

West Virginia Flood Resiliency Framework (WVFRF)



West Virginia Risk Explorer

Localized risk assessment tools for analysis and visualization

Behrang Bidadian, Ph.D.

September 28, 2026



WV GIS Technical Center
West Virginia University



About West Virginia GIS Tech Center (WVGISTC)

Director/Project Manager:

Kurt Donaldson



Faculty Director:

Aaron Maxwell, Ph.D.



Mission:

- Spatial data infrastructure enhancement
- Advisory services and training programs in geographic information science
- GIS research and education
- **Support disaster resilience in the state:**
Flood & Landslide risk assessment



WV GIS Technical Center (WVGISTC)

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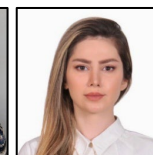
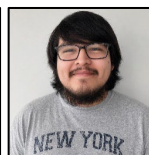
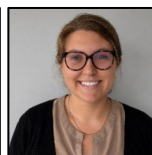
Full-Time Team:

- Three Risk Analysts/GIS Specialists
- Two GIS Programmers/Developers



Part-Time / Temporary Team:

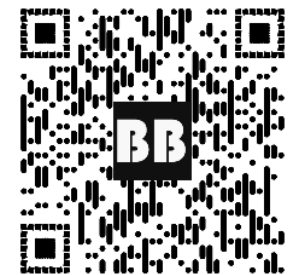
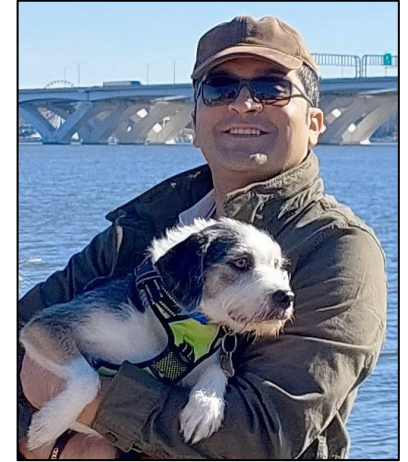
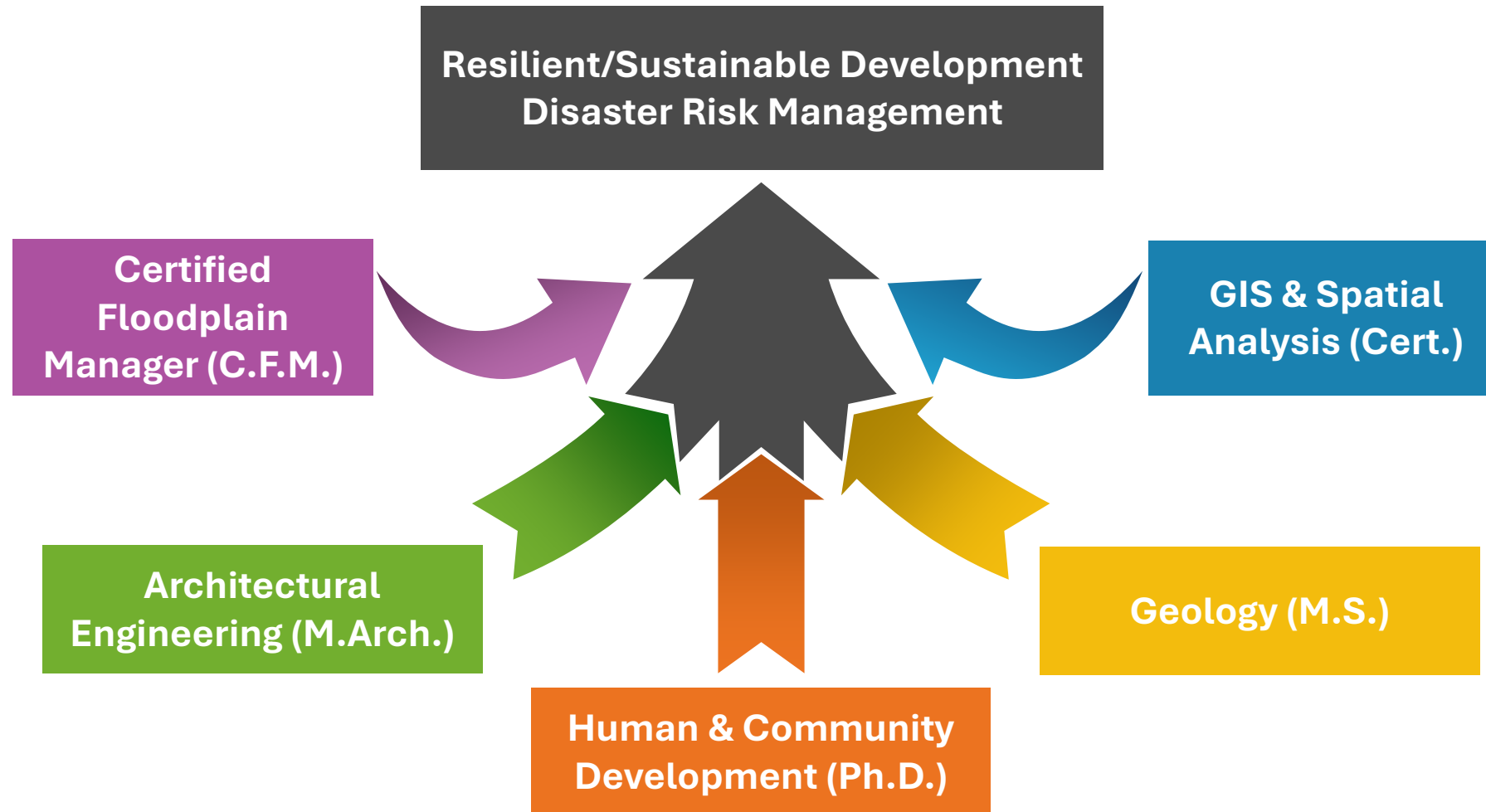
- Graduate Research Assistants (8 in Fall 2026)
- Undergraduate Student Workers (2 in Fall 2026)
- Mountaineer Temps (2 in Fall 2026)
- Contractors/Consultants



