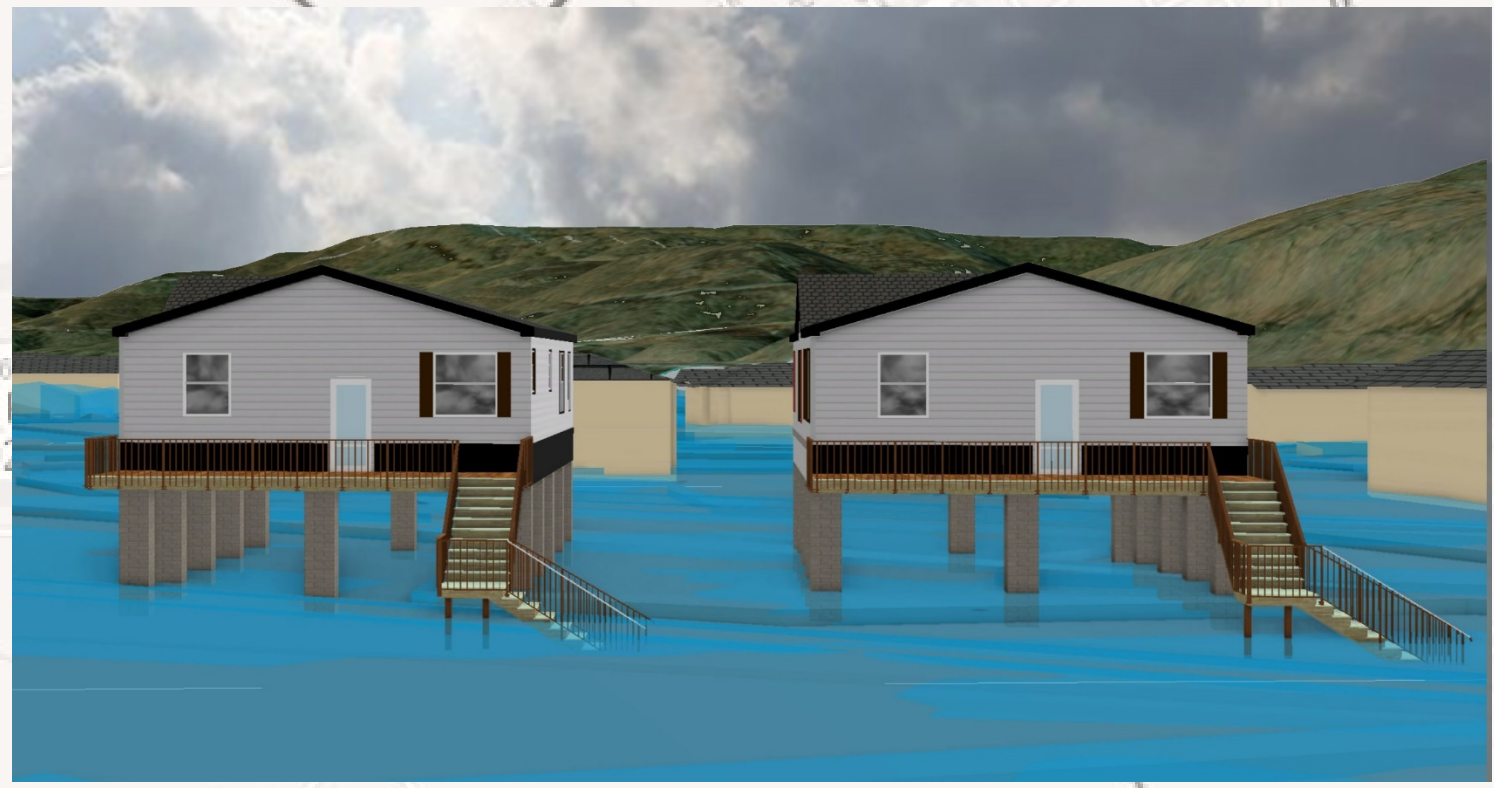
4% Probability of Flood in a year (25-year flood)



