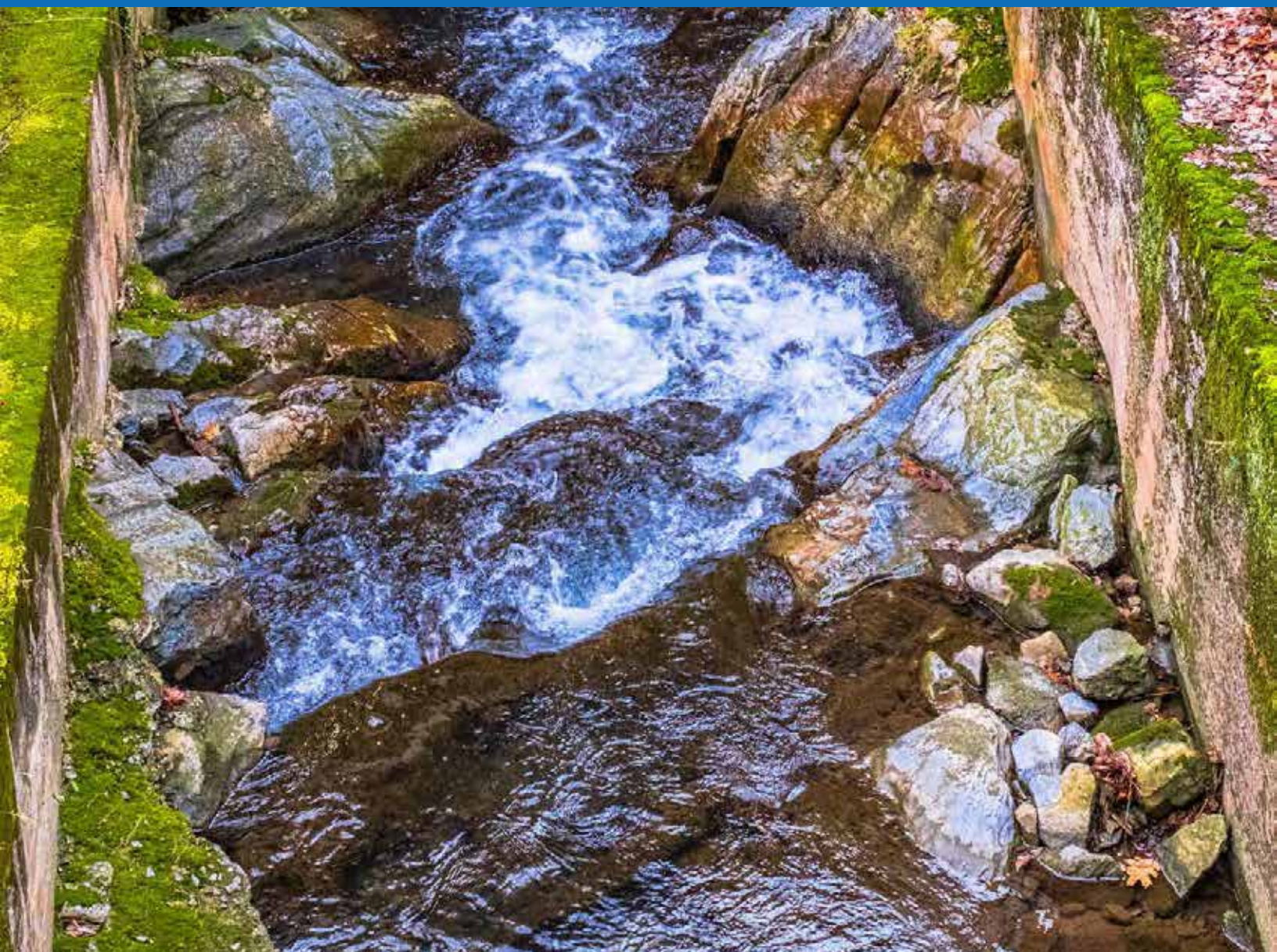


Central Shenandoah

Flood & Stormwater Resilience Plan

Draft Plan November 6, 2026



Acknowledgments

The Central Shenandoah Planning District Commission recognizes the residents, local government staff, and community partners who contributed local knowledge and technical input to the Central Shenandoah Flood and Stormwater Resilience Plan. Their participation helped identify recurring flood and drainage concerns, clarify local capacity needs, and shape practical resilience actions for the region.

Participating Localities:

Augusta, Bath, Highland, Rockbridge, Rockingham, Harrisonburg, Lexington, Waynesboro, Bridgewater, Broadway, Dayton, Elkton, Glasgow, Goshen, Grottoes, Mount Crawford, and Timberville

Other Participants:

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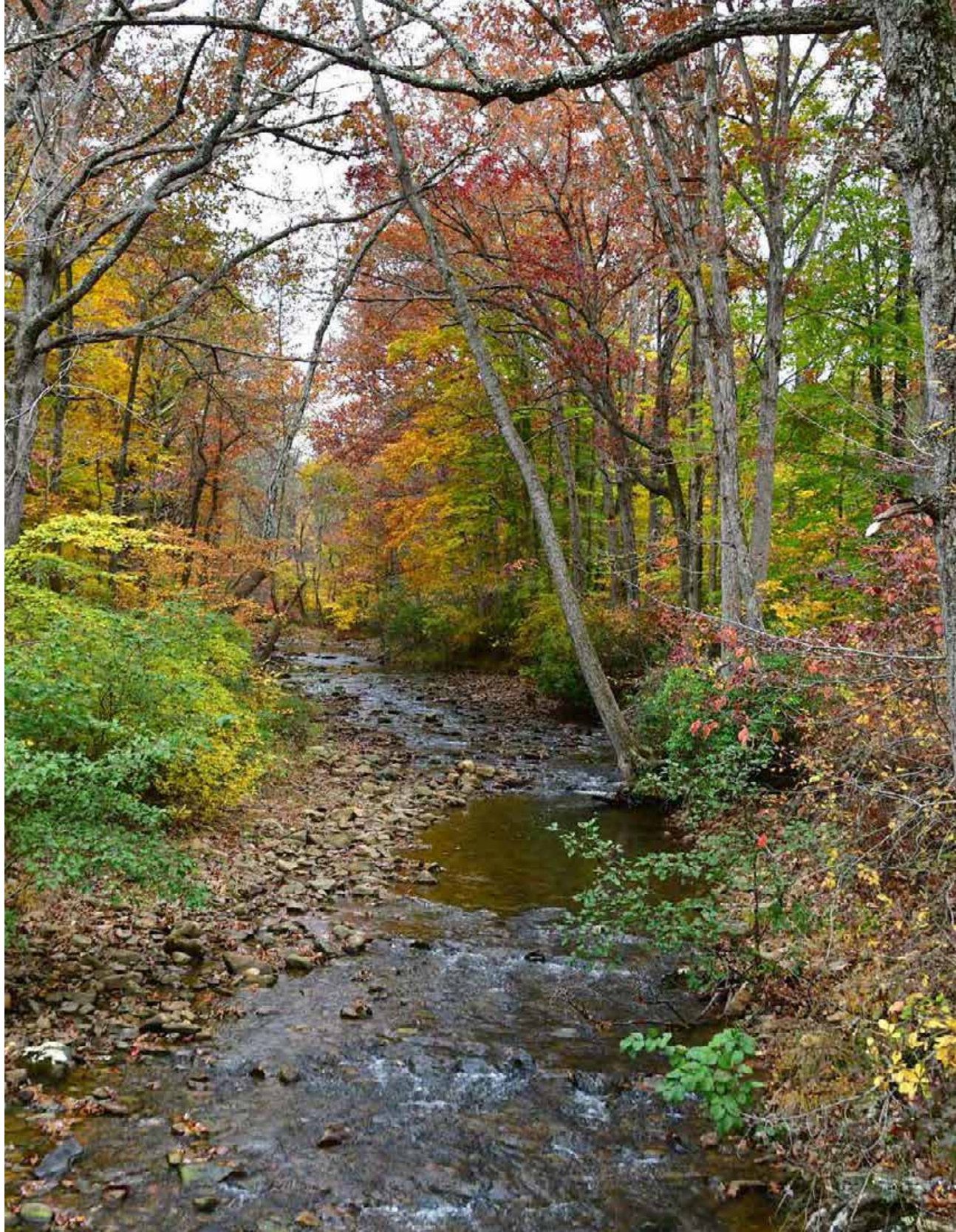


Common Abbreviations & Definitions

ACS	American Community Survey
BFE	Base Flood Elevation
BMP	Best Management Practice
CDBG	Community Development Block Grant
CDC	Centers for Disease Control and Prevention
CFM	Certified Floodplain Manager
CFPF	Community Flood Preparedness Fund
CRS	Community Rating System
CSPDC	Central Shenandoah Planning District Commission
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
DHCD	Virginia Department of Housing and Community Development
DSIS	Dam Safety Inventory System
EOP	Emergency Operations Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HMGP	Hazard Mitigation Grant Program
HMP	2026 Central Shenandoah Hazard Mitigation Plan
HRMPO	Harrisonburg-Rockingham Metropolitan Planning Organization
I-64 / I-81	Interstate 64 / Interstate 81
JMU	James Madison University
LIDAR	Light Detection and Ranging
MARISA	Mid-Atlantic Regional Integrated Sciences and Assessments
MPO	Metropolitan Planning Organization
MS4	Municipal Separate Storm Sewer System
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
RAPT	Resilience Analysis and Planning Tool
RL / SRL	Repetitive Loss / Severe Repetitive Loss
SAWMPO	Staunton-Augusta-Waynesboro Metropolitan Planning Organization
SFHA	Special Flood Hazard Area
SLAF	Stormwater Local Assistance Fund
SVI	Social Vulnerability Index
SWCD	Soil and Water Conservation District
SWIP	Stormwater Improvement Plan (City of Harrisonburg)
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VDEM	Virginia Department of Emergency Management
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VFMA	Virginia Floodplain Management Association
VFRIS	Virginia Flood Risk Information System
VOF	Virginia Outdoors Foundation
WSSI	Wetland Studies and Solutions, Inc.

Key Flooding & NFIP Terms

One-percent-annual-chance flood or 100-year flood: A flood that has a 1 percent chance of occurring in any year. The term does not mean that such a flood occurs only once every 100 years.

Base Flood Elevation: The expected water-surface elevation during the one-percent-annual-chance flood. It is the reference elevation used for floodplain regulation in mapped areas.

Community Rating System: A voluntary NFIP program that recognizes floodplain-management activities that exceed minimum requirements and can reduce flood-insurance premiums within participating communities.

Elevation Certificate: A FEMA form that documents a building's elevation and related characteristics for floodplain management and, when applicable, flood-insurance rating.

Flood Insurance Rate Map: FEMA's official map showing mapped flood-hazard areas, flood zones, and other flood-risk information used for insurance and local regulation.

Flood zone: A mapped geographic area assigned a flood-risk category. A flood-zone designation does not mean that flooding cannot occur outside the mapped high-risk area.

Floodplain: Land that is susceptible to flooding, generally along a river, stream, or other water body.

Freeboard: An added safety height above the Base Flood Elevation required or selected for construction. Freeboard provides protection against uncertainty and floods higher than the mapped base flood.

National Flood Insurance Program: The federal program administered by FEMA that provides flood insurance in participating communities that adopt and enforce minimum floodplain-management standards.

No-Rise Certification: An engineering analysis showing that a proposed project in a regulatory floodway will not increase base flood elevations.