About me

Behrang Bidadian

Working at the WV GIS Tech Center since 2019



behrangbidadian.org

Flood Risk in WV



- **65** Federally Declared Flood Disasters Since 1953

- **233** Lives Lost to Flood Disasters

- About **98,000** Buildings (**9%**) in the 1%-Annual-Chance (100-Year) Floodplain

- About **199,000** People (**11%**) Reside in the 100-Year Floodplain



July 1961
(22 + 2 landslide fatalities)



February 1972
(123 fatalities)



November 1985
(49 fatalities)



June 2016
(23 fatalities)



July 2026
(2 fatalities)



WV Flood Resiliency Framework (WVFRF)



A virtual hub of risk assessment, visualization, planning, and training resources for building community flood resiliency in WV

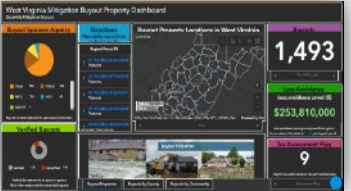
Flood Visualizations



WV Flood Tool



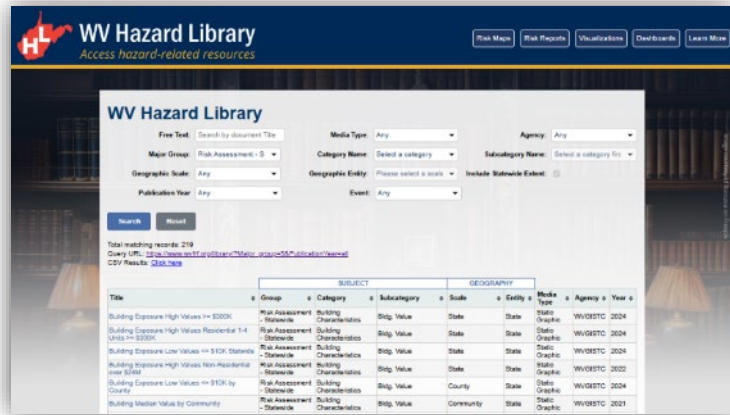
Flood Dashboards



WV Risk Explorer



Example Tools



Hazard Library

RISK TOOLS

- WV Risk Explorer
- WV Flood Tool
- Visualizations
- Dashboards

9 Geographic Scales

COMMUNITY ENGAGEMENT

- Focused Outreach Meetings
- Flood Symposiums
- Resiliency Tools & Products
- Learning Resources & Reports



Community Engagement Meeting

HAZARD LIBRARY

Search online hazard resources by title, subject, media, event, geography, data, etc.

STAKEHOLDERS

- Risk Reduction Associates
- Emergency Responders
- Floodplain Managers
- Local Officials
- Volunteers
- Public



Flood Symposium Stakeholders

Stakeholders



WVFRF

[PROJECT OVERVIEW](#) [WV RISK EXPLORER](#) [WV FLOOD TOOL](#) [CONTRIBUTORS](#) [CONTACT US](#)

WEST VIRGINIA FLOOD RESILIENCY FRAMEWORK



Image courtesy of The Atlantic

A virtual hub of risk assessment, visualization, planning, and training resources for building community flood resiliency in West Virginia

PRIMARY TOOLS



WV Risk Explorer



WV Flood Tool



WV Property Viewer



WV Hazard Library

Benefits of the Tools



■ Planning

- Enhancing state resiliency and hazard mitigation plans
- Updating emergency operation plans
- Prioritizing and allocating resources
- Identifying the need for more refined risk assessments



■ Risk Communications

- Encouraging community-level risk communication and engagement
- Educating new homeowners and renters
- Informing the insurance and mortgage industries



■ Mitigation

- Identifying areas of mitigation interest
- Supporting the development or enhancement of codes and standards
- Informing long-term community recovery



WV Floodplain Building Inventory (BI)



Riverine Flood Exposure Assessment (Building-Level)

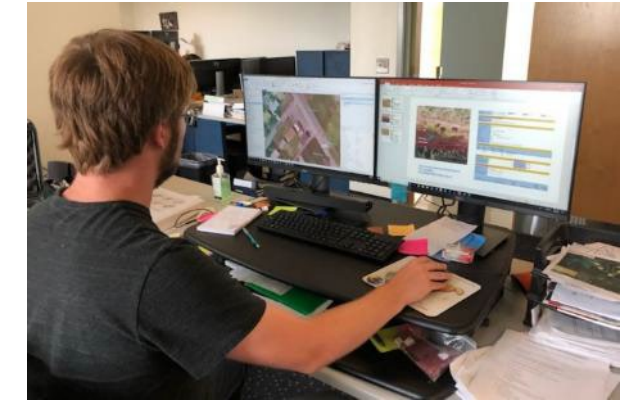
Funded by: FEMA Hazard Mitigation Grant Program (HMGP), Cooperating Technical Partners (CTP) Program, and State Hazard Mitigation Office