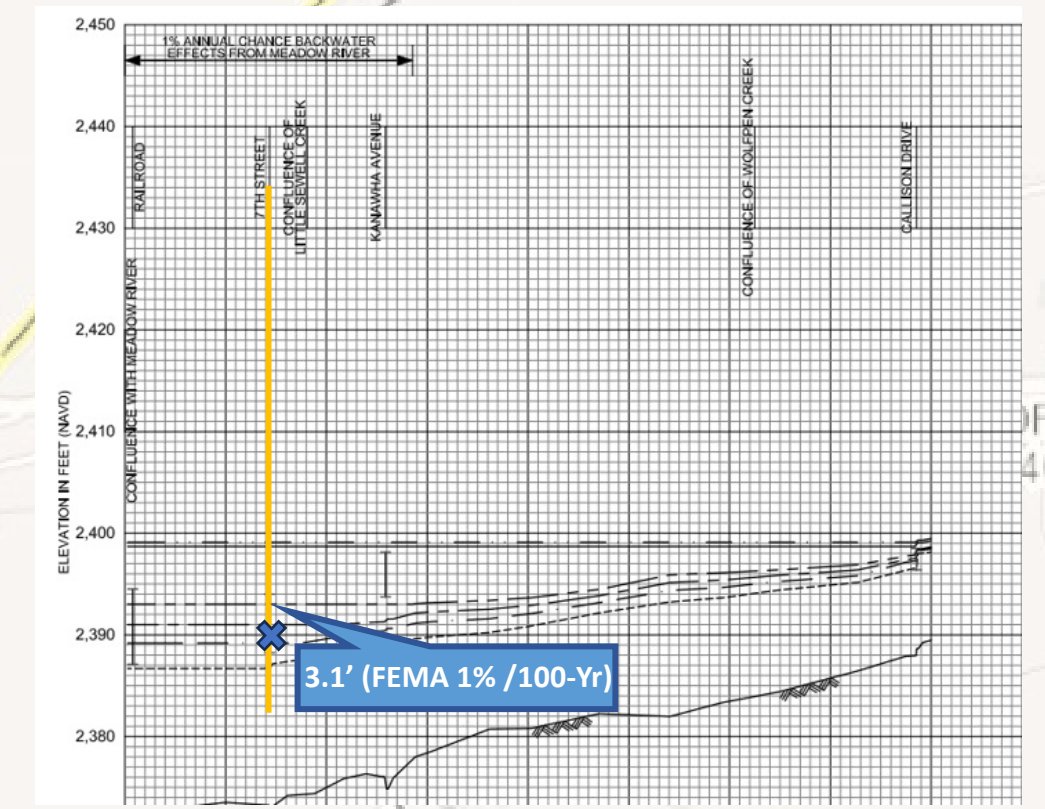


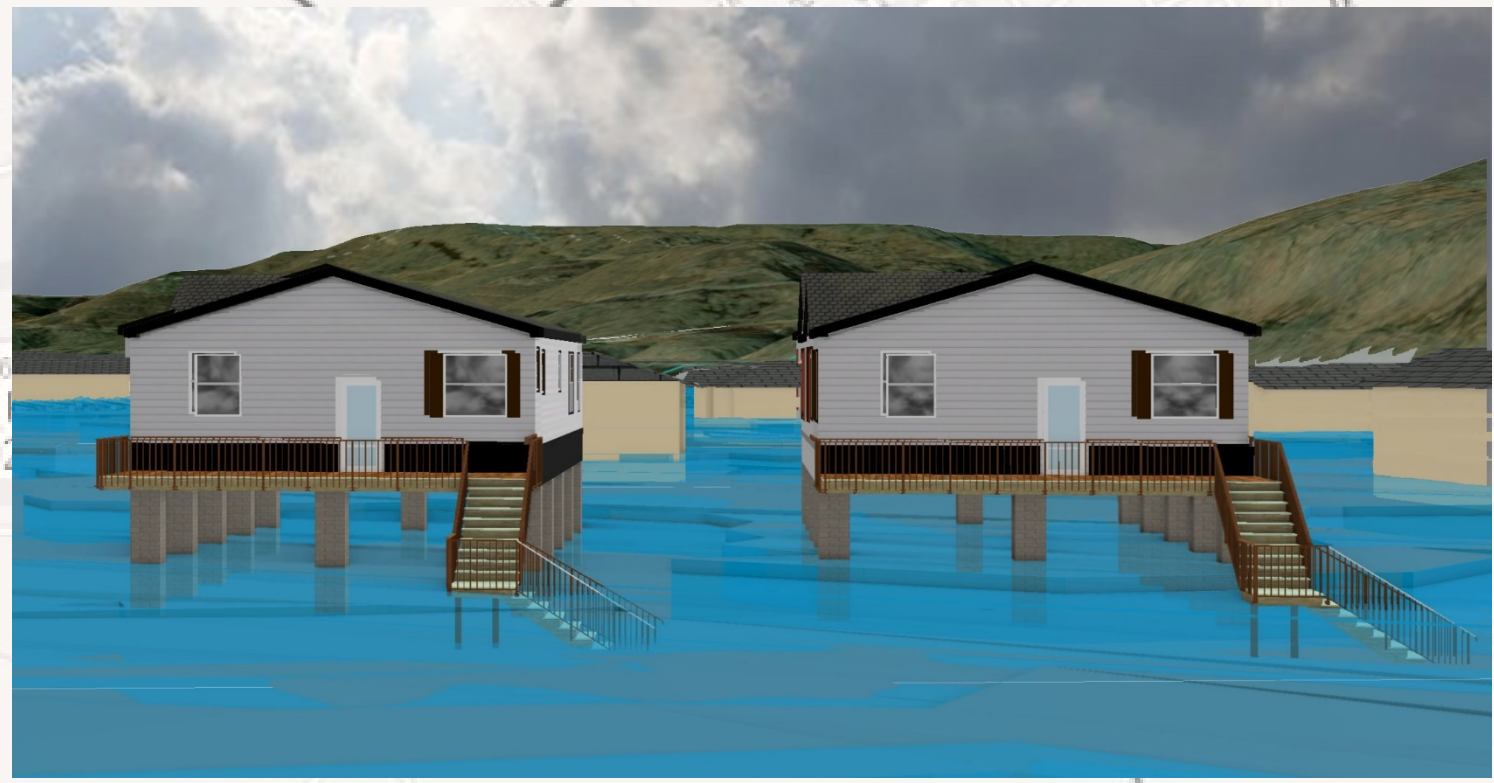
2% Probability of Flood in a year (50-year flood)