Pre-FIRM and post-FIRM: Pre-FIRM buildings generally predate a community's first effective FIRM or December 31, 1974, whichever is later; post-FIRM buildings were constructed after that date and are subject to the standards then in effect.

Regulatory Floodway: The channel of a river or stream and the adjacent land that must be kept free of encroachment so the base flood can pass without raising flood levels more than a designated height.

Repetitive Loss: An NFIP-insured structure that has received two or more paid flood claims of more than $1,000 each within any rolling 10-year period since 1978.

Severe Repetitive Loss: An NFIP-insured residential structure that has received four or more claim payments of more than $5,000 each, with a cumulative total of more than $20,000, or at least two building claim payments that together exceed the building's market value.

Special Flood Hazard Area: The area mapped by FEMA as having at least a 1 percent chance of flooding in any year. SFHAs are generally shown as A or V zones on a FIRM.

Substantial Damage: Damage from any cause for which the cost of restoring a building to its pre-damage condition equals or exceeds 50 percent of its market value before the damage, subject to the community's adopted ordinance.

Substantial Improvement: Any reconstruction, addition, or improvement of a building whose cost equals or exceeds 50 percent of the building's market value before the work begins.

Executive Summary

The Central Shenandoah Flood and Stormwater Resilience Plan documents flood and stormwater needs and recommended improvements for 17 participating localities and James Madison University (JMU). Through this planning process, participants identified 61 priority projects, and the highest-priority projects include 10% design concepts with planning-level cost estimates, with particular emphasis on smaller localities with limited staff capacity. Non-structural recommendations complement these projects at both the local and regional levels, including floodplain and stormwater management procedures, ordinance updates, staff training, debris management, and interagency coordination. Adoption of the plan makes participating localities eligible to apply for implementation funding through the Community Flood Preparedness Fund (CFPF).

The priority projects fall into six broad types. The largest group, 26 projects, addresses undersized or failing local drainage systems, including storm sewers, ditches, inlets, and culverts in neighborhoods and downtowns. Nine projects reduce riverine flooding in developed areas through studies, floodproofing, berms, and voluntary buyouts, and another nine stabilize or restore eroding streams and channels. Eight address road and bridge crossings that flood or erode, most of them in Highland County. Six protect critical facilities, including wastewater treatment plants, sewer pump stations, and drinking water sources. The remaining three address watershed coordination, a park facility, and maintenance of an existing stormwater facility.

About half of the projects begin with a study or preliminary engineering to define the problem and the best solution, while 26 are ready to move into design and construction. Most projects combine approaches, and 39 include nature-based elements such as stream restoration, floodplain benches, riparian buffers, or bioretention.

Regional Trends

Most flooding now happens outside mapped floodplains

A handful of tropical storms dominate the historical record. Four floods, the 1985 Election Day Flood, the June 1995 storms, Hurricane Fran in 1996, and Hurricane Isabel in 2003, account for 63 percent of the 1,262 paid flood insurance claims recorded in the region since 1978. Today, localities manage smaller, more frequent storms that overwhelm local drainage, often in neighborhoods outside flood zones mapped by the Federal Emergency Management Agency where few residents carry flood insurance. Only 15 percent of public survey respondents live in a mapped flood zone, yet about 80 percent reported at least one flood impact.

Infrastructure is aging, undersized, and divided among many owners

Most towns have no inventory of their pipes, culverts, and easements, and railroads and private landowners control many of the culverts and drainage paths behind local flooding. The median bridge or bridge-length culvert in participating localities was built in 1969, and the Virginia Department of Transportation (VDOT) owns about 90 percent of these structures.

Flood risk is expected to grow

Regional climate projections show annual rainfall rising by about 2 inches by mid-century, with the 10-year design storm deepening by 12 to 19 percent and the 100-year storm by 13 to 31 percent by 2070. Drainage systems sized for past rainfall will be overwhelmed more often.

Shared Regional Needs

The plan identifies seven needs shared across the region:

- Project development capacity and funding: project engineering, cost estimates, grant support, and help meeting local match requirements.
- Infrastructure condition and flood risk data: stormwater inventories, condition assessments, and better records of where flooding occurs.
- Maintenance and replacement of existing drainage systems: recurring maintenance, replacement of aging pipe, and permitting for debris and sediment removal.
- Floodplain and stormwater management staffing, procedures, and training: floodplain and stormwater ordinance updates, substantial damage procedures, debris management plans, and training for small staffs.
- Interagency and cross-jurisdictional coordination: working arrangements with VDOT, the metropolitan planning organizations, railroads, dam owners, and neighboring localities.
- Critical facilities and emergency access: protection of water, wastewater, and public safety facilities and of the roads that flooding cuts off.
- Nature-based solutions and water quality: identifying regionally impactful projects such as riparian buffers, stream restoration, and floodplain storage that reduce flooding and pollution on a larger scale.

Regional Actions

The plan identifies eight voluntary regional actions, each organized around a single deliverable that the Central Shenandoah Planning District Commission (CSPDC), localities, and partner agencies can pursue as funding allows. The actions will (1) maintain an annual regional project pipeline; (2) complete a multi-locality stormwater infrastructure inventory and (3) a regional aging infrastructure assessment; (4) develop a floodplain and emergency management toolkit and resources webpage; (5) coordinate regional training; and (6) complete regional assessments of transportation flood vulnerability, (7) critical facilities and emergency access, and (8) nature-based solutions.

Each locality profile includes a short table of locality actions, which in most cases is paired with the locality's priority projects. Project details and design concepts appear in Appendix A. Actions are realistic and voluntary, assign a Near, Mid, or Long timeline, and link to the 2026 Central Shenandoah Hazard Mitigation Plan (HMP).

Next Steps

After adoption, localities can use the plan to apply for CFPF and other funding, incorporate priority projects into capital and comprehensive plans, and combine flood projects with water quality and transportation funding. CSPDC will meet with each locality annually to update needs and projects, track progress with the HMP, and identify projects ready for funding.

Chapter 1
Introduction

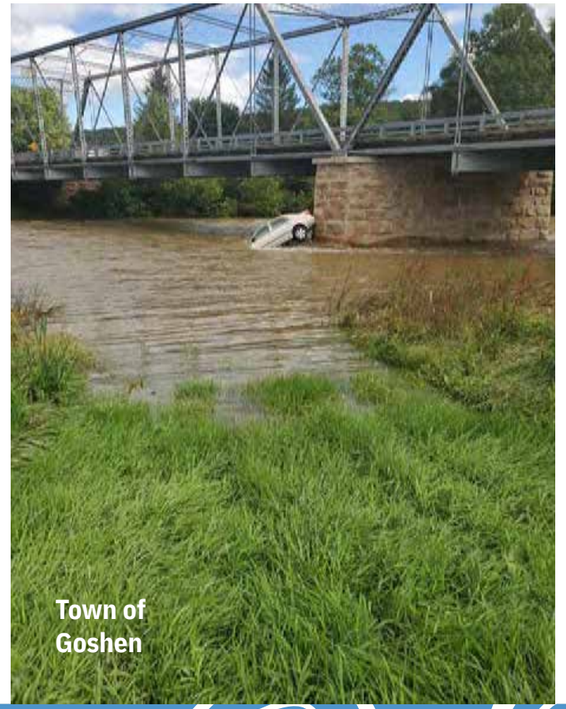
Purpose

The Central Shenandoah Regional Flood and Stormwater Resilience Plan (“Resilience Plan”) identifies and prioritizes flood mitigation and stormwater management needs, projects, and non-structural recommendations for 17 participating localities and 1 university within a five-county region in the Shenandoah Valley. The Resilience Plan serves as a companion to the 2026 Central Shenandoah Hazard Mitigation Plan (HMP), which covers a broader range of natural hazards and human-caused threats across the region.

The Central Shenandoah Planning District Commission (CSPDC) prepared this plan at the request of its member localities, none of which previously had an adopted Resilience Plan. Completion of the Resilience Plan allows participating localities to be eligible for the Virginia Department of Conservation and Recreation (DCR) Community Flood Preparedness Fund (CFPF) project implementation funding.

The Resilience Plan builds on information gathered through local staff interviews, a public survey, and engineering field visits to document recurring flooding issues across the region. For each participating locality, the plan provides a prioritized project list that includes project descriptions and planning-level cost estimates. The plan also identifies non-structural recommendations related to floodplain management procedures, ordinance updates, staff training, debris management, and interagency coordination at both the local and regional level. Together, the project lists and non-structural recommendations strengthen local capacity to administer floodplain programs and to advance projects from concept to construction. Localities can also use this information to pursue future grant funding, inform capital and comprehensive planning, and support future HMP updates.

Within the CSPDC region, locality needs vary based on the size of each local government and staff capacity, and the scope of this plan depends on each locality’s status as a Municipal Separate Storm Sewer System (MS4) permit holder. MS4 localities are generally more urbanized and subject to regulatory requirements under the Clean Water Act and Virginia Stormwater Management Act to establish programs that address stormwater runoff, pollutant discharges, and water quality. As a result, MS4 localities tend to have more staff capacity to address flooding issues. Non-MS4 localities are generally smaller and have more limited staff and technical capacity to plan and implement flood and stormwater management projects. Accordingly, the Resilience Plan places additional emphasis on project identification and design concept development for non-MS4 localities, while supporting all participating localities in advancing future flood mitigation and stormwater management projects.



Town of Goshen

Plan Goals

1 **Support Community Flood Preparedness Fund (CFPF) Eligibility**

Establish a foundation for localities to pursue project implementation funding through DCR's CFPF by meeting the criteria in the CFPF Grant Guide.

2 **Identify and Document Potential Projects**

Develop a list of site-specific candidate projects addressing flooding and stormwater management, including conventional and nature-based improvements, stream restoration, and maintenance needs. Each project includes a description of the issue, the proposed improvement, and planning-level cost estimates to support future funding and implementation efforts.

3 **Establish a Project Evaluation Framework**

Develop a consistent process that localities can use to evaluate, prioritize, and advance future flood mitigation, stormwater management, and nature-based projects.

4 **Advance Priority Projects in Non-MS4 Localities**

Identify the top priority projects in each non-MS4 locality and develop 10% design concepts and cost estimates to increase project readiness for future grant opportunities.

5 **Integrate Resilience Planning with Existing Planning Efforts**

Utilize the resilience plan as a companion document to the current HMP and incorporate the resilience plan into future HMP updates and local planning documents such as comprehensive plans and capital improvement plans.

Resilience Plan Requirements

This plan serves as the regional and locality-specific resilience plan for participating Central Shenandoah localities under DCR's CFPF. This plan is required to be updated a minimum of once every five years to maintain CFPF eligibility. Appendix F of the Round 5 CFPF Manual details nine requirements a plan must meet before a locality can apply for CFPF implementation funding. Each requirement is listed below, followed by a summary of how this plan addresses it and where supporting content can be found.

1. Prioritize project-based improvements, with projects focused on flood control and resilience.

The community profiles in Chapter 4 identify recurring flood and stormwater concerns, document locality needs, and connect those needs to priority projects and resilience actions. Appendix A presents each locality's prioritized projects, including 10% design concepts and planning-level cost estimates, so projects can advance through feasibility review, design, permitting, funding, and construction.