- All primary (insurable) structures in FEMA's 1%-annual-chance (100-yr) floodplain
- Community Assets (Historical & Non-Historical) in the 100-yr floodplain
- Essential Facilities in the 100-yr and 500-yr floodplains

Essential Facilities



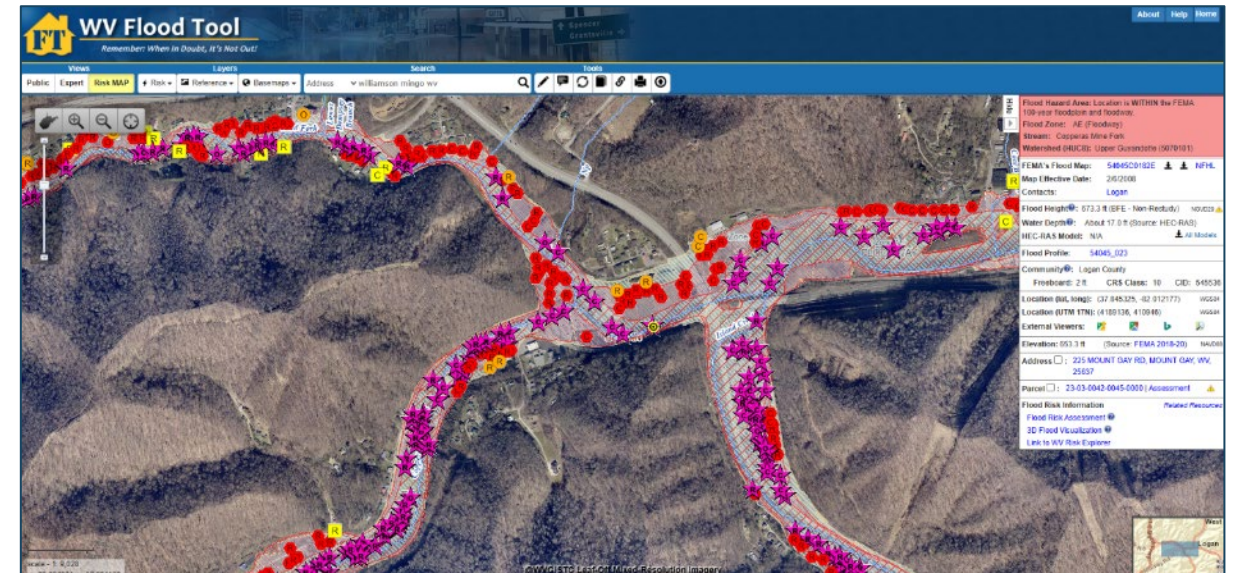
Community Assets



Detailed building characteristics from tax assessment
+
Damage assessment based on flood loss models
+
Population exposure and displacement estimates (100-yr flood)

Manual process of identification using Arc GIS
+
Programmed scripts to extract and process data

Product: **WV Flood Tool**  mapwv.gov/flood



Analytical & Visualization Tools at Multiple Scales



Political Boundaries

State



PDC Regions (11)



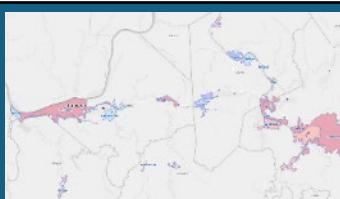
Counties (55)



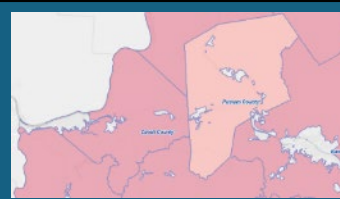
Communities (284)



**Incorporated
Places
(229)**



**Unincorporated
Areas
(55)**



Drainage Areas / Streams

**Watersheds
(33)**



**Streams/Rivers
(156)**

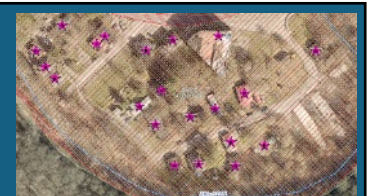


Property Levels

Parcels



Buildings



Overall Flood Risk

(1) FLOODPLAIN CHARACTERISTICS

Floodplain Area

Floodplain Length^{1 2}

Floodplain Depth^{1 2}

Flood Disaster Frequency

(2) BUILDING EXPOSURE

Building Floodplain Count^{1 2}

Building Floodway Count^{1 2}

Building Floodplain Ratio²

Building Density^{1 2}

(3) BUILDING CHARACTERISTICS

Building Value^{1 2}

Mobile Homes

Basement

One Story

Building Year*

(4) CRITICAL INFRASTRUCTURE

Essential Facilities

Roads Inundated

(5) COMMUNITY ASSETS

Historical Assets

Non-Historical Assets

(6) BUILDING DAMAGE LOSS

Substantial Damage Estimates^{*1 2}

Previous Claims

Repetitive Losses

(7) PEOPLE / SOCIAL VULNERABILITIES

Population in Floodplain

Population Displaced

WV Social Vulnerability Index

(8) OTHER HAZARDS

Landslides

Karst**

Dam/Levee Failure**

Used for the Index

* Multiple Indicators

** In Progress

¹ River/Stream Indicator

² Watershed Indicator

Geographic Entities at VERY HIGH Risk (Top 10%)