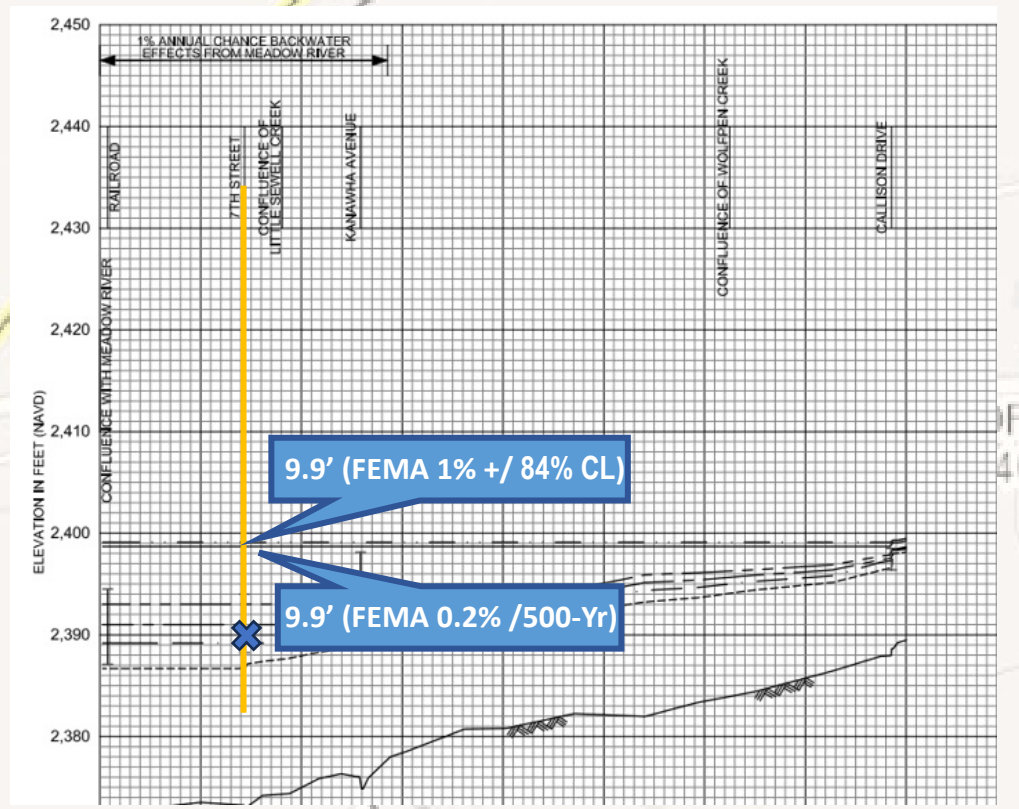


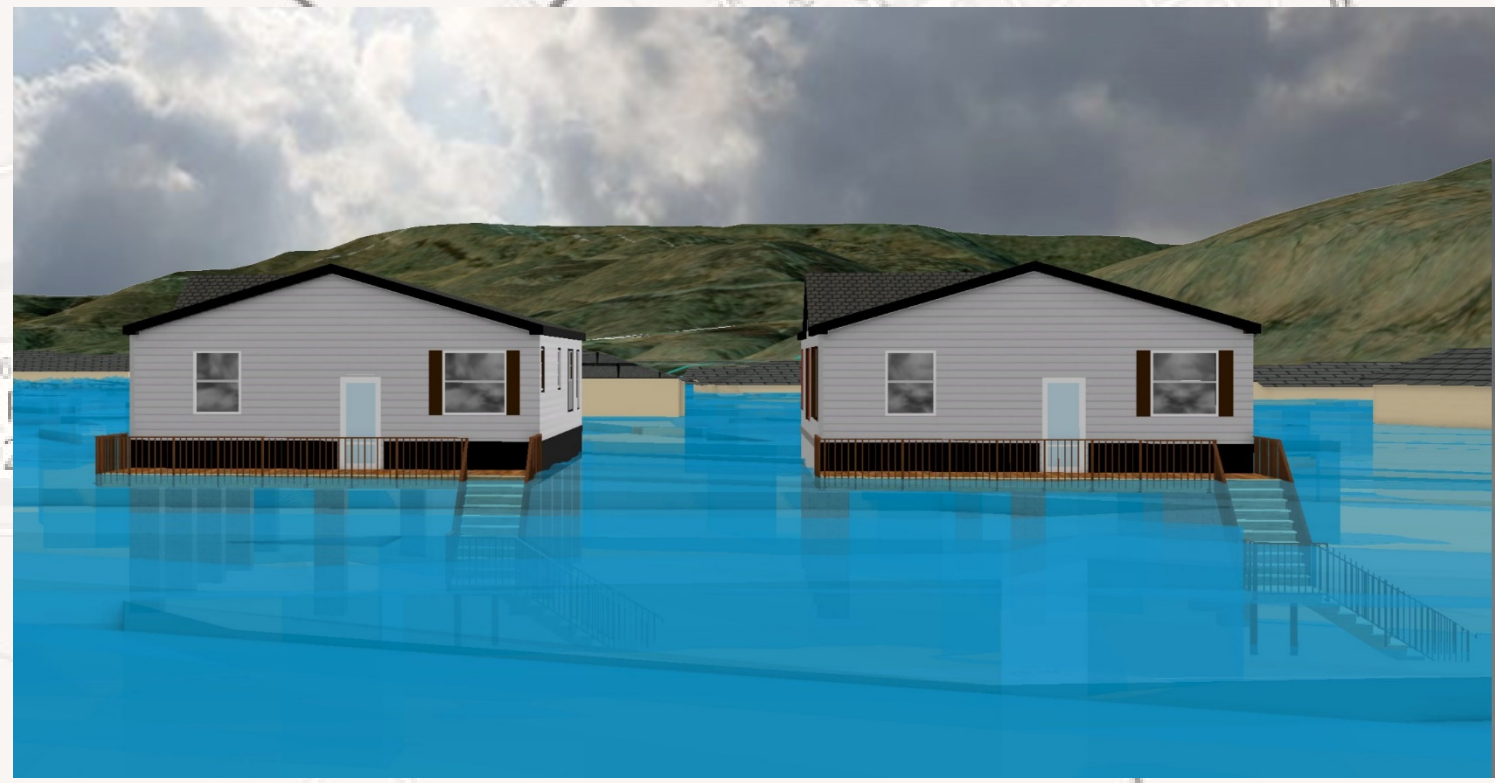
1% Probability of Flood in a year (100-year flood)





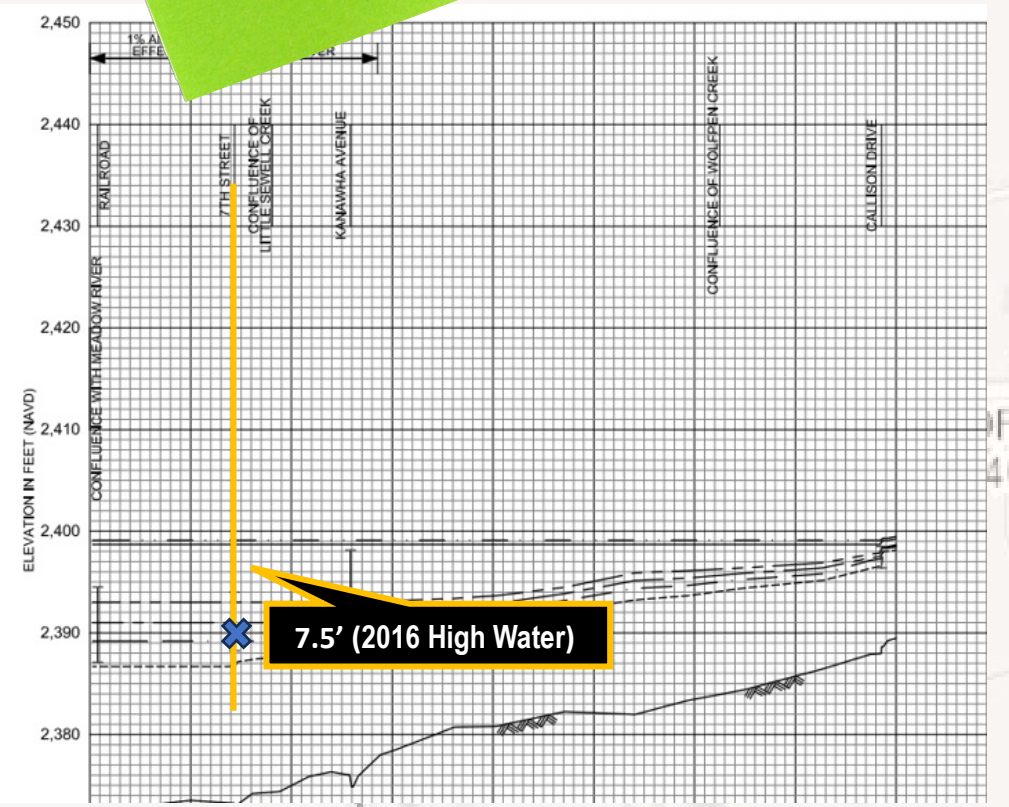
0.2% Probability of Flood in a year (500-year flood)