2. Incorporate nature-based infrastructure to the maximum extent possible.

The plan prioritizes floodplain and riparian protection, stream restoration, conservation, increased vegetation, and other nature-based practices where they are feasible and effective. Locality assessments identify natural resources, land cover, conservation lands, and ecological cores that can support flood attenuation. Structural or hybrid solutions remain appropriate where site conditions, public safety, or infrastructure constraints require them. Wetland Studies and Solutions, Inc. (WSSI) conducted field visits with participating localities to verify flood and stormwater issues and identify corresponding mixed or nature-based solutions (see Appendix A), and Regional Action 8 calls for a regional nature-based solutions and riparian prioritization study.

3. Consider all parts of each locality regardless of socioeconomic status or race and addresses the flood-resilience needs of underserved populations within the community.

The regional overview (Chapter 2) and locality profiles (Chapter 4) evaluate social vulnerability, transportation access, and other conditions that can affect preparedness, evacuation, and recovery. Locality needs and actions address communities that lose road access during floods, residents without vehicles, and lower-income neighborhoods, several of which qualify for the CFPF's reduced local match.

4. Identify flooding in all areas of the community, not only within Special Flood Hazard Areas, and provides the number and location of Repetitive Loss and Severe Repetitive Loss properties.

The plan addresses riverine flooding, flash flooding, localized stormwater and drainage flooding, dam inundation risk, and recurring access and infrastructure problems, including locations outside mapped Special Flood Hazard Areas (SFHAs) (see Chapters 2 and 4). The plan includes the available counts and generalized locations of Repetitive Loss and Severe Repetitive Loss properties using FEMA-protected data in a manner consistent with applicable privacy and disclosure requirements. Under Regional Action 1, CSPDC's annual meetings with each locality will record flooding that is not captured through National Flood Insurance Program (NFIP) claims.

5. Consider property-acquisition or relocation guidelines are included, they provide equitable relocation strategies for all affected people, and acquired land remains undeveloped as permanent open space under locality ownership or easement in perpetuity, except that flood-control structures may be constructed on the property.

Any acquisition or relocation action developed from this plan in the future should provide a feasible path to relocation for owners and tenants, address barriers created by depressed property values, and follow DCR, the Federal Emergency Management Agency (FEMA), and local requirements. Acquired property must be protected and maintained as permanent open space through public ownership or an enforceable easement, except for allowable flood-control structures. This plan does not include regional acquisition actions. However, the 2026 HMP includes locality actions for voluntary acquisition, elevation, or floodproofing in Waynesboro (WA-6), Glasgow (GL-7), and Bridgewater (BW-4), and Broadway has expressed willingness to consider voluntary buyouts. Any such project would follow these guidelines.

6. Include or consider a strategy for debris management.

Debris management in the region relies on locality staff, on-call contractors, fire departments, the Virginia Department of Transportation (VDOT), and volunteers, coordinated through emergency operations plans. Three of the region's six emergency operations plans include a debris management annex (see Chapter 3). The regional strategy is to identify priority roads, bridges, culverts, drainage systems, and critical-facility access routes before an event; establish responsibility for inspection and clearance; stage or contract for appropriate equipment; document and dispose of debris in accordance with applicable requirements; and restore drainage capacity promptly after flooding. Regional Action 4 provides a debris management annex template for localities without one, and several locality actions call for adding an annex.

7. Include administrative procedures for substantial development and substantial improvement of structures within the Special Flood Hazard Area.

Participating localities administer substantial damage and substantial improvement requirements through their adopted floodplain management ordinances, permit review, and designated floodplain administrators, in coordination with the Virginia Uniform Statewide Building Code and NFIP minimum standards. Most smaller localities do not yet have written procedures for making and tracking these determinations (see Chapter 3). Regional Action 4 provides a model substantial damage and post-disaster damage assessment procedure, including cumulative improvement tracking, that localities can adopt or adapt.

8. Coordinate with other local and interjurisdictional projects, plans, and activities and includes a clearly articulated timeline or phasing for implementation.

The plan builds on the HMP and coordinates resilience work with comprehensive plans, capital improvement programs, transportation planning, watershed plans, emergency operations, and other local and regional efforts. The regional and locality action tables (Chapters 3 and 4) identify partners and related HMP actions and assign each action a Near, Mid, or Long timeline. Regional Action 1 provides an annual progress review through meetings with each locality and an updated regional project pipeline.

9. Develop plan based on the best available science and incorporates climate change, sea-level rise, storm surge where appropriate, and current flood maps.

The plan uses current FEMA and Virginia Flood Risk Information System flood mapping, geographic analysis, locality knowledge, field observations, and engineering-based planning. It also incorporates Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) Local Hazard Outlooks, including locality- and county-scale projections for changes in extreme-heat days, annual precipitation, and frost-free periods through 2070. Sea-level rise and coastal storm surge are not applicable to the inland Central Shenandoah region, but tropical systems and their inland rainfall effects remain relevant.

Planning Process

The Resilience Plan combines existing data, historical research, community input, and field visits to build a full picture of flood and stormwater conditions across the region. No single source captures every flooding problem. Mapped floodplains and insurance records show where flood risk is documented, while residents and local staff know where water collects, roads wash out, and drainage fails. Using these sources together allowed the project team to identify problems and focus recommendations where they are most needed. The plan draws on five main types of information:

Existing Conditions Data

Several existing datasets form the basis of the regional and local profiles described in Chapters 2 and 4.

Key demographic datasets include:

- Total population and race data from the U.S. Census Bureau's 2020 Decennial Census.
- Median household income data from the U.S. Census Bureau's 2023 American Community Survey (ACS) 5-Year Estimates.
- Age and sex data from the U.S. Census Bureau's 2024 American Community Survey (ACS) 5-Year Estimates.
- Population estimates from the University of Virginia Weldon Cooper Center for Public Service's 2026 Virginia Population Estimates

Key flood history datasets and sources include:

- FEMA's Floodsmart.gov data and reports, including Policy and loss statistics by flood zone, Policies in force (PPIF) rolling 12 months.
- Natural Resource Defence Council's (NRDC) "Losing Ground: Severe Repetitive Flooding in the United States" Visualization Tool.
- 2002 Central Shenandoah Valley Regional Flood Mitigation Plan.
- Central Shenandoah PDC Monthly Newsletter.

Key GIS datasets include:

- FEMA flood zone data from the Virginia Flood Risk Information System (VFRIS), which shows mapped SFHAs and other flood zones.
- Dam inundation zones from the DCR Dam Safety Inventory System (DSIS), which show areas that could flood if a dam failed.
- The Social Vulnerability Index (SVI) from the Centers for Disease Control and Prevention (CDC), which ranks census tracts by factors that can make it harder for residents to prepare for and recover from disasters.
- Infrastructure and crash data from VDOT, including bridge condition and crash locations along flood-prone routes.
- Conserved lands and ecological cores from DCR, which identify natural areas that store floodwater and slow runoff.

Overlaying these layers shows where flood exposure coincides with vulnerable populations, critical infrastructure, and natural systems. Some datasets are incomplete; for example, not every dam inundation zone in the region has been digitized. These gaps are noted in the locality profiles where they apply.

Historical Flood Research

Records of past floods show where flooding has occurred, how often, and what damage resulted. The plan draws on National Weather Service (NWS) storm records, U.S. Geological Survey (USGS) stream gauge data, historical accounts, and news coverage to document major events and recurring problem areas in each locality. The plan also uses FEMA Repetitive Loss (RL) and Severe Repetitive Loss (SRL) data to identify properties with repeated flood insurance claims. To protect property owners' privacy, RL and SRL data are presented only as counts and generalized locations.

Future Conditions Data

Past floods do not fully predict future risk. The plan uses the Local Hazard Outlooks published by MARISA, which project changes in extreme heat, annual rainfall, and frost-free periods through 2070 under low- and high-emissions scenarios. These projections are planning ranges, not precise predictions. They help localities consider how heavier rainfall and longer warm seasons may affect drainage systems, infrastructure, and residents over the life of a project.

Community Input and Field Verification

Residents, locality staff, and regional partners contributed local knowledge through surveys and meetings, and engineers visited reported problem sites to confirm conditions and refine solutions. This process is described in detail in the following section.

Existing Plans and Policies

The plan builds on work localities and regional partners have already done. The project team reviewed the HMP, including its assessment of local floodplain management and staffing capacity, along with local comprehensive plans, capital improvement programs, stormwater plans, floodplain ordinances, and emergency operations plans. This review identified projects already planned or underway, documented existing floodplain standards and debris management procedures, and helped align the Resilience Plan with the plans localities use to make budget and policy decisions.

Project Identification and Prioritization

Together, these sources allowed the project team to document existing and future conditions, identify each locality's needs, and develop a list of projects and non-structural recommendations. Candidate projects came from locations reported through the public, locality, and stakeholder surveys; flooding and drainage problems identified by staff during the March 2026 locality meetings; and recurring problem areas documented in existing plans and the 2026 HMP. Locality staff ranked their candidate projects during the meetings, and WSSI visited each site in June and July 2026 to verify conditions and refine the projects.

WSSI prepared a project identification memo for each priority project (Appendix A). Each memo describes the location, the flooding or drainage issue, the project purpose, known constraints, information still needed, a recommended approach with a planning-level cost estimate that includes a 30 percent contingency, alternatives, and water quality considerations. Where a project's scope depends on information not yet available, the memo recommends a study or assessment as the first phase.

Each project is assigned a severity rating of High, Moderate, or Low, based on how often the problem occurs, impact on people and property, impact on critical facilities and access, and whether conditions are stable or getting worse. Ratings reflect information from locality staff and are separate from each project's priority rank, which are the locality's own priorities.. WSSI developed one priority project further into a 10% design concept with a planning-level cost estimate for [illegible] County and Bridgewater. In [illegible] this was the top-ranked project, but site constraints or readiness sometimes led to another project being selected.