RANK	All Communities	Index Score	Incorporated Places	Index Score	Unincorporated Areas	Index Score	Counties	Index Score	Regions	Index Score
1	New Martinsville - Incorporated	100.0%	Clendenin - Incorporated	100.0%	Kanawha County* - Unincorporated	100.0%	Kanawha	100.0%	PDC Region 2	100%
2	Boone County* - Unincorporated	99.6%	New Martinsville - Incorporated	99.5%	Boone County* - Unincorporated	98.1%	Boone	98.1%	PDC Region 3	90%
3	Clendenin - Incorporated	99.2%	Alderson** - Incorporated	99.1%	Wayne County* - Unincorporated	96.2%	McDowell	96.2%		
4	Marlinton - Incorporated	98.9%	Marlinton - Incorporated	98.6%	McDowell County* - Unincorporated	94.4%	Logan	94.4%		
5	Wheeling** - Incorporated	98.5%	Kimball - Incorporated	98.2%	Mingo County* - Unincorporated	92.5%	Mingo	92.5%		
6	McDowell County* - Unincorporated	98.2%	Parsons - Incorporated	97.8%	Logan County* - Unincorporated	90.7%	Wyoming	90.7%		
7	Alderson** - Incorporated	97.8%	Wheeling** - Incorporated	97.3%						
8	Wayne County* - Unincorporated	97.5%	Northfork - Incorporated	96.9%						
9	Parsons - Incorporated	97.1%	Danville - Incorporated	96.4%						
10	Kanawha County* - Unincorporated	96.8%	Madison - Incorporated	96.0%						
11	Madison - Incorporated	96.4%	Milton - Incorporated	95.6%						
12	Kimball - Incorporated	96.1%	Oceana - Incorporated	95.1%						
13	Lincoln County* - Unincorporated	95.7%	Keystone - Incorporated	94.7%						
14	Milton - Incorporated	95.4%	Wellsburg - Incorporated	94.2%						
15	Mingo County* - Unincorporated	95.0%	Gary - Incorporated	93.8%						
16	Logan County* - Unincorporated	94.6%	Rowlesburg - Incorporated	93.4%						
17	Danville - Incorporated	94.3%	Grantsville - Incorporated	92.9%						
18	Wellsburg - Incorporated	93.9%	Richwood - Incorporated	92.5%						
19	Oceana - Incorporated	93.6%	Rainelle - Incorporated	92.1%						
20	Rowlesburg - Incorporated	93.2%	Mannington - Incorporated	91.6%						
21	Northfork - Incorporated	92.9%	Spencer - Incorporated	91.2%						
22	Gary - Incorporated	92.5%	Welch - Incorporated	90.7%						
23	Wyoming County* - Unincorporated	92.2%	Buckhannon - Incorporated	90.3%						
24	Welch - Incorporated	91.8%								
25	Summers County* - Unincorporated	91.5%								
26	Buckhannon - Incorporated	91.1%								
27	Richwood - Incorporated	90.8%								
28	Ceredo - Incorporated	90.4%								
29	Mannington - Incorporated	90.1%								

Last update: Aug. 2024

Streams & Watersheds: Jul. 2025

Colors:

Black --> Incorporated places

Black on yellow** --> Split communities

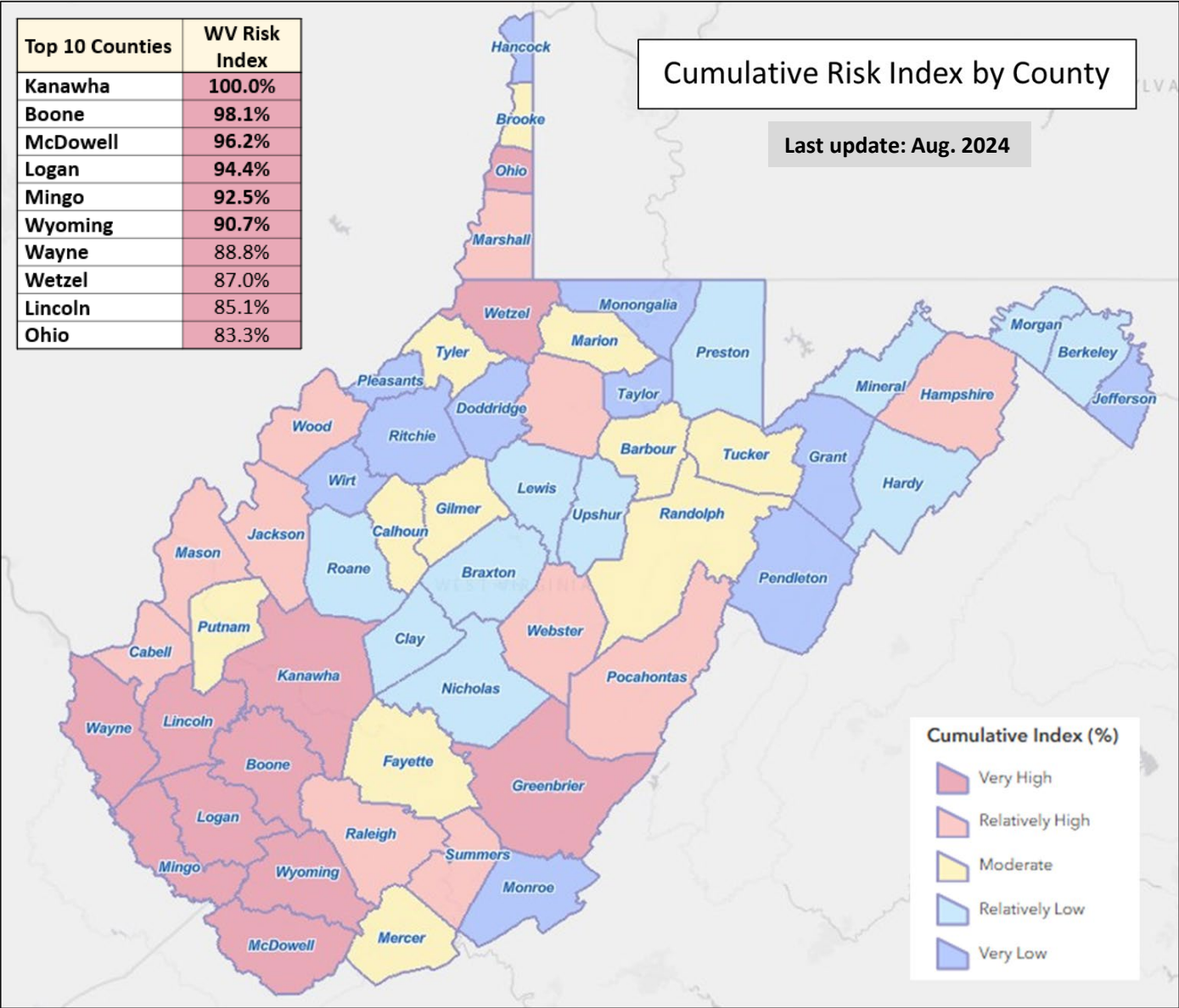
Black on blue: Incorporated communities included in the detailed risk report (Camden-on-Gauley, Clendenin, Marlinton, Rainelle, Richwood, and White Sulphur Springs)