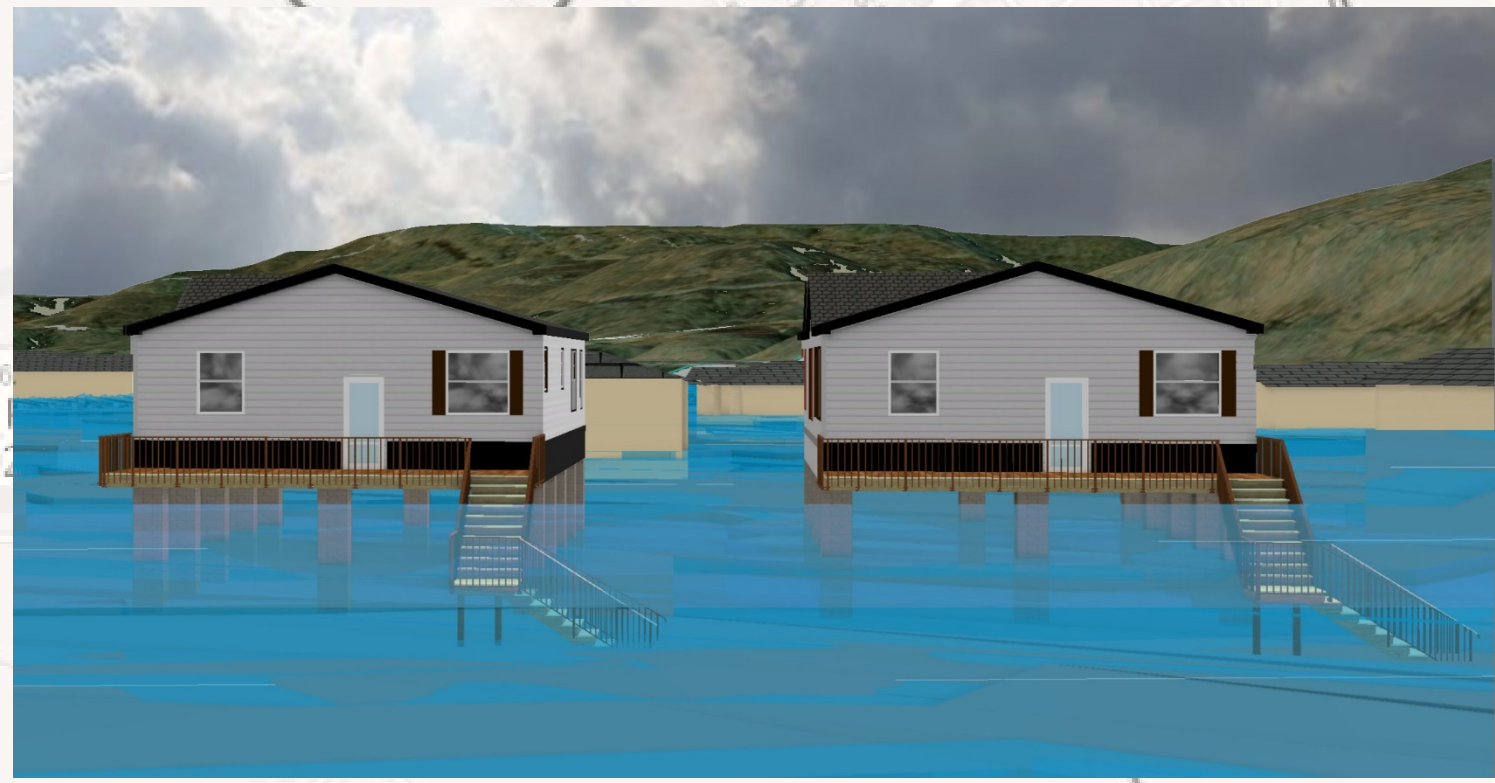




2016 High Watermark

High Watermark





	HEIGHT (ft.)
BUILDING	
First Floor Height	9
Freeboard (FBD)	2
FLOOD DEPTH	
FEMA 10% (10-Yr)	NA
FEMA 4% (25-Yr)	NA
FEMA 2% (50-Yr)	1.9
2016 Flood HWM	
FEMA 1% (100-Yr)	
FEMA 100-Yr + FBD	
FEMA 1%+	
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building: 13-13-0001-0054-0000_182

182 Seventh Street, Rainelle, WV, 25962

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

	HEIGHT (ft.)
BUILDING	
First Floor Height	9
Freeboard (FBD)	2
FLOOD DEPTH	
FEMA 10% (10-Yr)	NA
FEMA 4% (25-Yr)	NA
FEMA 2% (50-Yr)	1.9
2016 Flood HWM	
FEMA 1% (100-Yr)	3.1
FEMA 100-Yr + FBD	
FEMA 1%+	
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr) Climate	

Building: 13-13-0001-0054-0000_182

182 Seventh Street, Rainelle, WV, 25962

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

	HEIGHT (ft.)
BUILDING	
First Floor Height	9
Freeboard (FBD)	2
FLOOD DEPTH	
FEMA 10% (10-Yr)	NA
FEMA 4% (25-Yr)	NA
FEMA 2% (50-Yr)	1.9
2016 Flood HWM	
FEMA 1% (100-Yr)	3.1
FEMA 100-Yr + FBD	5.1
FEMA 1%+	9.9
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

Building: 13-13-0001-0054-0000_182

182 Seventh Street, Rainelle, WV, 25962

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

	HEIGHT (ft.)
BUILDING	
First Floor Height	9
Freeboard (FBD)	2
FLOOD DEPTH	
FEMA 10% (10-Yr)	NA
FEMA 4% (25-Yr)	NA
FEMA 2% (50-Yr)	1.9
2016 Flood HWM	7.5
FEMA 1% (100-Yr)	3.1
FEMA 100-Yr + FBD	5.1
FEMA 1%+	9.9
FEMA 0.2% (500-Yr)	
FSF 0.2% (500-Yr)	

FLOOD DEPTHS: **FEMA** **First Street Foundation (FSF)** **USGS 2016 Flood High Water Mark**