Augusta County

Table 1.1 | 2025 CSPDC Resilience Plan Comprehensive Plans

Non-MS4 Localities		
Locality	**Comprehensive Plan**	**NFIP Numbers**
Bath County	Bath County Comprehensive Plan, 2024	510196#
Broadway	Town of Broadway Comprehensive Plan, 2024	510135#
Dayton	Town of Dayton Comprehensive Plan, 2023	510136#
Elkton	Town of Elkton Comprehensive Plan, 2024	510137#
Glasgow	Town of Glasgow Comprehensive Plan, 2024	515526#
Goshen	Town of Goshen Comprehensive Plan, 1986	510217#
Grottoes	Town of Grottoes Comprehensive Plan, 2025	510138#
Highland County	Highland County & the Town of Monterey Comprehensive Plan, 2021	510311#
Lexington	City of Lexington Comprehensive Plan, 2026	510089#
Mount Crawford	Town of Mount Crawford Comprehensive Plan, 2023	510224#
Rockbridge County	Rockbridge County Comprehensive Plan, 2024	510205#
Rockingham County	Rockingham County Comprehensive Plan, 2024	510133#
Timberville	Town of Timberville Comprehensive Plan, 2023	510139#
MS4		
Augusta County	Augusta County Comprehensive Plan, 2025	510013D
Bridgewater	Town of Bridgewater Comprehensive Plan, 2024	510134#
Harrisonburg	City of Harrisonburg Comprehensive Plan, 2018	510076#
Staunton	City of Staunton Comprehensive Plan, 2026	510155#
Waynesboro	City of Waynesboro Comprehensive Plan, 2018	515532D

Table 1.2 | 2025 CSPDC Resilience Plan Floodplain Ordinances

Non-MS4 Localities		
Locality	**Floodplain Ordinance**	**NFIP Numbers**
Bath County	Chapter 12. Floodplain Management Ordinance	510196#
Broadway	Sec. 640.00 Flood Hazard Districts	510135#
Dayton	Sec. 30-576. Flood Plain District	510136#
Elkton	Sec. 100-615 Flood Hazard District FH-1	510137#
Glasgow	Chapter 18. Article V-A. Flood Plain District F-1	515526#
Goshen	Article XLVII. Floodplain Overlay (FPO) Districts	510217#
Grottoes	Chapter 100. Article XIX. Flood Hazard Districts	510138#
Highland County	Sec. 614.00 Flood Hazard Overlay District	510311#
Lexington	Chapter 420. Article X. General Floodplain District (FP)	510089#
Mount Crawford	Chapter 171 Floodplain Ordinance	510224#
Rockbridge County	Sec. 608.00 Flood Hazard District - FH-1	510205#
Rockingham County	Chapter 6D - Floodplain Management	510133#
Timberville	Article 6. Title 611. Flood Hazard District FH-1	510139#
MS4		
Augusta County	Augusta County Comprehensive Plan, 2015	510013D
Bridgewater	Sec. 6-14. Flood Plain Districts and Regulations	510134#
Harrisonburg	Title 10. Chapter 3. Article Y. Floodplain Zoning District	510076#
Staunton	Chapter 18.170 Floodplain Districts and Regulations	510155#
Waynesboro	Sec. 98-3.3.5. - Floodplain Overlay (FO)	515532D

Planning Process

Kick off Meeting

Flooding Public Survey

Project Identification

Site Visits

Project Evaluation & Prioritization

Project Concepts

Plan Drafting

Winter 2025 Regional Coordination and Review

Spring 2026 Community Coordination

Summer 2026 Project Identification and Evaluation

Fall 2026 Priority Plan Concept Development

Winter 2026 Plan Drafting and Approval

Information Request

In-Person Meeting

Plan and Project Graphics & Formatting

Plan Approval



Community Input & Participation

Introduction

Many flooding and drainage problems in the region occur outside FEMA-mapped floodplains or are never reflected in flood insurance claims. To capture these conditions, the plan draws on the local knowledge of residents, locality staff, and regional partners. Engagement took place in five phases: a kick-off meeting with locality staff, public and stakeholder surveys, meetings with staff from each locality, engineering field visits, and a review of the draft plan with locality staff. The input gathered through this process shaped the needs and resilience actions in each community profile (Chapter 4) and the priority projects in Appendix A.

Kick-Off Meeting

In October 2025, the project team held a virtual kick-off meeting with staff from each participating locality. Approximately 30 attendees reviewed the plan's purpose and objectives, data needs, the public input process, CFPF-eligible project types, and next steps.

Surveys

The project team released a public survey in February 2026, described in detail below. The team also distributed modified versions of the survey to locality staff and to regional stakeholders, including representatives of James Madison University, VDOT, and the Virginia Department of Emergency Management. These versions focused on the mapping question, asking respondents to identify locations that have flooded in the past, and all participating localities responded.

Locality Meetings

In March 2026, the project team met with each participating locality to review the public input, document local flood and stormwater conditions, identify and rank priority locations, and gather information on existing infrastructure, prior studies, and implementation barriers. The results were compiled and provided to WSSI before the field visits.

Field Visits

In June and July 2026, WSSI staff visited each participating locality to verify reported problems, assess site conditions, and refine candidate projects. Findings from these visits are documented in the project identification memos in Appendix A.

Review

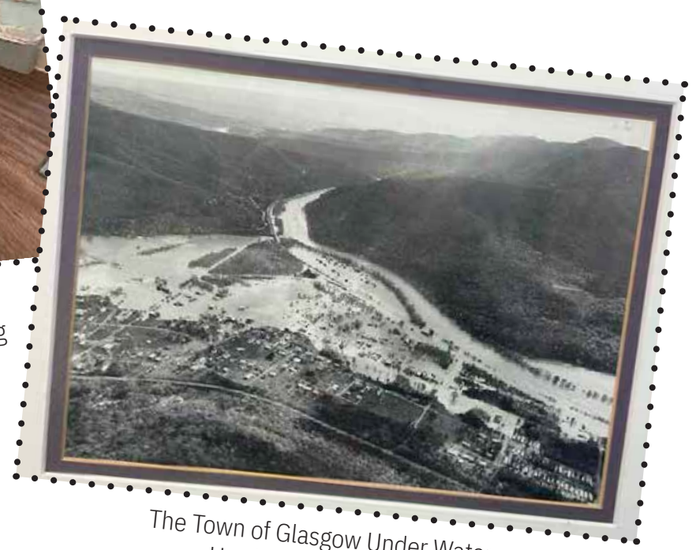
In November 2026 the project team held a second virtual meeting with locality staff to review the draft plan's findings, priority projects, and resilience actions, and to gather comments before the plan was finalized for adoption.



CSPDC Flood and Stormwater Resilience Website Homepage



Glasgow Town Manager, Allyson Finchum Displaying Historic Town Flooding



The Town of Glasgow Under Water Hurricane Juan, 1985

Public Survey Methodology

The project team developed an online public survey to gather community perspectives on flooding and stormwater conditions throughout the Central Shenandoah region. The survey was posted on the CSPDC Flood and Stormwater Resilience Plan webpage, where participants could also review information about the plan's purpose, participating localities, project schedule, and available flood-resilience resources.

This survey was promoted through the distribution of social media posts by localities and the PDC, printed postcards, and bookmarks sent to local libraries, locality offices and community centers. The survey was available from February through April 2026. It asked respondents to identify their locality and length of residence, describe their experiences with flooding, indicate whether they considered themselves vulnerable to flooding, identify topics about which they wanted more information, and provide additional comments.

An interactive mapping question allowed participants to identify locations where they had observed repeated flooding or stormwater problems and provide a brief description of each location.

A total of 39 people completed the survey. Collectively, respondents submitted 80 mapped observations. Because respondents could select multiple answers for questions about flood impacts and educational interests, percentages for those questions do not total 100 percent. Survey results represent the experiences and perceptions of participating respondents and should not be interpreted as a statistically representative sample of the region's population.

Survey Limitations

The survey findings are subject to several limitations:

- Participation was voluntary and self-selected.
- The survey received 39 responses and was not designed as a statistically representative public-opinion poll.
- Responses were unevenly distributed among participating localities.
- The survey captured conditions known to participants and may underrepresent locations with limited participation, internet access, or public awareness.

With these considerations in mind, the survey provides valuable firsthand information about recurring problems, community concerns, perceived vulnerability, and potential locations for further technical review.

Respondent Characteristics

Responses were received from residents of 10 of the 18 participating localities. The greatest numbers came from the City of Waynesboro and Town of Bridgewater, with eight respondents each, followed by the City of Harrisonburg with six. No responses were recorded from eight participating localities.

Most participants had substantial familiarity with their communities. Twenty-four respondents, or approximately 62 percent, reported living in the community or region for more than 10 years. Seven had lived in the region for six to 10 years, six for one to five years, and two for one year or less.

Only six respondents, approximately 15 percent, reported living in a FEMA-designated flood zone. Twenty-four reported that they did not live in a flood zone, while nine were unsure. Nevertheless, 18 respondents, or approximately 46 percent, considered themselves personally vulnerable to flooding. This difference suggests that residents' perceptions of flood vulnerability extend beyond formally mapped floodplains and may include stormwater drainage, roadway flooding, utility interruptions, and localized runoff problems.



City of Harrisonburg

Reported Flood Impacts

Road closures and travel disruptions were the most commonly reported impacts, identified by 19 respondents. Loss of utilities was nearly as common, reported by 18 respondents. Other frequently reported impacts included:

- Closure or loss of community spaces — 11 respondents
- Damage to homes, vehicles, or belongings — 10 respondents
- Disruptions to businesses or workplaces — 8 respondents
- Temporary or long-term displacement — 2 respondents
- Health impacts or injuries — 1 respondent
- Agricultural or livestock issues — 1 respondent

Eight respondents reported that they had not personally experienced flood impacts. Six supplied additional descriptions, including yard and crawlspace flooding, runoff from nearby development, and recurring problems affecting residential property.

These findings indicate that flooding affects the region through both direct property damage and broader disruptions to transportation, utilities, employment, and community facilities. In particular, the prominence of roadway and utility impacts demonstrates that flood resilience is not limited to properties located within mapped flood zones.

Public Information Priorities

Participants were asked about topics for additional information, depicted below. These results suggest an opportunity for the CSPDC and participating localities to communicate more clearly about ongoing projects, local responsibilities, household preparedness, available assistance, and the relationship between changing rainfall patterns and localized flooding.

Local Government Flood Mitigation Efforts
20 respondents

Preparing Homes or Property for Flooding
14 respondents

Causes and Effects of Increased Rainfall Intensity and Flooding
12 respondents

Resilience Resources and Programs
11 respondents

Flood Insurance
10 respondents

No Additional Information
16 respondents

Mapped Observations

All 39 respondents contributed at least one mapped observation, producing 80 locations in total. Fourteen respondents submitted more than one location, and individual submissions ranged from one to eight points.

The observations included recurring street and roadway flooding, water overtopping low-water bridges, insufficient or blocked drainage infrastructure, basement and crawlspace flooding, stormwater and sewer backups, streambank erosion, culvert limitations, runoff from adjacent properties or development, and flooding of parks and other community spaces. Several respondents also documented roads becoming impassable during heavy rainfall or major storms.