Brown on gray --> Unincorporated areas

Green --> Counties (Total)

RANK	Streams (Top 20)	Index Score	Watersheds	Index Score
1	Coal River	100.0%	Lower Kanawha	100%
2	Ohio River	99.7%	Coal	96.7%
3	Little Coal River	99.5%	Upper Kanawha	93.5%
4	Greenbrier River	99.3%	Tug	90.3%
5	Davis Creek	99.1%		
6	Island Creek	98.9%		
7	Kanawha River	98.7%		
8	Campbells Creek	98.4%		
9	Wheeling Creek	98.2%		
10	Pocatalico River	98.0%		
11	Cacapon River	97.8%		
12	Big Coal River	97.6%		
13	Mud River	97.4%		
14	Cabin Creek	97.1%		
15	Pond Fork	96.9%		
16	Elk River	96.7%		
17	Twelvepole Creek	96.5%		
18	Buckhannon River	96.3%		
19	South Branch Potomac River	96.1%		
20	Paint Creek	95.8%		

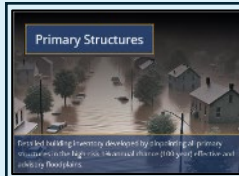
Cumulative Risk Index Map



■ Risk Assessment Tools

- Localized riverine flood risk assessment by quantifying and aggregating detailed building-level data at multiple scales
- Help identify the communities most at risk of riverine flooding for efficient allocation of limited mitigation resources

Building/Property-Level



Aggregated



■ Mitigation Assessment Tools

- Quantifies mitigation efforts such as elevation, relocation, and buyouts and calculation of loss estimates
- Enable planners and decision-makers to evaluate past and ongoing efforts, identify gaps, and prioritize future investments

Mitigated Structures Dashboard



Open-Space Mitigation Dashboard



■ Risk Communication Tools

- Scenario-based 2D and 3D visualizations for effective risk communication
- Facilitate risk comprehension for various stakeholders to support informed decision-making and encourage public engagement

WV Flood Visualizations

Visualize 3D and 2D flood models at the community and building level scales.

Visualizations



■ Hazard Library and Data Access

- Access to online hazard resources including data, documents, and media searchable by title, subject, event, geography, and more.
- Allow users to access comprehensive datasets for use in analyses, maps, or applications to support planning, research, and decision-making related to hazard mitigation and response

WV Hazard Library

Search the document and visual media library for hazard information.

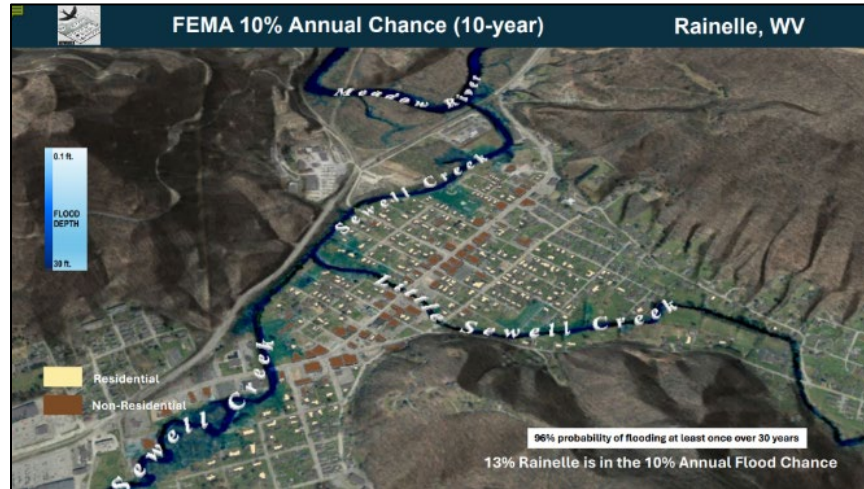
Hazard Library

Access Data

Download risk data for use in your own analyses, maps, or applications.