	HEIGHT (ft.)
BUILDING	
First Floor Height	9
Freeboard (FBD)	2
FLOOD DEPTH	
FEMA 10% (10-Yr)	NA
FEMA 4% (25-Yr)	NA
FEMA 2% (50-Yr)	1.9
2016 Flood HWM	7.5
FEMA 1% (100-Yr)	3.1
FEMA 100-Yr + FBD	5.1
FEMA 1%+	9.9
FEMA 0.2% (500-Yr)	9.9
FSF 0.2% (500-Yr)	

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

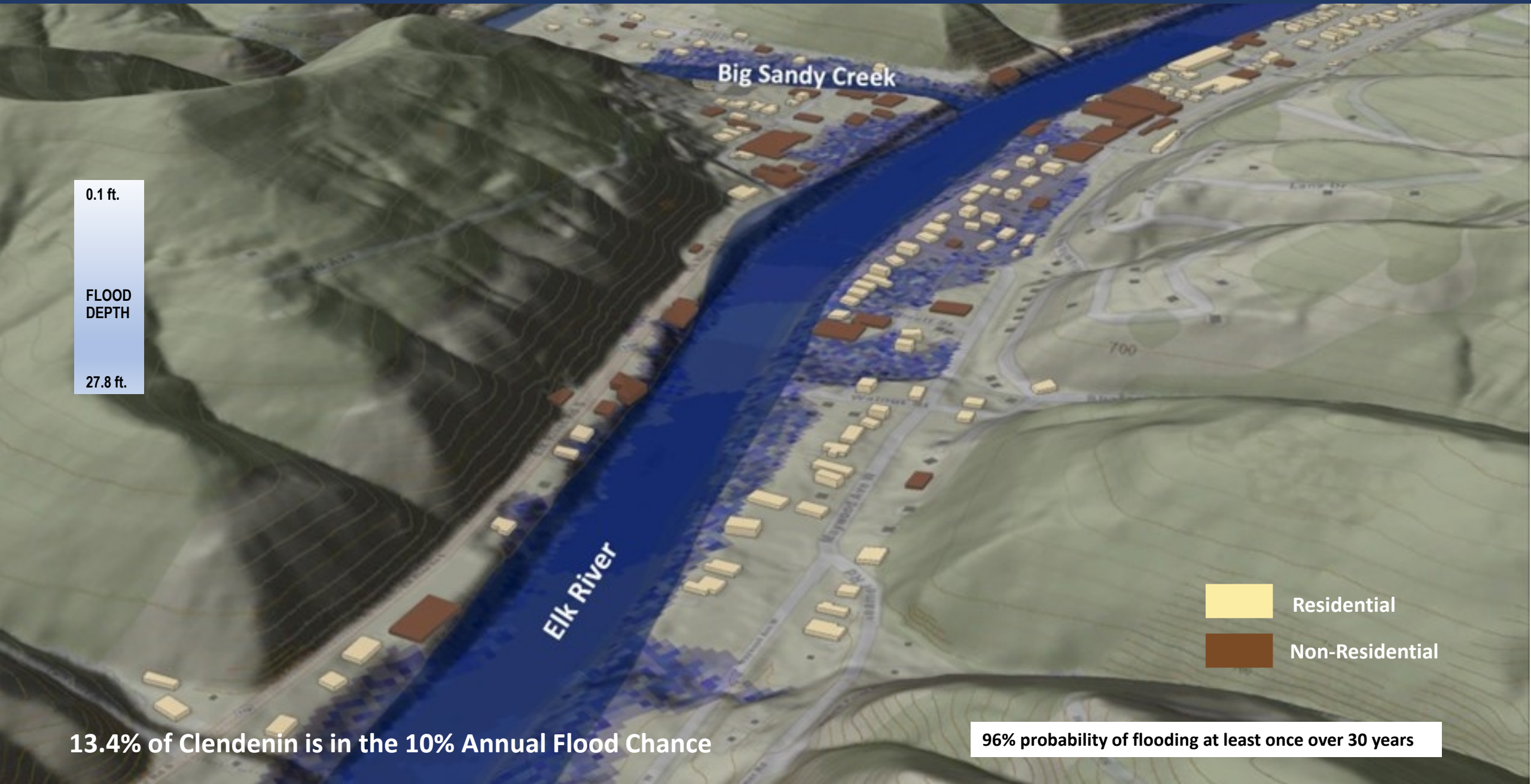
	HEIGHT (ft.)
BUILDING	
First Floor Height	9
Freeboard (FBD)	2
FLOOD DEPTH	
FEMA 10% (10-Yr)	NA
FEMA 4% (25-Yr)	NA
FEMA 2% (50-Yr)	1.9
2016 Flood HWM	7.5
FEMA 1% (100-Yr)	3.1
FEMA 100-Yr + FBD	5.1
FEMA 1%+	9.9
FEMA 0.2% (500-Yr)	9.9
FSF 0.2% (500-Yr)	12.2

FLOOD DEPTHS: FEMA | First Street Foundation (FSF) | USGS 2016 Flood High Water Mark

Clendenin

FEMA 10% Annual Chance (10-year)