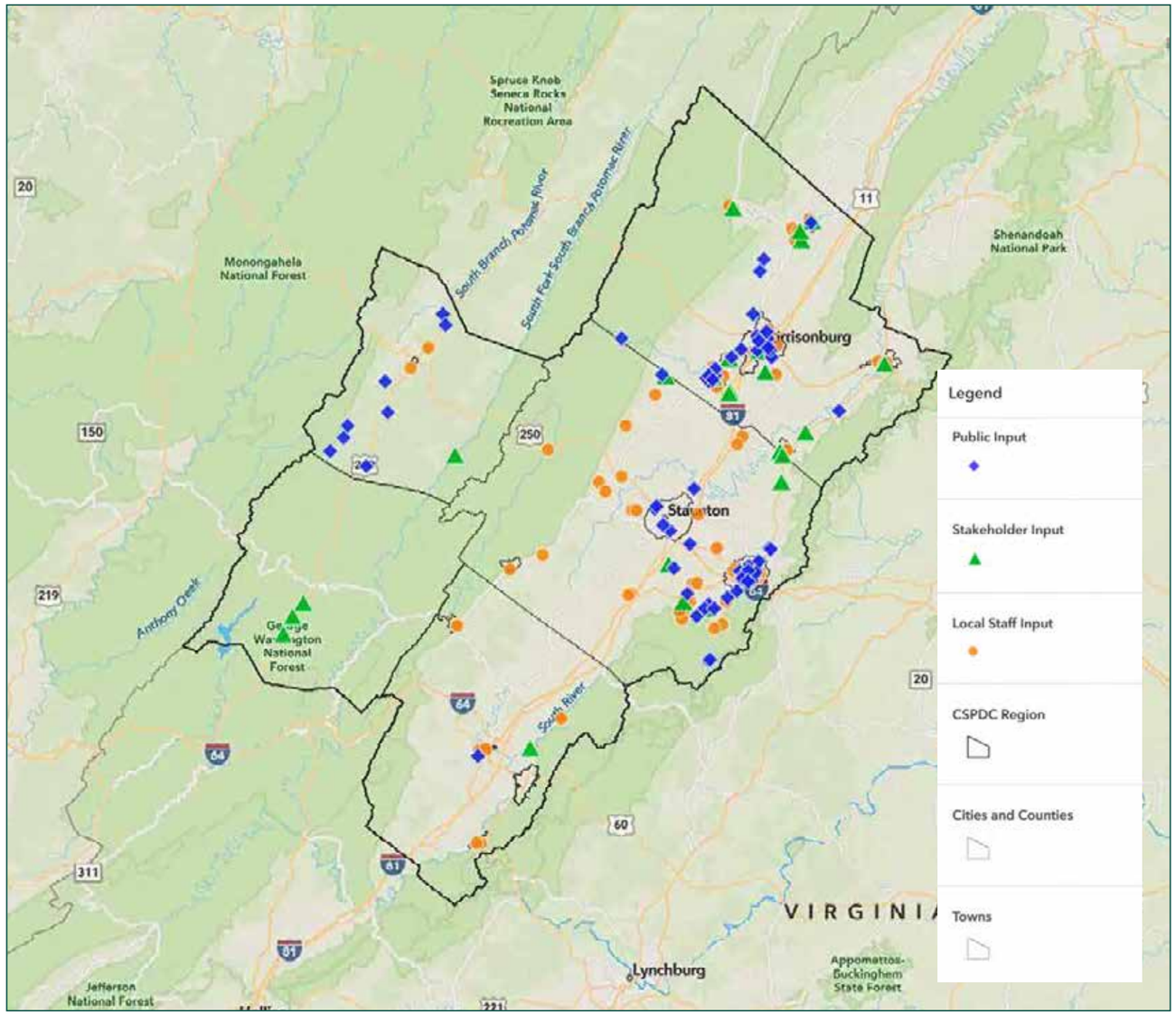
Mapped observations were particularly concentrated in and around Waynesboro, Harrisonburg, Bridgewater, Staunton, Stuarts Draft, and Highland County.

Several broad geographic patterns emerged:

- Urban observations frequently described undersized or obstructed drainage systems, street ponding, basement flooding, sewer backups, and flooding near bridges or community facilities.
- Rural observations more often described water crossing roadways, low-water bridge closures, washed-out gravel roads or driveways, stream and river flooding, and erosion.
- Multiple observations linked flooding to drainage from uphill properties, subdivisions, or other development.
- Several observations documented recurring problems rather than isolated events, suggesting locations that may warrant further investigation by locality staff.

The mapped observations provide useful location-specific evidence for comparison with floodplain data, drainage information, infrastructure inventories, locality input, and field observations.

Map 1.1 | Flood Hotspot Survey of Public, Localities, and Stakeholders



Resilience Actions

What is an Action?

In this plan, a resilience action is any measure that reduces flood risk or builds the capacity to address it. The plan includes two kinds of measures. Priority projects are specific improvements at specific locations, such as a culvert upgrade or a stream restoration, and are described in the project identification memos and 10% design concepts in Appendix A. Resilience actions are the broader steps localities and partners can take to support those projects and manage flood risk over time, such as staff training, ordinance updates, and interagency coordination. Regional actions appear in Chapter 3, and each locality's actions appear in its profile in Chapter 4.

Both fall into four categories: infrastructure and control structures, nature-based solutions, building-level mitigation, and policy and planning. Most priority projects combine more than one category, for example pairing a culvert upgrade with a floodplain bench and riparian plantings.

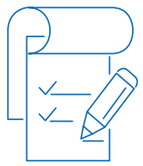


Building Level Mitigation

Building level mitigation delivers risk reduction where people live and work, providing a path to loss reduction and continuity of operations at the smallest scale. These actions protect life and property, lower insurance and recovery costs, and preserve community assets and economic recovery after flooding events. They also offer flexible, scalable options, from individual property upgrades to neighborhood-scale buyouts, which can be prioritized based on cost-effectiveness and environmental considerations. Since these actions operate at the individual structure scale, they can sometimes be faster to implement than projects at the local-government wide or interjurisdictional scale, but they can sometimes face funding and private property ownership challenges. Ten priority projects include building-level measures, such as voluntary buyouts of repeatedly flooded properties and floodproofing of wastewater plants, wells, and pump stations.

Action Types

- Relocation
- Utility Elevation
- Voluntary Acquisition/ Demolition
- Dry Floodproofing
- Wet Floodproofing
- Mitigation Reconstruction
- Structural Elevation



Policy & Planning

Planners, policymakers, and local governments use these actions to inform which flood risk reduction measures are required, permitted, funded, prioritized, and implemented. By setting clear regulations and guidelines, these actions promote development that occurs in safer locations, that infrastructure is built to withstand flooding, and that natural landscapes are preserved for their protective benefits. Strong policy and planning frameworks create the foundation for coordinated, long-term flood risk management, ensuring that public resources are invested wisely and that communities become more resilient over time. Most regional and locality actions fall in this category, along with five priority projects that focus on flood warning, emergency planning, dam safety coordination, and flood map amendments.

Action Types

- Stormwater, Water Quality,
- Floodplain Regulations
- GIS and Floodplain Capacity Building
- Multi-Use Floodplains
- Higher Standards Regulations

Infrastructure & Control Structures

Infrastructure and control structure actions are a key part of flood resilience strategies because they block or redirect water, keeping it away from people, property, and essential services. Protecting critical infrastructure ensures that power, water, healthcare, communications, and other critical services remain operational during and after flooding events. Collectively, these actions are crucial for maintaining public safety, minimizing economic disruption, and quickly recovering after severe flooding events by preventing water from moving into areas where it can do the most harm. Forty-four of the plan's 61 priority projects include infrastructure improvements, most often upgrades to undersized storm sewers, culverts, and ditches in neighborhoods and downtowns.



Action Types

- Storm Water Management Activities
- Levee/Dike/Berm
- Critical Infrastructure
- Debris Removal
- Roadway Elevation/Road
- Crossing Modification
- New and Existing Dam Structures

Nature Based Solutions

Nature based solutions provide an array of benefits for flood risk reduction by harnessing the power of natural processes and landscapes. These solutions help to slow, absorb, and safely move excess water, reducing the intensity and frequency of flooding events. By increasing the capacity of soil and vegetation to capture and store rainfall, nature based actions lower runoff and decrease the likelihood of overwhelming drainage systems. Restored wetlands, floodplains, and riparian buffers provide natural storage areas for floodwaters, protecting downstream communities from sudden surges. Additionally, nature based solutions improve water quality, support biodiversity, and offer recreational and aesthetic value to local communities. They are often cost-effective, adaptable, and sustainable, making them a resilient approach to managing flood risks. Thirty-nine priority projects include nature-based elements, making them the second most common approach in the plan.



Action Types

- Permeable Pavement
- Bioretention
- Green Roofs
- Bio-Swales
- Afforestation
- Floodplain Preservation
- Flood Storage Wetlands
- Floodplain Restoration
- Riparian Buffers

Where & Why Are These Actions Needed?

When using the resilience plan, location and vulnerability are two key factors that shape which actions are recommended for each community. The unique characteristics of each place, such as its geography, climate, and existing infrastructure, determine the types and frequency of flood hazards faced, as well as any environmental or policy-based constraints on viable solutions. At the same time, understanding who and what is most vulnerable to these hazards (including people, properties, infrastructure, and ecosystems) helps direct resources to where they have the greatest flood risk reduction potential. Because not all actions are appropriate for every community, their effectiveness depends on a match between local hazards, vulnerabilities, environmental context, and local support. Therefore, actions are most effective when selected and tailored for the specific location and flood risk a community faces.

Location



The location of a community or structure is a primary factor in determining which actions are appropriate. The region faces three main flood types: riverine flooding along its major rivers, flash flooding in steep mountain watersheds, and drainage flooding in towns and cities when local systems are overwhelmed. Soils, karst geology, topography, and existing land use further shape which solutions will work at a given site.

Where to find it in this plan: regional flood hazards (Chapter 2) and each locality's flood history and existing conditions (Chapter 4).

Examples of How Location Shapes Appropriate Actions

- Riverine floodplains: voluntary buyouts, elevation, floodplain restoration
- Steep mountain watersheds: culvert and crossing upgrades, debris management, flood warning
- Towns and cities: storm sewer upgrades, regional detention, bioretention
- Karst areas: site investigation before any infiltration or excavation

Vulnerability



Vulnerability refers to the people, infrastructure, and natural systems at risk of harm from flooding. Assessing vulnerability helps direct actions where they will protect the most at-risk residents, keep critical services running, and preserve natural systems that store floodwater. Projects in lower-income areas may also qualify for a reduced local match through the CFPF.

Where to find it in this plan: social vulnerability and critical facilities (Chapter 2) and each locality's vulnerable populations and infrastructure (Chapter 4).

Examples of How Location Shapes Appropriate Actions

- Critical facilities: floodproofing and elevating equipment, relocation
- Communities cut off by flooding: flood warning and emergency access plans
- Lower-income neighborhoods: projects that qualify for the CFPF's reduced match
- Repetitive-loss properties: voluntary buyouts and elevation

Chapter 2

The Central Shenandoah Region

Regional Profile

Chapter 2 describes conditions across the Central Shenandoah region that affect flood and stormwater management. Seventeen of the Central Shenandoah Planning District Commission's (CSPDC's) 21 local governments and James Madison University participate in this plan. While Buena Vista, Staunton, Craigsville, and Monterey are not participating in this plan, all four are included in this regional profile for context.

The chapter profiles the region's geography, development, infrastructure, people, and natural resources, which together shape where flooding occurs and who it affects. It then examines the region's flood history and hazards, including insured losses, repetitive-loss properties, and high hazard potential dams, and closes with projected changes in rainfall, heat, and storm intensity. Chapter 3 builds on these conditions to assess local capacity, identify shared regional needs, and present regional resilience actions.

The Central Shenandoah region is the largest of Virginia's planning districts by land area, covering approximately 3,420 square miles and about 304,000 residents. The region includes 21 local governments, all served by CSPDC.

Counties:
Augusta
Bath
Highland
Rockbridge
Rockingham

Cities:
Buena Vista
Harrisonburg
Lexington
Staunton
Waynesboro

Towns:
Bridgewater
Broadway
Craigsville
Dayton
Elkton
Glasgow
Goshen
Grottoes
Monterey
Mount Crawford
Timberville

Geography and Watersheds

The Central Shenandoah region is bounded by the Allegheny Mountains along the West Virginia border to the west and the Blue Ridge Mountains to the east. The region contains the headwaters of the Potomac and James rivers, both of which drain to the Chesapeake Bay. Because the region includes headwaters, nearly all of its floodwater originates within the region, and local land use, development, and drainage decisions directly shape local flood conditions.

Four major subbasins drain the region:

- **South Fork Shenandoah River (Potomac basin).** The North, Middle, and South Rivers drain Augusta County, Staunton, Waynesboro, and western Rockingham County. These rivers join near Port Republic to form the South Fork. The full subbasin covers about 1,670 square miles.
- **North Fork Shenandoah River (Potomac basin).** The North Fork drains northern Rockingham County, including Broadway and Timberville. The full subbasin covers about 1,030 square miles.
- **Upper James River (James basin).** The Jackson, Cowpasture, and Bullpasture Rivers drain Bath County and most of Highland County. The full subbasin covers about 2,210 square miles.
- **Maury River (James basin).** The Calfpasture and Maury Rivers drain western Augusta County, Goshen, Rockbridge County, Lexington, and Buena Vista before joining the James River at Glasgow. The full subbasin covers about 840 square miles.