Access Data

Risk Communication Tools: Visualization Examples



Viewshed for Rainelle



Building Profile in Clendenin



3D Movie for Logan County



Building Profile in Charleston

Future Direction

- Maintenance and Data Updates
- Training and Technical Support
- Sustainable Funding for Ongoing Operations of the Tools
- Framework Adaptation and Regional Expansion



Building a more resilient future, together!

Thank you!

Questions?



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Backup Slides

- Communities with higher social vulnerability are less able to prepare for, respond to, and recover from flood disasters quickly and fully.

Poverty Rate

Unemployment Rate

Vulnerable Ages Rate

Disability Rate

Population without a High School Diploma

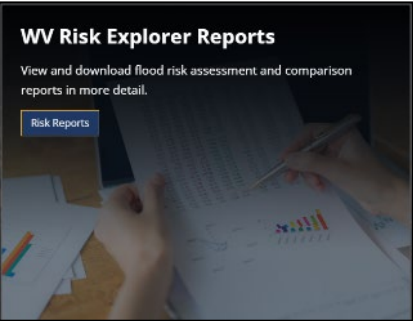
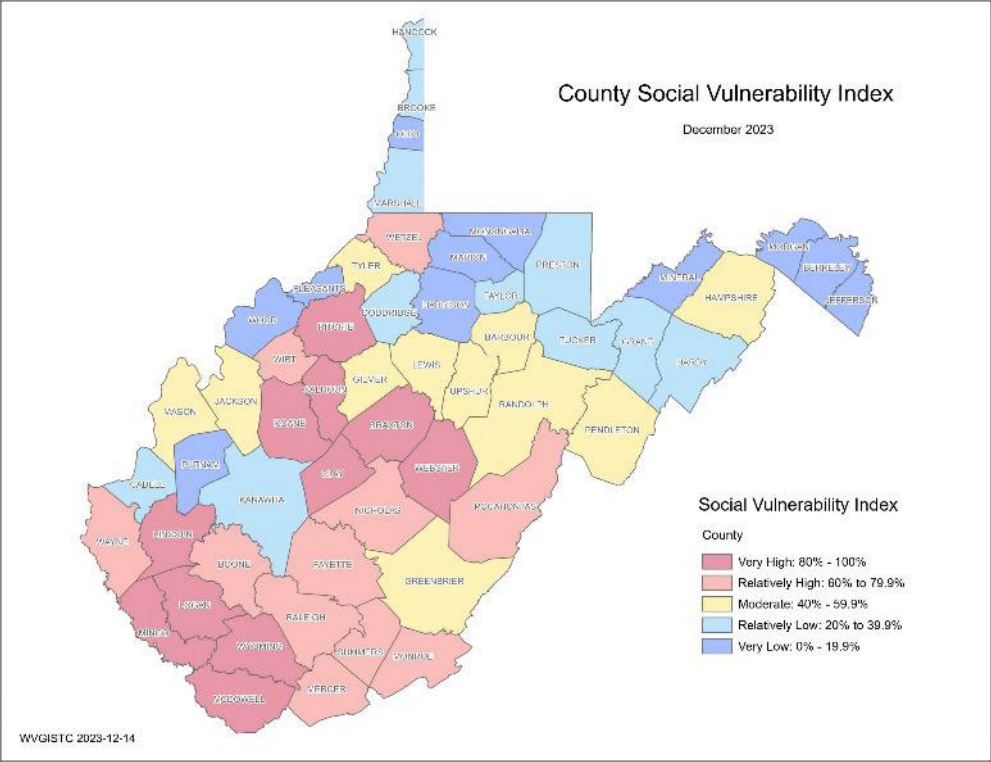
Population Change

Median Housing Unit Value

Percentage of Mobile Homes in Housing Units

Social Vulnerability Index (WV SVI) (0% to 100%)

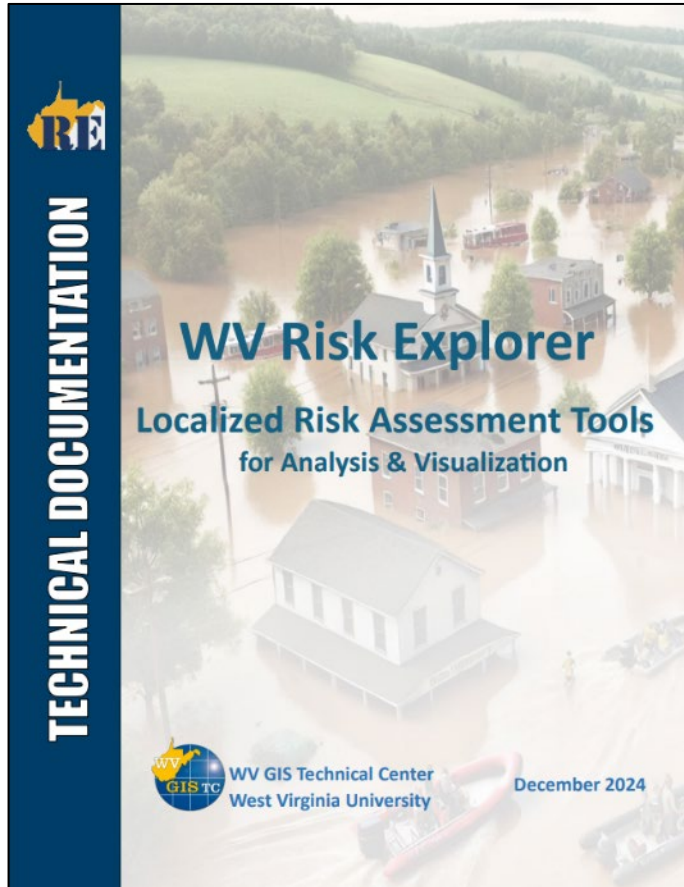
Combines indicators of:



Top
5
Counties

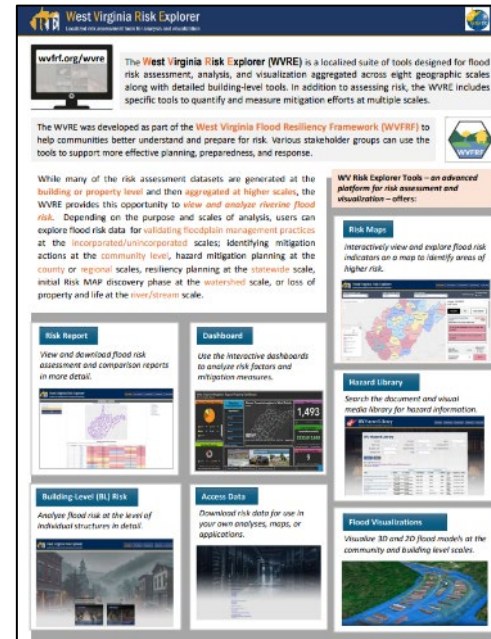
People / Social Vulnerabilities Comparison						
Table 8. People / Social Vulnerabilities: Below is a comparison of 3 flood factors under the People / Social Vulnerabilities category for the selected Counties.						
#	STATE CATEGORY RANK	COUNTY	PEOPLE / SOCIAL VULNERABILITIES			
			POPULATION IN FLOODPLAIN RATIO	POPULATION DISPLACED RATIO	WV SOCIAL VULNERABILITY INDEX	CATEGORY SCORE
1	1	McDowell	45.0%	30.4%	100.0%	100.0%
2	3	Wyoming	30.0%	17.6%	98.1%	96.2%
3	2	Mingo	34.1%	20.5%	96.3%	98.1%
4	7	Clay	25.8%	10.1%	94.4%	88.8%
5	6	Webster	28.4%	14.9%	92.6%	90.7%

WVRE Technical Document



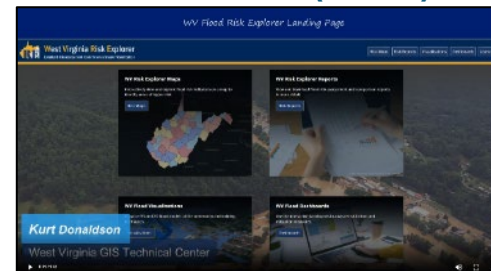
https://data.wvgis.wvu.edu/pub/RA/RI/WVRE/DOCS/WVRE_TechnicalDoc.pdf

WVRE One-Pager



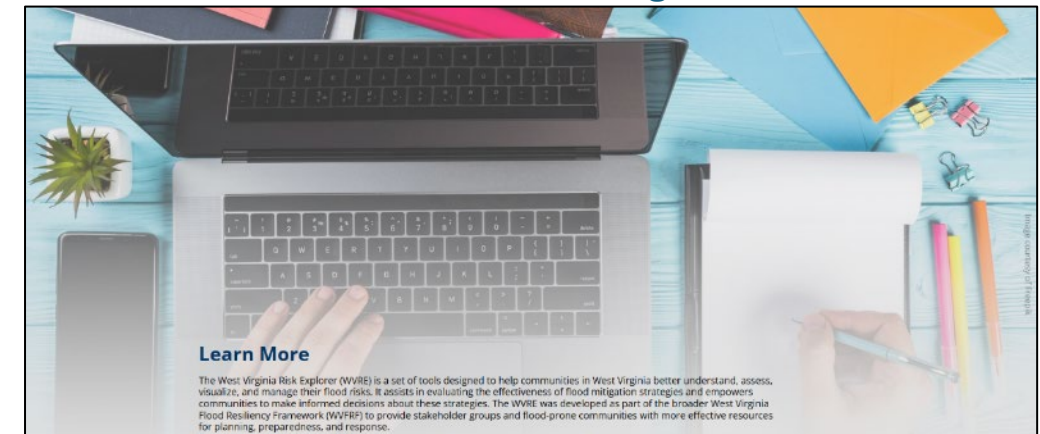
https://data.wvgis.wvu.edu/pub/RA/HL/WVFRF/Flyer/WVRE_Info_OnePager.pdf

WVRE Demo (Video)



https://data.wvgis.wvu.edu/pub/RA/HL/WVFRF/Video/WV_Risk_Explorer_Movie_20240826.mp4

WVRE Learn More Page



<https://wvrf.org/wvre/more/>

Metadata Documents

Data Dictionary (Metadata) WV Risk Index (Rankings/Scores)

https://data.wvgis.wvu.edu/pub/RA/HL/Data/RA-AL/1a_AL-RISK-INDEX/2_Metadata/WV_RiskIndex_DataDictionary.pdf

Data Dictionary (Metadata) Risk Full Data Matrix

https://data.wvgis.wvu.edu/pub/RA/HL/Data/RA-AL/1b_AL-MATRIX/2_Metadata/Full_Matrix_DataDictionary.pdf

Metadata, Full Building-Level Risk Assessment (BLRA) for Primary Structures

https://data.wvgis.wvu.edu/pub/RA/HL/Data/RA-BL/2a_BL-BLRA/3_Metadata/Full_BLRA_Metadata.pdf