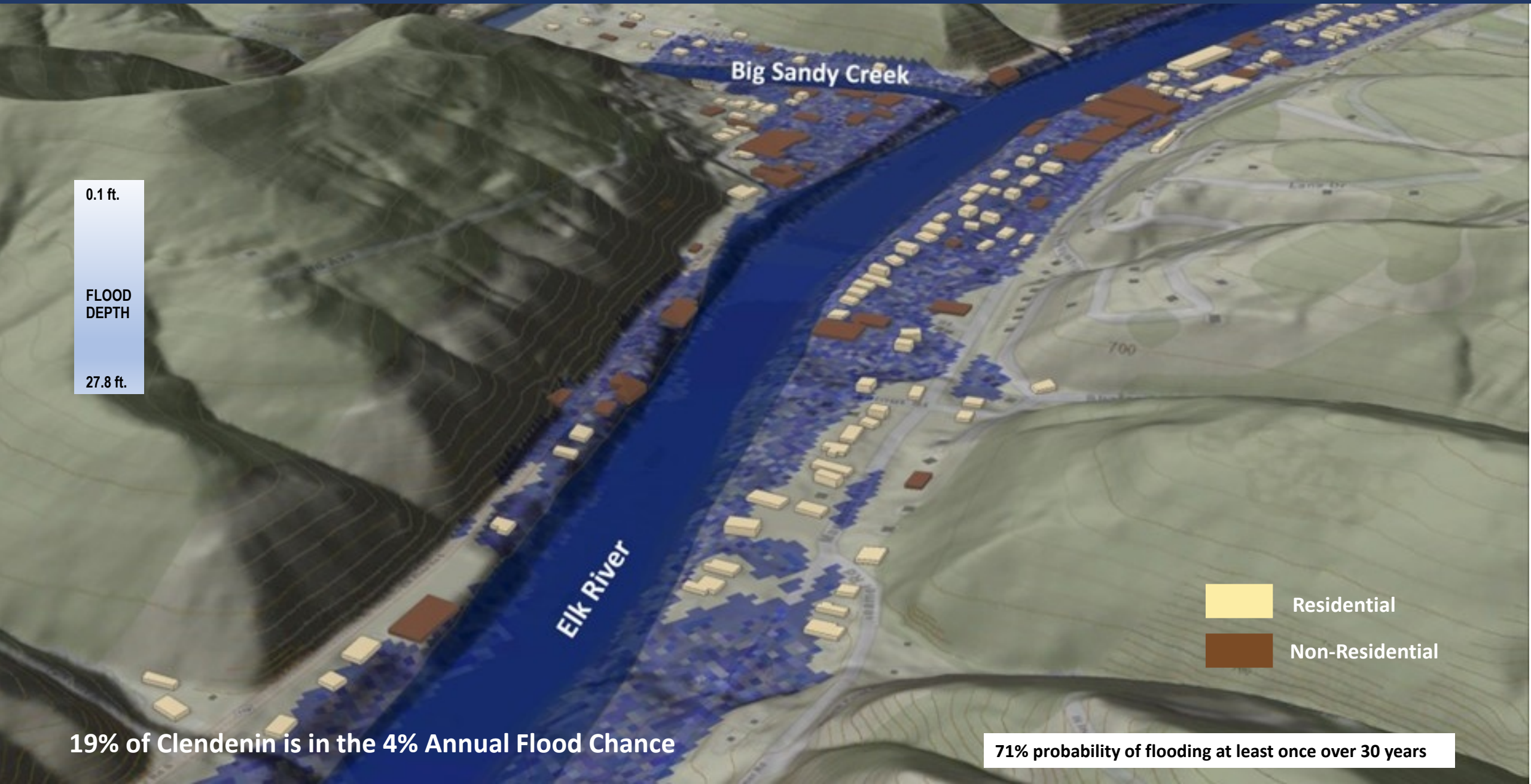
Clendenin, WV



13.4% of Clendenin is in the 10% Annual Flood Chance

96% probability of flooding at least once over 30 years

FEMA 4% Annual Chance (25-year) Clendenin, WV

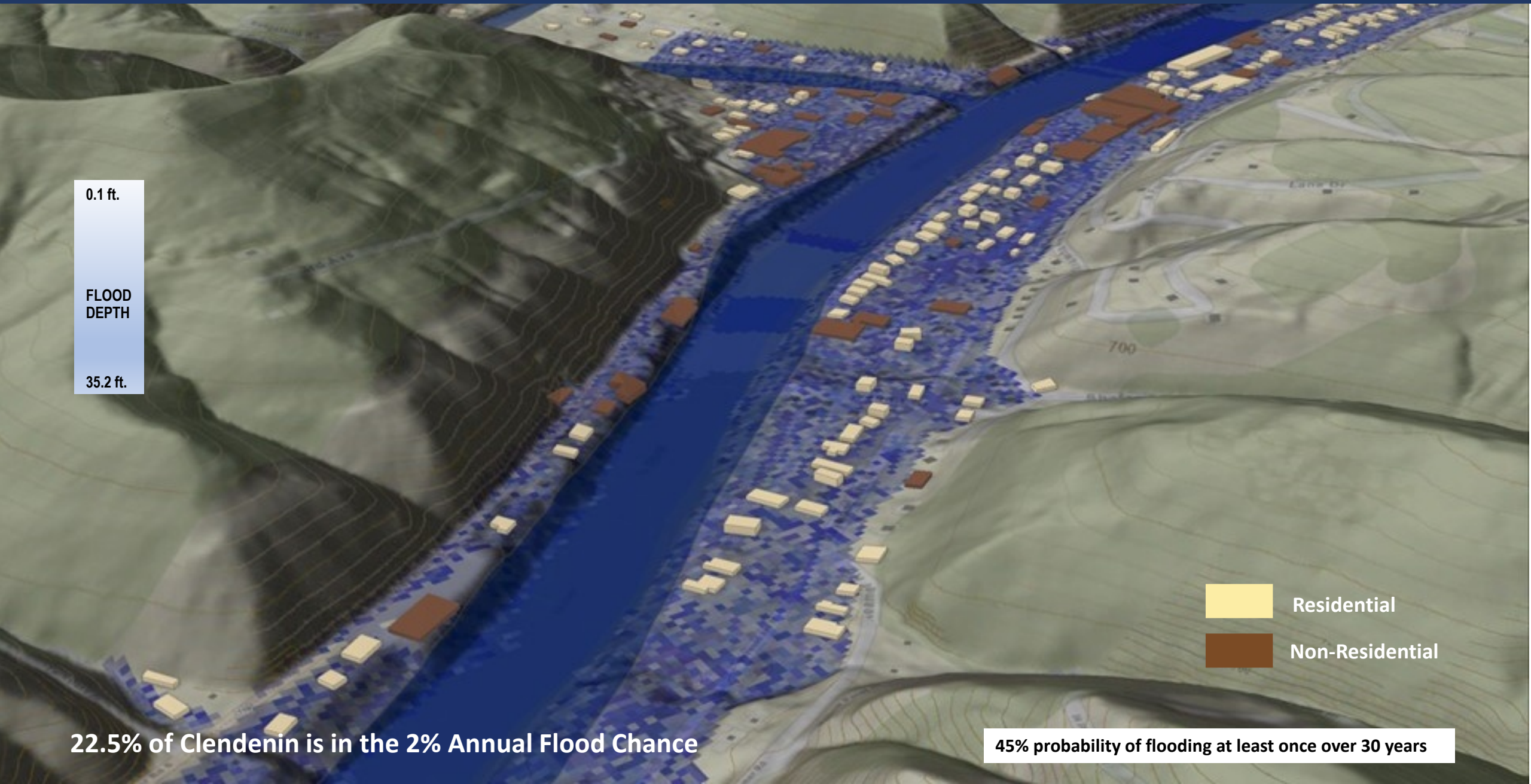


19% of Clendenin is in the 4% Annual Flood Chance

71% probability of flooding at least once over 30 years

FEMA 2% Annual Chance (50-year)

