

CASE STUDY

UNDERSTANDING AND MANAGING FLOOD RISKS IN BUCHANAN COUNTY, VA

Challenge

Buchanan County, Virginia, faces severe flood risk due to steep terrain, abandoned mines, unstable slopes, and unpredictable storms. These factors drive both direct flooding and secondary risks from infrastructure blockages

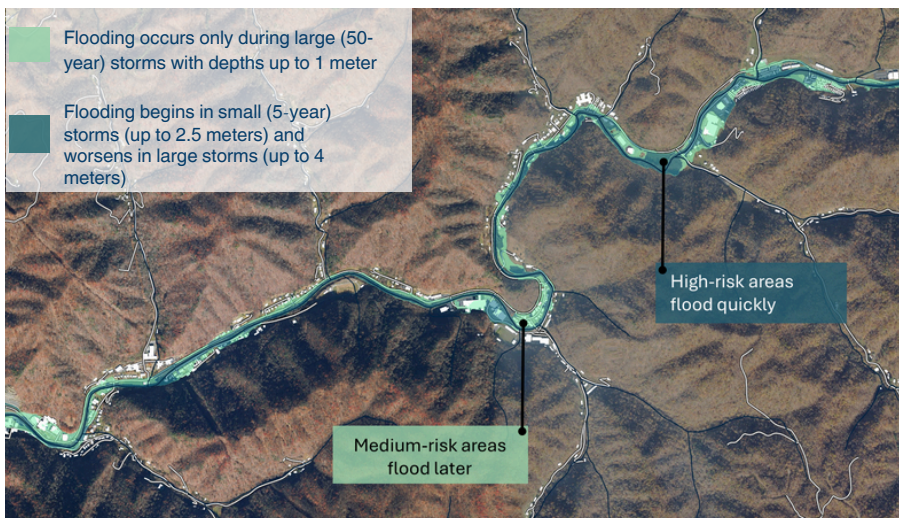
Solution

To better understand these risks, Mērak Labs assessed flood extent, debris flow hazards, landslide risk, and mine blowout potential under different storm scenarios, identifying critical locations where infrastructure failures could lead to catastrophic impacts.

Flood Risk

Primary Flood Risk: Mapping the extent and depth of flooding in 5-year and 50-year storm events, identifying areas most vulnerable to inundation.

Secondary Flood Risk: Evaluating the impact of debris accumulation at key infrastructure points, such as bridges and culverts, which can lead to backed-up water, expanded flood zones, and infrastructure failure.



Key results

- **High-risk areas** flood frequently, deeply in large storms, and carry significant debris.
- **Medium-risk areas** flood only in large storms with minimal debris movement.
- **Clogged bridges** act as dams, worsening floods, especially in 2-year storms by altering flow paths.



201

Parcels affected by 5-year storm events



\$95M

Structural value at risk

Impact of Blockages on Flood Risk

Flood risk downstream of Heritage Hall in Grundy, VA, showing the impact of bridge and culvert clogging on flood extent and depth.

A 3.3-meter clog at Booth Branch Road Bridge caused 0.5- to 1.5-meter secondary flooding during 2-year and 5-year storms.



Debris Flow and Landslide Risk

The interaction of steep terrain, saturated clay soils, and floodwaters significantly increases the risk of debris flow and landslides, which can block evacuation routes, damage homes, and intensify flooding.



Debris transport risk in Pilgrim's Knob, VA, during a 50-year storm. Higher values indicate increased risk of blockages, infrastructure damage, and expanded flooding.

Key results

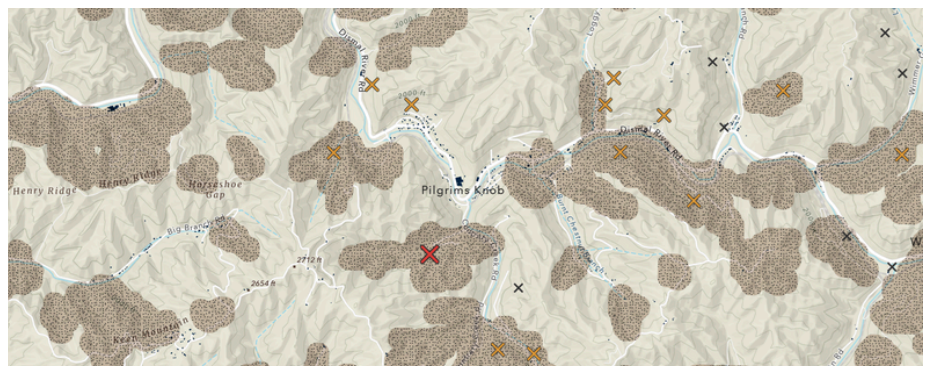
- **Debris-laden floods** heighten infrastructure blockage risks.
- **Risk maps** show where flood depth x velocity can transport debris and trigger secondary flooding.
- **Landslide-prone areas** overlap with major flood zones, compounding hazards.

Mine Blowout and Structural Failure Risk

Key results

- **Mapped high-risk mines** indicate where terrain instability and hydrological pressure increase blowout likelihood.
- **Mine failures** can contribute to rapid localized flooding, amplifying downstream flood risk.
- **Landslide-prone slopes** surrounding mines further increase structural instability.

Abandoned and deteriorating mines—particularly those predating the 1977 Surface Mining Control and Reclamation Act (SMCRA)—pose a severe risk of blowouts, which can trigger sudden flooding and introduce additional debris into streams.





Benefits

This analysis provides a comprehensive view of flood risk in Buchanan County, integrating primary flood hazards, secondary clog-related risks, debris flow potential, landslide susceptibility, and mine failure risks.

| Risk Factor | Key Impact | Primary Concern |
|----------------------|------------------------------|-------------------------------|
| Primary Flood Risk | Inundation from storm events | Roads, homes, infrastructure |
| Secondary Flood Risk | Blocked culverts/bridges | Expanded flood extent |
| Debris Flow Risk | Transported flood debris | Clogs, infrastructure failure |
| Landslide Risk | Slope failures | Road closures, home damage |
| Mine Blowouts | Sudden flooding and mudflows | Rapid, unexpected impacts |

Next Steps

Future steps include:

- **Targeted mitigation** efforts to clear debris-prone areas before storm events.
- **Infrastructure adaptations** to prevent clogging at critical bridges and culverts.
- **Implementation of flood monitoring** software to support real-time risk assessments and emergency response.

By prioritizing high-risk areas for pre-storm maintenance, infrastructure improvements, and emergency response planning, Buchanan County can better prepare for and mitigate the growing flood hazards that threaten homes, roads, and critical assets.

Contact Us

erin@meraklabs.co

www.meraklabs.co



Merak Labs