Because these basins cross jurisdictional lines, flooding in one locality often depends on conditions upstream. For example, Blacks Run drains most of Harrisonburg into Cooks Creek, which flows past Dayton and Mount Crawford before joining the North River. As a result, development and drainage decisions in Harrisonburg affect flood conditions in both towns downstream.

Steep mountain watersheds deliver runoff rapidly to narrow valley floors, and flash flooding is most severe along the slopes of the Blue Ridge and Allegheny Mountains. Additionally, karst geology underlies much of the Shenandoah Valley, producing sinkholes and unpredictable subsurface drainage that complicate stormwater design.

Natural Resources

Public forest land is the region's largest natural flood-protection asset. Forested slopes absorb rainfall and slow runoff before it reaches streams. The George Washington and Jefferson National Forests cover approximately 635,000 acres, about 30 percent of the region's land area. Shenandoah National Park, along the Blue Ridge in eastern Augusta and Rockingham Counties, and the Blue Ridge Parkway in Augusta and Rockbridge Counties add further protected land. Together with the region's farms and other working lands, these areas support habitat, groundwater recharge, water quality, agriculture, recreation, and tourism.

Most of this protected land sits on mountain slopes and ridges. The valley floors, where floodplains store and carry floodwater, are largely farmed or developed and have far less formal protection. This gap makes riparian buffers, floodplain easements on working farms, and stream restoration the region's largest remaining opportunity for nature-based flood reduction, and these practices also advance Chesapeake Bay water quality goals.



Land Use, Growth, and Economy

Development is concentrated along the Interstate 81 (I-81) corridor and in the cities and towns, and the rest of the region is predominantly rural. Population growth varies widely by locality, with Rockingham County (8,391 residents) growing at a rate of 6.7% and Augusta County (78,872 residents) growing at a rate of 4%. These two counties together comprise over half of the region's population. Highland County (2,300) and Bath County (4,212) are among the least populated counties in Virginia, and Rockbridge County (22,542) is also one of the less populous counties in the state. These three counties average a negative or steady rate of population growth (US Census).

Outside the developed areas, farms define much of the valley landscape. Agriculture is the region's largest industry, and many operations are exposed to flooding. Rockingham and Augusta Counties are the two largest agricultural counties in the state, with about 435,000 acres in farms between them based on 2022 US Census of Agriculture data. Livestock and poultry operations account for approximately 90 percent of agricultural sales. Poultry houses, dairy operations, manure storage, and farm roads are often located near streams and can be a source of stormwater pollutants.

Other major employment sectors include higher education, health care, manufacturing and food processing, freight and logistics along I-81, and tourism. Tourism is concentrated around Shenandoah National Park, the Blue Ridge Parkway, the George Washington and Jefferson National Forests, and Lake Moomaw. Tourism in Bath, Highland, and Rockbridge Counties depends on a small number of rural roads, so road closures due to flooding carry direct economic costs in those counties in particular.

Development pressure is reshaping drainage in the region's growth areas. New development upstream of older neighborhoods adds runoff to existing drainage systems not designed to accommodate growth. In Timberville, the Town's entire designated growth area drains to a single culvert at US Route 211 that already floods the Virginia Avenue and Maple Avenue neighborhoods. Rockingham County's Taylor Spring Lane regional basin, completed in 2023, resolved flooding in the area it serves but is now at or near capacity as the Stone Spring Road corridor builds out.

Many of the region's downtowns and main street areas are flood-prone. For example, in Bath County, Hot Springs Run floods businesses in the Hot Springs village center; Elkton's downtown triangle at Ashby Avenue and Warren Street floods from as little as a quarter inch of rain; and downtown Dayton sits in a natural bowl served by an undersized stormwater system.

Transportation and Drainage Infrastructure

The region's roadway network is defined by I-81, which runs north-south and carries the highest truck freight volume percentages in the state, and Interstate 64 (I-64), which runs east-west. A network of primary routes, including US Routes 11, 33, 60, 220, 250, and 340 and State Routes 39 and 42, connects the cities and towns. Beyond these corridors, most travel in the region depends on the Virginia Department of Transportation's (VDOT's) secondary road system, much of which consists of narrow two-lane roads built along stream valleys and across low-lying floodplains. In the mountain counties, roads such as State Route 39 through Goshen Pass and US Route 220 in Bath and Highland Counties run beside rivers for long distances.

The National Bridge Inventory lists 1,085 bridges and bridge-length culverts (structures with spans of more than 20 feet) in participating localities, and 933 (86 percent), cross a stream or river. VDOT owns about 90 percent of these structures. The inventory is aging, with the median structure built in 1969, and about 60 percent of stream crossings are 50 years old or older. Thirty-nine structures, about 4 percent, are rated in poor condition, and 36 of those cross water. VDOT maintains condition data for culverts on state roads, but most towns have no systematic record of the size or condition of their drainage pipes.

Responsibility for drainage infrastructure is divided between localities, VDOT, railroads, and private landowners. In Virginia, cities and towns with a population over 3,500 people typically maintain their own streets and storm drainage; however, in the Central Shenandoah region, the towns of Elkton and Grottoes, which both have populations below the 3,500 threshold, also maintain their own roads. VDOT owns and maintains roads, bridges, and culverts in the localities that do not maintain their own roads. Most localities identified VDOT coordination as necessary to advance at least one priority need. Most small localities in the region do not have an inventory or know the location of pipes, ditches, inlets, and culverts within their boundaries, and often VDOT records for this infrastructure is often incomplete.

Private landowners own many drainage easements and ditches in older subdivisions, and these ownership lines frequently intersect local priorities. Three localities noted that railroad embankments or culverts affect their priority sites, and eight localities identified easements or private-property cooperation as a requirement for project implementation.



Vulnerable Populations

Social vulnerability describes how well residents can prepare for, respond to, and recover from flooding. Vulnerable, flood-risk populations include older adults, people with disabilities, low-income households, households without reliable transportation, residents of manufactured housing, agricultural workers, students, and residents who depend on private wells and septic systems and/or live in flood-prone areas.

The Virginia Department of Conservation and Recreation (DCR) evaluates vulnerable populations for the Community Flood Preparedness Fund program using ADAPT Virginia's social vulnerability data and the Centers for Disease Control and Prevention (CDC) Social Vulnerability Index, which assesses vulnerability through 16 indicators. Of the indicators most related to flood risk, the region exceeds the state average on four: residents in the region are slightly more likely to be 65 or older, to have a disability, to live in a manufactured home, and to have lower incomes (Table 2.1). Vulnerability is not uniform across the region, and small or dispersed populations may have limited access to services even where regional indicators appear moderate.

Regionally, the cities are the most vulnerable areas, with Harrisonburg and Waynesboro the most vulnerable participating localities. Cities have the highest poverty rates and the most households without a vehicle, and census tracts in Harrisonburg and Staunton are classified as having high social vulnerability in DCR's data.

Rural county areas typically have a higher percentage of the population that is 65 or older or living in a manufactured home. Isolation compounds vulnerability in rural mountain areas and small towns, where road flooding along mountain slopes can cut residents off from emergency services.

Together, these characteristics shape where flooding occurs and who it affects: steep watersheds that cross jurisdictional lines, development concentrated in valleys, aging drainage infrastructure with divided ownership, and residents who may have difficulty preparing for or recovering from a flood. The following sections examine flooding directly, beginning with the region's flood history.

Table 2.1 | Selected Social Vulnerability Indicators, Central Shenandoah Region and Virginia

Indicator	Region	State
Above the state average		
Age 65 and older	19.0%	16.0%
With a disability	13.9%	12.1%
Mobile homes (share of housing)	6.5%	4.5%
Below 150% of poverty level	21.8%	16.5%
Below the state average		
Households without a vehicle	5.6%	6.1%
Housing cost burden	22.6%	23.4%
Multi-unit housing (share of housing)	7.3%	13.9%
Minority populations	17.9%	40.0%

Source: CDC/ATSDR Social Vulnerability Index 2022 (2018–2022 American Community Survey), Virginia county file. Regional figures are weighted by population, households, or housing units and approximate official Census rates. County figures include incorporated towns. Excluding Harrisonburg, the poverty figure is 18.3 percent.



Regional Flooding Timeline

1870 Sept

Sept 1896

1906 Aug

36

Oct 1942

49

1950 Sept

69

72

85

1992 May

April 1993

96

2001 Aug

03

July 2006

2010 Jan

12

May 2018

18

2019 June

Feb 2022

2024 May

24

Feb 2025

Heavy rain falling on an already deep snowpack caused widespread flooding across Virginia during the Great St. Patrick's Day Flood. Across the Central Shenandoah region, roads and bridges were washed out, streams overflowed, homes were evacuated, and major manufacturing facilities were forced to close.

March 1936
The Great St. Patrick's Day Flood

Hurricane Camille produced some of the deadliest flooding in Virginia history, claiming more than 150 lives across the Commonwealth. In the region, Rockbridge, Buena Vista, and Glasgow bore the brunt of the flooding, with more than two dozen fatalities, downtown closures, and agricultural fields stripped of livestock and topsoil.

August 1969
Hurricane Camille

CATEGORY 5 HURRICANE

Three days of sustained rainfall produced widespread flash flooding across the Central Shenandoah region during the Election Day Flood. The timing contributed to one of the lowest voter turnouts in Virginia history, while floodwaters damaged homes, businesses, and public facilities throughout the region.

November 1985
Election Day Flood

Hurricane Isabel ranked among the most expensive storms in U.S. history at the time it struck Virginia. In the Central Shenandoah region, flooding and storm damage were greatest along the South River, particularly around Sherando in Augusta County and communities in northeastern Rockbridge County.

September 2003
Hurricane Isabel

CATEGORY 5 HURRICANE

Hurricane Florence brought widespread flooding and road closures across the Central Shenandoah region, particularly in Staunton, Augusta County, and Waynesboro. Augusta County officials opened emergency shelters as conditions worsened, while the storm's agricultural impacts later contributed to Rockbridge County's inclusion in a statewide agricultural disaster declaration.

CATEGORY 4 HURRICANE

September 2018
Hurricane Florence

June 1949
Flood of 1949

A devastating flash flood swept through the Town of Bridgewater, sending water as high as the second floor of homes. Four people lost their lives, and approximately 100 homes and businesses were damaged. The disaster spurred construction of Bridgewater's levee and helped prompt the development of flood-control dams across Rockingham and Augusta counties.

CATEGORY 1 HURRICANE

June 1972
Hurricane Agnes

Hurricane Agnes became one of the costliest hurricanes to strike the eastern United States. Thirteen people died in Virginia, with statewide damages exceeding $1 billion in 2019 dollars. In the region, Waynesboro, Buena Vista, and Glasgow were hit hardest, forcing more than 100 people to evacuate downtown centers and neighborhoods.

CATEGORY 3 HURRICANE

September 1996
Hurricane Fran

Hurricane Fran pushed the Shenandoah River and its tributaries to record levels, surpassing flood stages reached during the 1972 and 1985 events. Damage across the Shenandoah Valley exceeded $97 million in 2019 dollars, with Augusta and Rockingham counties among the areas most heavily affected in the region.