Clendenin, WV

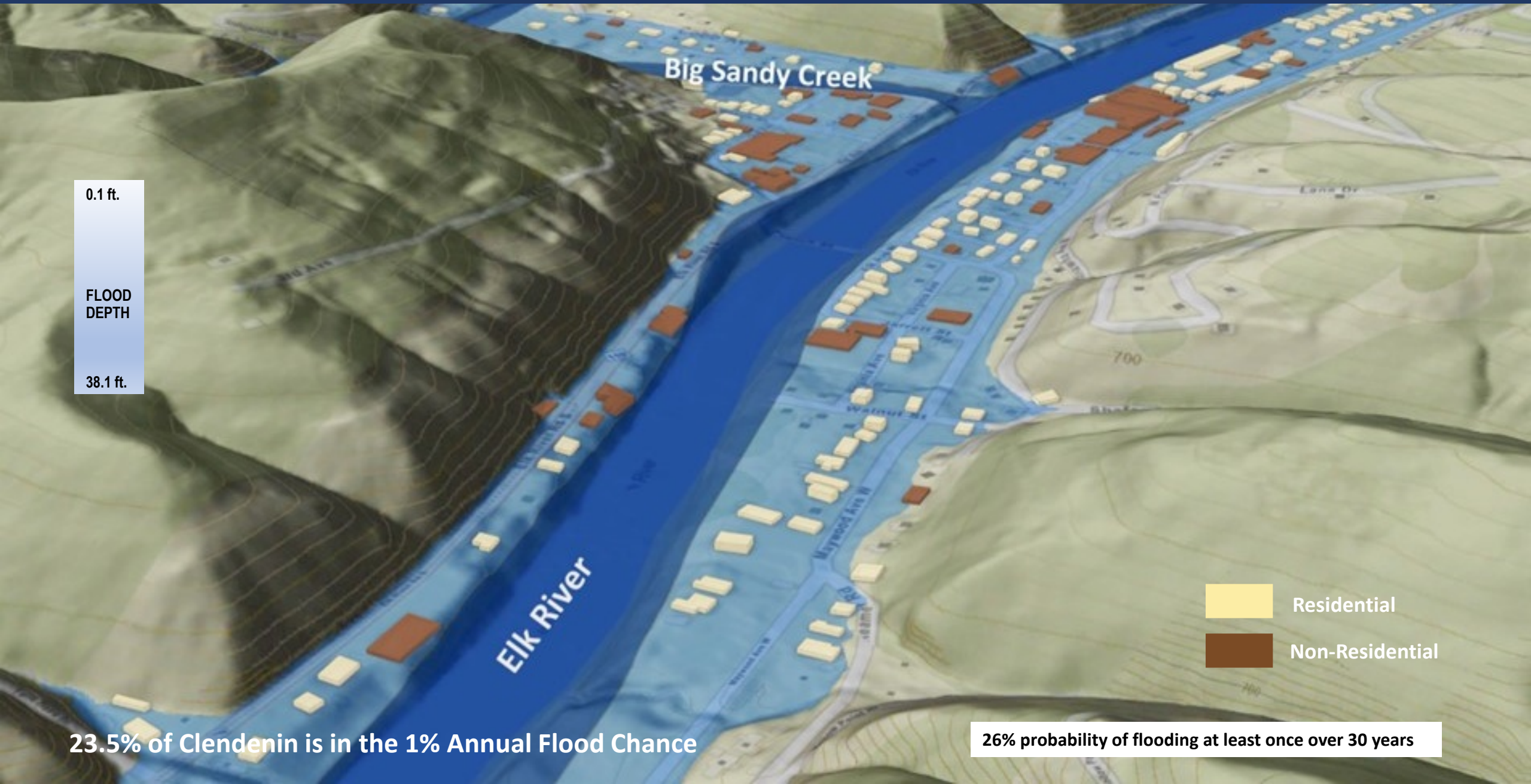


22.5% of Clendenin is in the 2% Annual Flood Chance

45% probability of flooding at least once over 30 years

FEMA 1% Annual Chance (100-year)