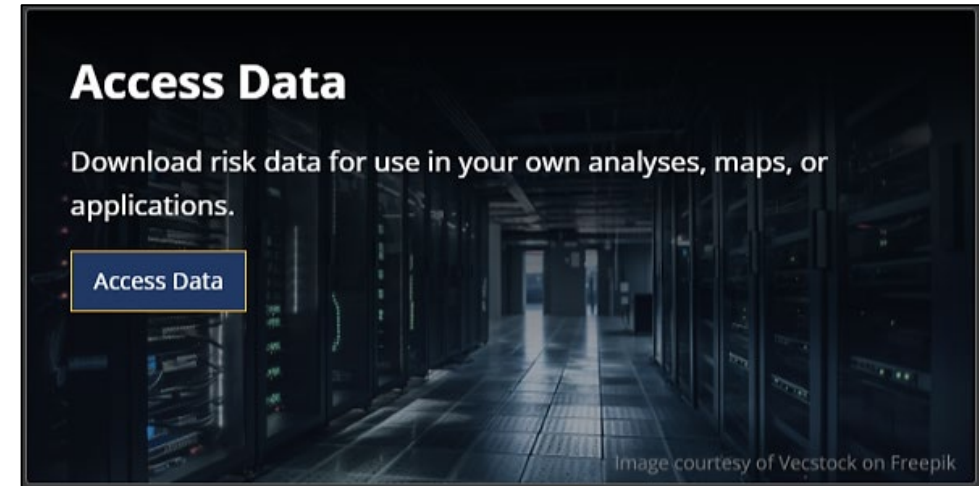
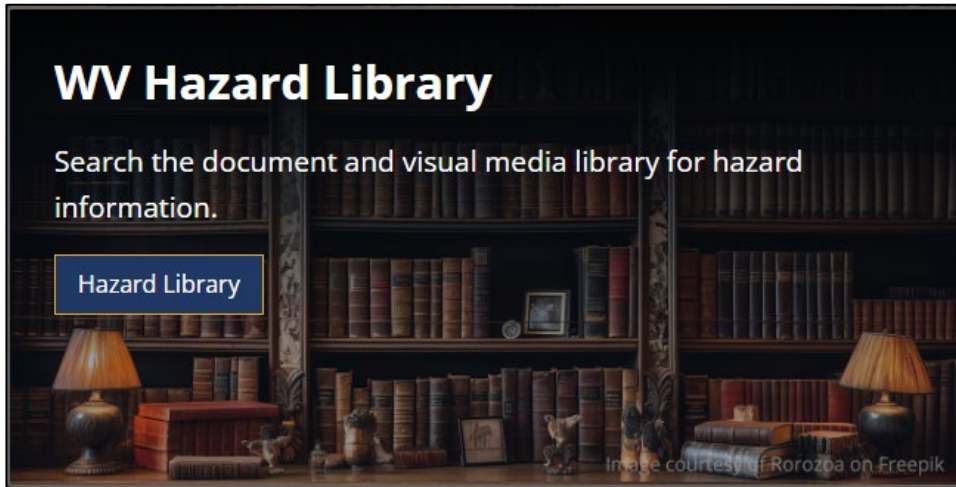
Metadata, Building-Level Significant Structures at Risk

https://data.wvgis.wvu.edu/pub/RA/HL/Data/RA-BL/2b_BL-SIG-STRC/1_All_Sig_Structures/2_Metadata/Significant_Structures_Metadata.pdf

Hazard Library and Data Access



- Online hazard resources including comprehensive datasets, documents, and media



WV HAZARD LIBRARY		
TOPICS	MEDIA TYPES	SEARCH TYPES
Risk Assessment & Planning - State Risk Assessments - Local Risk Assessments - Planning Resources - Web Tools Mitigation - Flood Insurance - Floodplain Management - Floodplain Mapping - Other Mitigation Measures Flood Disaster - Flood Event - Flood Research	3D Movie - Bldg. Profile - Dashboard - Data-GIS - Data-Metadata - Data-Table - Flyer - Graphic - Guide - Journal Article - Letter - News Article - Picture - Plan - Poster - Report - Slides - Social Media - Static Map - Story Map - Video - Viewshed - Web Info - Web Tool	- Agency - Downloadable Data - Event Disaster - Event Meeting - Geographic Scale - Entity - Media Type - Publication Date - Subject - Major Group - Category - Subcategory - cross-indexing - Stakeholder Type - Title (free text search) - Predefined Searches - Visualizations - Floodplain Management Key Materials



Building-Level Flood Risk Data:

Building-Level Risk Assessment (BLRA)*:

[Table](#) | [Online BLRA Metadata](#) | [Full BLRA Metadata](#) | [GIS](#)

* Passcode required to access, please contact the [WVGISTC](#).

At-Risk Significant Structures:

[Table](#) | [Metadata](#) | [Essential Facilities GIS](#) | [Community Assets GIS](#)

Aggregated-Level Flood Risk Data:

Risk Index (Rankings/Scores):

[Table](#) | [Metadata](#)

Risk Full Matrix:

[Table](#) | [Metadata](#)

West Virginia Social Vulnerability Index (WV SVI):

[Table](#) | [Metadata](#)

Flood Mitigation Data:

Buyout Properties:

[Table](#) | [GIS](#) | [Metadata](#)

Floodplain Data:

[GIS](#) | [Effective Metadata](#) | [Advisory Metadata](#)

Landslide Data:

[Table](#) | [GIS](#) | [Metadata](#)