CATEGORY 3 HURRICANE

October 2012
Hurricane Sandy

Hurricane Sandy brought intense rainfall, widespread flooding, and damaging winds to the Central Shenandoah region, prompting Governor McDonnell to declare a statewide emergency. Highland County was particularly affected when a transmission line failed, leaving approximately 90% of the county without power for an extended period.

CATEGORY 4 HURRICANE

September 2024
Hurricane Helene

Hurricane Helene brought catastrophic flooding and tornadoes to the southern Appalachians, resulting in at least 250 deaths and becoming the deadliest hurricane to strike the contiguous United States since Hurricane Katrina. In the region, communities along the Blue Ridge experienced the greatest impact, with portions of Skyline Drive closed for several weeks.

Regional Flood History

The Central Shenandoah region has a long record of damaging floods. The timeline on the preceding pages highlights major events over the past century. It is not a complete record, but it shows the patterns that shape the region's flood risk today.

Most of the region's flooding comes from three types of storms. Late-summer and fall tropical systems, including Hurricanes Camille, Agnes, Fran, and Isabel, cause the most widespread river flooding. Winter rain-on-snow events can cause flooding with little warning, as in January 1996, when heavy rain and warm temperatures melted the snowpack left by the Blizzard of 1996. Summer thunderstorms cause flash flooding in steep tributary watersheds and drainage flooding in towns and cities.

Tropical systems have produced the region's largest floods. Hurricane Camille set the highest recorded peak on the Maury River near Buena Vista in 1969. The Election Day Flood, driven by the remnants of Hurricane Juan, set the highest recorded peak on the South River near Waynesboro in 1985. Hurricane Fran set the highest recorded peaks on the North River and on both forks of the Shenandoah River in 1996. Table 2.2 lists these record peaks.

After the June 2006 storms, only two federal disaster declarations for flooding have included a locality in the region: the 2012 declaration for Hurricane Sandy (FEMA-4092-DR), which included Highland County, and the early 2025 declaration for severe winter storms and flooding (FEMA-4863-DR), which included Rockingham County. Nonetheless, localities report more frequent drainage and flash flooding. Intense, short-duration storms, including the May 2024 storm in Harrisonburg and the remnants of Tropical Storm Helene in late September 2024, repeatedly overwhelmed local drainage systems across the region, often outside mapped floodplains.

Table 2.2 | Highest Recorded Peak Flows at Selected USGS Stream Gages

Gage	Peak flow (cfs)	Date	Event
South River near Waynesboro	17,500	November 4, 1985	Election Day Flood
North River near Burketown, Augusta County	70,400	September 6, 1996	Hurricane Fran
North Fork Shenandoah River at Cootes Store, Rockingham County	63,400	September 6, 1996	Hurricane Fran
South Fork Shenandoah River near Lynnwood, Rockingham County	107,000	September 7, 1996	Hurricane Fran
Maury River near Buena Vista	105,000	August 20, 1969	Hurricane Camille

Source: USGS National Water Information System, annual peak streamflow records, accessed October 2026. Peaks are the highest recorded during each gage's period of record (74 to 102 years). cfs = cubic feet per second.

Flood Insurance and Repetitive Loss

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), is the main source of flood insurance for homes and businesses in the region. All 17 participating localities participate in the NFIP, and in exchange for adopting and enforcing floodplain management standards, the NFIP makes flood insurance available to their residents and businesses. However, flood insurance is required only for buildings in Special Flood Hazard Areas (SFHAs) with mortgages from federally backed or regulated lenders, so for most property owners, it is optional.

As a result, coverage in the region is limited. About 1,050 NFIP policies were in force across the region at the start of 2026. Many properties that flood, particularly from drainage flooding outside mapped floodplains, carry no flood insurance at all. NFIP records therefore capture only part of the region's flood damage. Even so, they are the most consistent long-term record available, showing where these floods caused insured damage and which properties have flooded more than once.

Since 1978, the region has recorded 1,262 paid NFIP claims totaling $24.6 million, not adjusted for inflation. Four floods account for 63 percent of all paid claims and 69 percent of all payments: the 1985 Election Day Flood, the June 1995 storms, Hurricane Fran in 1996, and Hurricane Isabel in 2003. Hurricane Fran alone produced 337 claims and $7.6 million in payments, about 31 percent of all insured flood losses in the region. Adding the January 1996 rain-on-snow flood, which struck eight months before Fran and produced 139 claims and $2.6 million in payments, these five events account for 74 percent of all paid claims and 79 percent of all payments.

These figures understate total flood damage because NFIP data exclude most agricultural losses, such as crops, livestock, fencing, farm roads, and outbuildings. Agricultural damage can be substantial. For example, it accounted for about one-third of Highland County's estimated $5 million in losses from the 1985 flood, and Rockingham County reported $10 million in poultry, livestock, and crop losses from Hurricane Fran.

Table 2.3| NFIP Policies and Claims by County and City

Locality	Policies in Force (January 1, 2026)	Paid Claims Since 1978	Total Paid
Augusta County	200	149	$3.0 million
Bath County	21	12	$0.1 million
Highland County	19	3	$0.1 million
Rockbridge County	117	261	$5.1 million
Rockingham County	332	220	$4.5 million
City of Buena Vista	31	221	$4.0 million
City of Lexington	9	25	$0.3 million
City of Harrisonburg	87	39	$0.8 million
City of Staunton	118	36	$0.8 million
City of Waynesboro	117	296	$6.0 million
Total	**1,051**	**1,262**	**$24.6 million**

Source: FEMA OpenFEMA NFIP Redacted Policies and Claims datasets, accessed October 2026. County figures include incorporated towns. Payments are nominal dollars.

Within the insured record, a small number of properties account for a large share of losses. FEMA defines two categories of repeatedly flooded properties. These classifications can help localities prioritize mitigation assistance, including elevation, floodproofing, voluntary acquisition, relocation, or demolition, as appropriate:

> **Repetitive Loss (RL):** An NFIP-insured structure that has received two or more paid flood claims of more than $1,000 each within any rolling 10-year period since 1978.
>
> **Severe Repetitive Loss (SRL):** An NFIP-insured residential structure that has received four or more separate claim payments of more than $5,000 each, with a cumulative total of more than $20,000, or at least two separate building claim payments that together exceed the building's market value.

According to FEMA claims and policy data, SRL properties in Virginia have an average of 5.4 NFIP claims. Across the state, SRL properties represent 21.1 percent of all NFIP claims, while only accounting for 1 percent of NFIP policies. These properties represent the greatest documented financial and property risk from flooding.

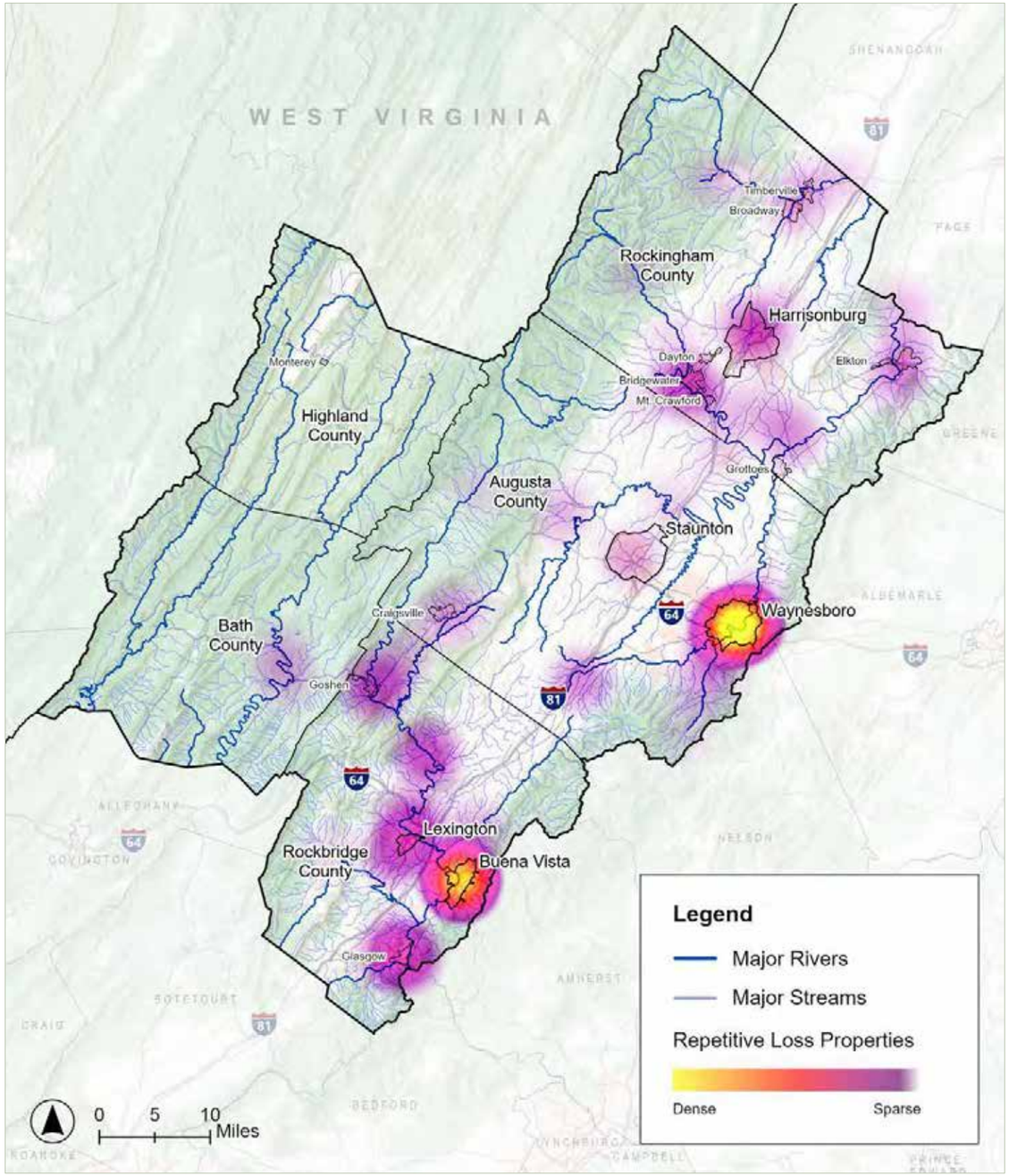
The 2026 Central Shenandoah Hazard Mitigation Plan (HMP) uses a 2025 dataset provided by FEMA to identify RL and SRL structures. This inventory identifies 136 RL structures and 27 SRL structures in the region. FEMA repetitive loss and severe repetitive loss counts reflect FEMA records as of 2025 and may not account for properties that localities have mitigated through elevation, floodproofing, or acquisition, so current totals may be lower than shown. At the subregional scale, the Staunton-Augusta-Waynesboro and Lexington-Rockbridge-Buena Vista areas contain the highest recorded numbers of repetitive-loss properties. The City of Waynesboro accounts for 39 RL and 12 SRL structures and the City of Buena Vista accounts for 30 RL and 3 SRL structures.