Clendenin, WV

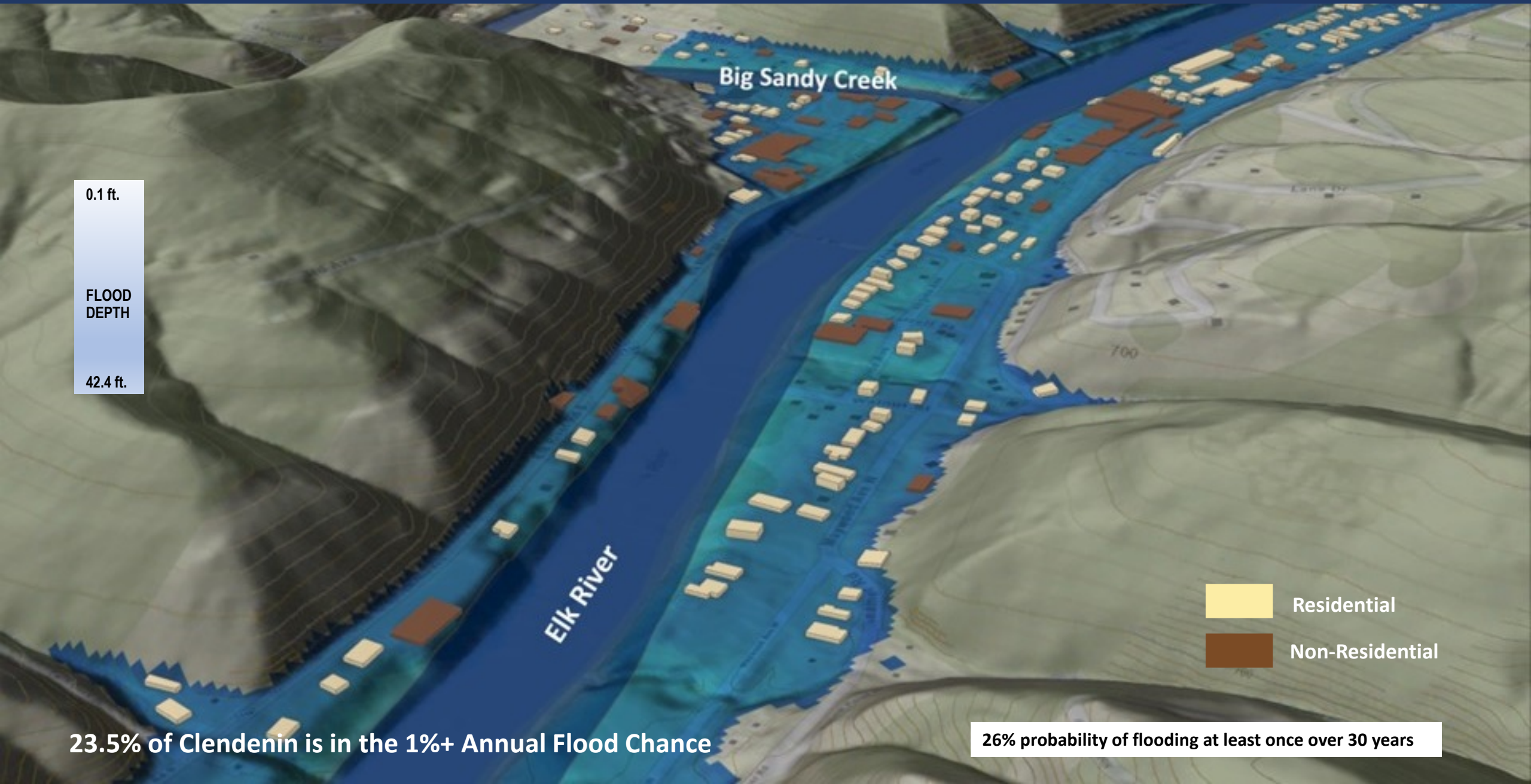


23.5% of Clendenin is in the 1% Annual Flood Chance

26% probability of flooding at least once over 30 years

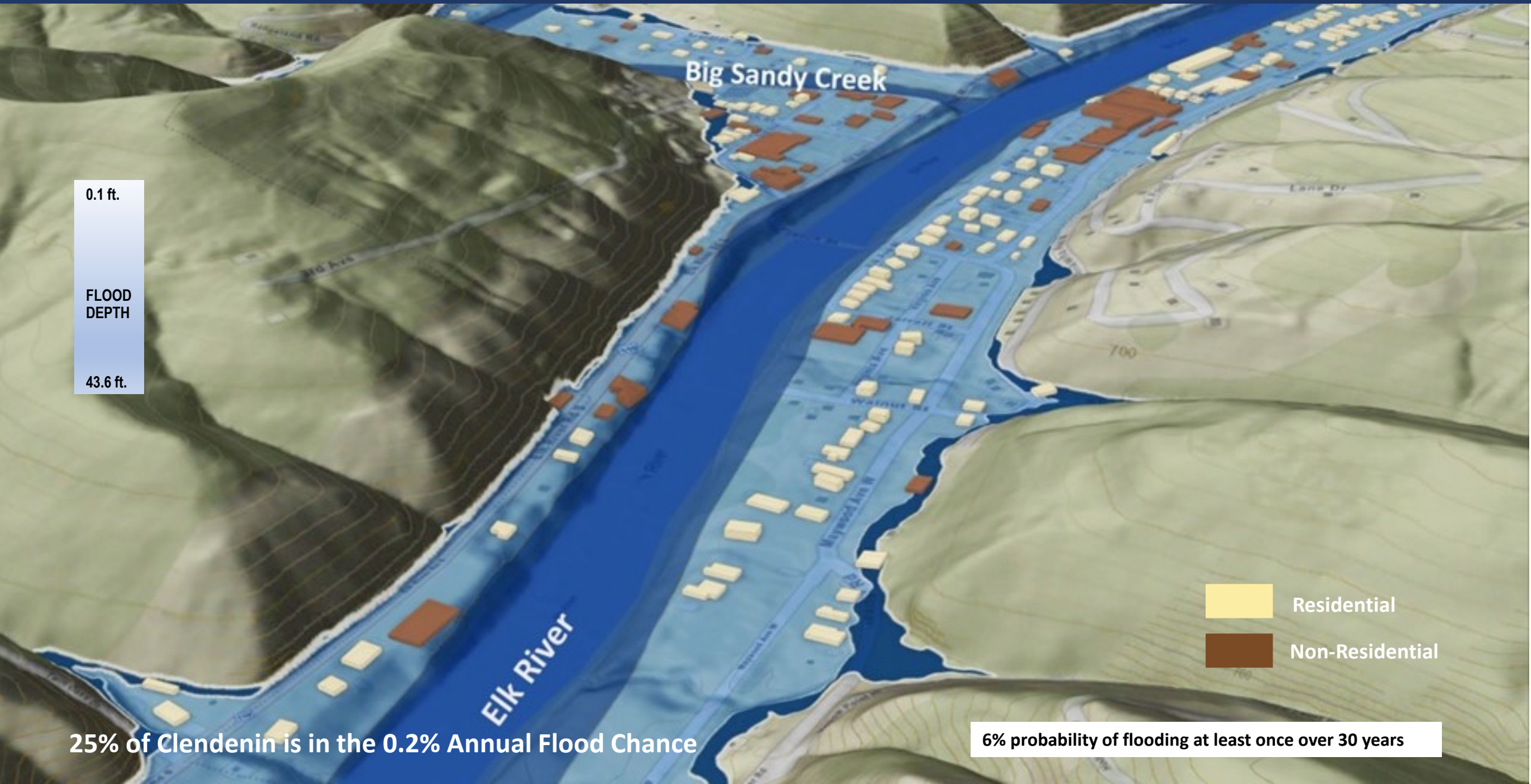
FEMA 1%+ Annual Chance (100-year)

Clendenin, WV



FEMA 0.2% Annual Chance (500-year)

Clendenin, WV



25% of Clendenin is in the 0.2% Annual Flood Chance

6% probability of flooding at least once over 30 years

Rainelle

FEMA 10% Annual Chance (10-year)

Rainelle, WV

96% probability of flooding at least once over 30 years

13% Rainelle is in the 10% Annual Flood Chance

FEMA 4% Annual Chance (25-year)

Rainelle, WV

71% probability of flooding at least once over 30 years

20% Rainelle is in the 4% Annual Flood Chance

FEMA 2% Annual Chance (50-year)

Rainelle, WV

FEMA 1% Annual Chance (100-year)

Rainelle, WV

FEMA 1%+ Annual Chance (100-year)

Rainelle, WV

26% probability of flooding at least once over 30 years

31% Rainelle is in the 1% + Annual Flood Chance

FEMA 0.2% Annual Chance (100-year)

Rainelle, WV

6% probability of flooding at least once over 30 years

37% Rainelle is in the 0.2% Annual Flood Chance