Table 2.4 | Repetitive Loss and Severe Repetitive Loss Structures by Locality

Locality	RL	SRL
City of Harrisonburg	4	0
Rockingham County	12	1
Town of Bridgewater	1	0
Town of Broadway	2	0
Town of Dayton	0	0
Town of Elkton	1	0
Town of Grottoes	0	0
Town of Mount Crawford	0	0
Town of Timberville	0	0
City of Staunton	2	0
City of Waynesboro	39	12
Augusta County	12	1
Town of Craigsville	0	1
City of Buena Vista	30	3
City of Lexington	3	1
Rockbridge County	14	7
Town of Glasgow	12	0
Town of Goshen	2	1
Bath County	2	0
Highland County	0	0
Regional Total	**136**	**27**

Source: 2026 Central Shenandoah Hazard Mitigation Plan, Table 4.1.5; FEMA data, 2025. Counts are presented by locality to protect property-level information.

Map 2.1 | Flood Hazards and Repetitive Loss



Flood Hazards

As described in the previous sections, the regional flood history is dominated by a few large flood events stemming from tropical storm systems. However, the flooding localities manage most often today is smaller, more frequent, and often outside mapped floodplains. This section describes the types of flooding that affect the region, the community facilities most exposed to them, and the risk posed by high hazard potential dams.

Three types of flooding affect the region, and the locality meetings show that each produces a distinct set of needs.

- **Riverine flooding.** Flooding along rivers is most severe along the South River in Waynesboro and Grottoes; the Maury and James Rivers in Buena Vista, Glasgow, and the Lexington area; the Calfpasture River and Mill Creek in Goshen; and the North and South Forks of the Shenandoah River. Riverine flooding accounts for most of the region's repetitive-loss claims.
- **Flash flooding.** Sudden flood events primarily affect areas in steep tributary watersheds and in towns at the base of mountain slopes, including western Augusta County and the Stuarts Draft area, Hot Springs Run in Bath County, the Fulks Run and Bergton area of Rockingham County, and roadway corridors in Highland and Rockbridge Counties.
- **Drainage flooding.** Drainage flooding occurs in every town and city when undersized culverts, aging pipes, and flat or depressional terrain prevent water from draining. It accounts for the largest share of the priority needs localities identified for this plan. Much of it occurs outside mapped floodplains, such as in the downtowns of Elkton, Dayton, and Glasgow; along US Route 11 in Mount Crawford; in older subdivisions in Augusta County and Bridgewater; and at the Glades in Rockbridge County.

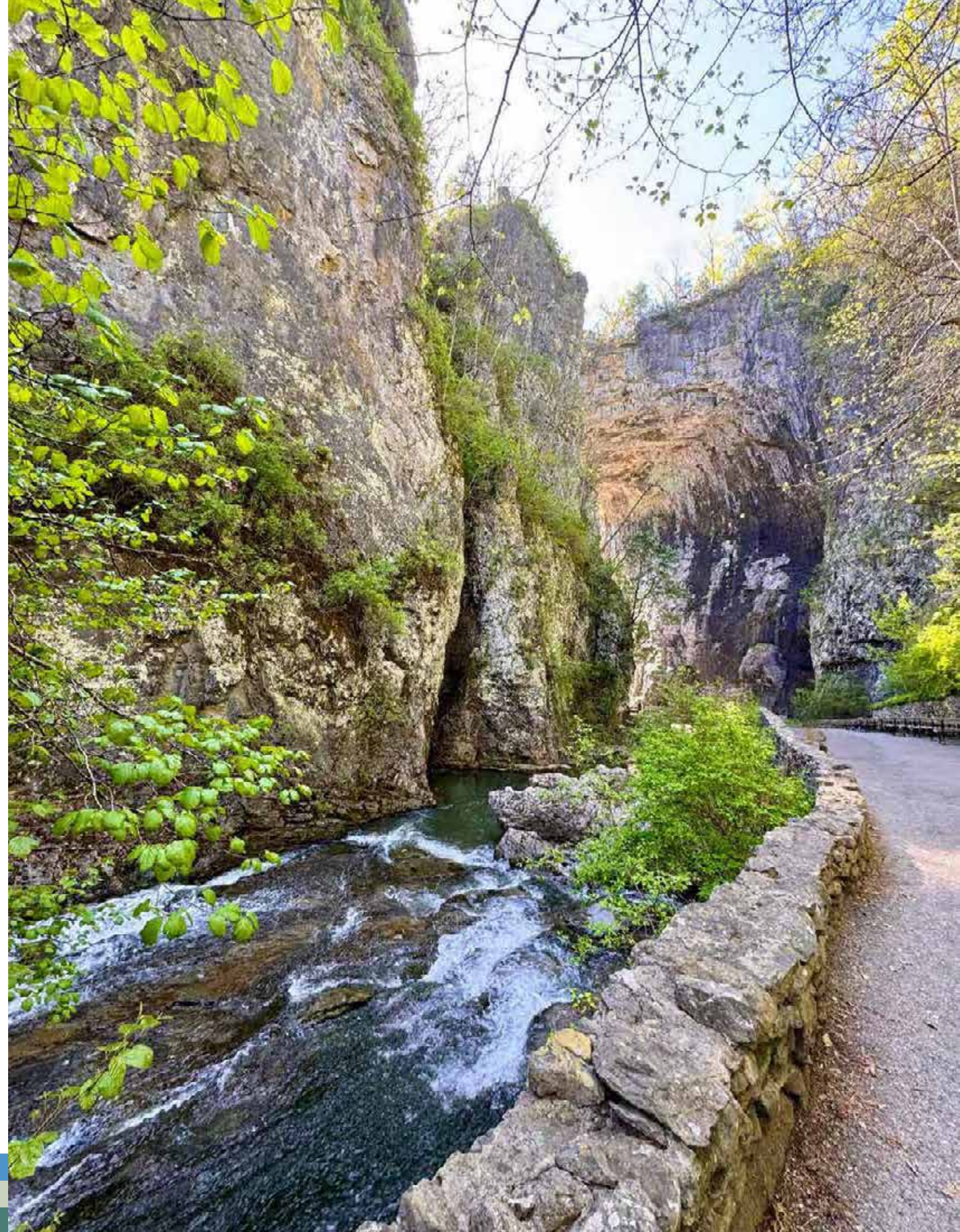
Rail lines affect drainage and flood access in several participating localities. Embankments and undersized rail culverts block natural drainage paths near Princess Anne Lane and Wayne Avenue in Augusta County, around Weyers Cave, and in Glasgow's Pocahontas Street and primary drainage channel areas. In Millboro in Bath County, sediment builds up at a railroad trestle over Cabin Creek, and in Broadway, the rail embankment forms one bank of Linville Creek. In Goshen, trains can block Main Street during floods, cutting off emergency access.

Critical Facilities

Flooding also threatens facilities that serve entire communities. Many water and wastewater facilities sit in or near floodplains because they must be located close to rivers, and nearly every locality meeting identified at least one at risk. Examples in the region include:

- The wastewater treatment plants in Glasgow and Elkton both lie in flood-prone areas. Elkton's plant shares the Elk Run and South Fork floodplain with an adjacent Rockingham County waste site.
- Broadway's wastewater pump station, which handles all of the Town's sewage, sits in the floodplain. The Town's municipal water intake on the North Fork is sensitive to flood-driven turbidity.
- Goshen's water pump house and inflow vault, Elkton's Stonewall Park well house, and the Maury Service Authority water intake in Rockbridge County face similar exposure.

Public safety and operations facilities are also at risk. These include Harrisonburg's Maryland Avenue fire station, an adjacent electrical substation, and the City's Public Works complex, as well as Rockingham County facilities in Elkton and Rockbridge County facilities leased in Goshen.



High Hazard Potential Dams

Many dams in the Central Shenandoah region, including the South River, North River, and Shoemaker River watershed dams, were built to control downstream flooding. These structures protect communities during heavy rainfall, but they also carry a risk: if a dam fails, the sudden release of water can flood areas downstream with little warning. Advanced flood warning systems help close this gap. Real-time stream gauges, reservoir level sensors, and rain gauges at or near high hazard potential dams allow dam owners and emergency managers to track rising water during a storm and act before conditions become critical.

According to the Virginia Dam Safety Inventory System (DSIS), the region has at least 90 dams, 71 of which are regulated under the Virginia Dam Safety Act and Dam Safety Regulations. DCR classifies each regulated dam as high, significant, or low hazard potential, based on the likely effect of a failure on people and property downstream. The classification reflects what is located downstream, not the condition of the dam or its likelihood of failing. In the region, 35 regulated dams are classified as high hazard potential and 6 as significant hazard potential.

The 2026 HMP used FEMA's Resilience Analysis and Planning Tool (RAPT) to estimate how many people live within the mapped inundation zones of high hazard potential dams. Of the 34 high hazard potential dams listed in Table 2.5, 20 have digitized inundation zone data. The other 14 do not, so the full number of people at risk across the region is likely higher than this analysis shows. The largest at-risk populations are downstream of the South River dams near Waynesboro, where three dams (#23, #25, and #26) each have more than 3,000 people in their inundation zones. Where data are available, dam inundation zones for individual localities are shown in the Existing Conditions maps in Chapter 4. Table 2.5 contains data from the DCR Virginia Safety Inventory System (DSIS) and the FEMA Resilience Analysis and Planning Tool (RAPT) from the 2026 HMP. "N/A" indicates that inundation zone data was not available in digital form for the population analysis.



City of Harrisonburg

Table 2.5 | High Hazard Potential Dams and Estimated At-Risk Population

Subarea	High Hazard Potential Dam	Estimated At-Risk Population
Staunton-Augusta-Waynesboro	Coles Run Dam	N/A
Staunton-Augusta-Waynesboro	South River Dam #4	148
Staunton-Augusta-Waynesboro	South River Dam #6	305
Staunton-Augusta-Waynesboro	South River Dam #7	93
Staunton-Augusta-Waynesboro	South River Dam #8A	N/A
Staunton-Augusta-Waynesboro	South River Dam #10A	N/A
Staunton-Augusta-Waynesboro	South River Dam #11	N/A
Staunton-Augusta-Waynesboro	South River Dam #19	171
Staunton-Augusta-Waynesboro	South River Dam #23	3,111
Staunton-Augusta-Waynesboro	South River Dam #25	3,556
Staunton-Augusta-Waynesboro	South River Dam #26	3,089
Staunton-Augusta-Waynesboro	Staunton Dam	N/A
Staunton-Augusta-Waynesboro	Upper North River Dam #10	N/A
Staunton-Augusta-Waynesboro	Upper North River Dam #76	N/A
Staunton-Augusta-Waynesboro	Upper North River Dam #77	949
Staunton-Augusta-Waynesboro	Upper Wallace Dam	N/A
Bath-Highland	Bath Co. Pumped Storage – Upper Dam	N/A
Bath-Highland	Bath Co. Pumped Storage – Lower Dam	N/A
Bath-Highland	Douthat Lake Dam	157
Harrisonburg-Rockingham	Newman Lake Dam	N/A
Harrisonburg-Rockingham	Lake Shenandoah Dam	N/A
Harrisonburg-Rockingham	Lower North River Dam #22B	74
Harrisonburg-Rockingham	Lower North River Dam #78	1,214
Harrisonburg-Rockingham	Lower North River Dam #80	772
Harrisonburg-Rockingham	Lower North River Dam #81C	N/A
Harrisonburg-Rockingham	Lower North River Dam #82	1,155
Harrisonburg-Rockingham	Lower North River Dam #83	952
Harrisonburg-Rockingham	Shoemaker River Dam #1A	21
Harrisonburg-Rockingham	Shoemaker River Dam #3B	128
Harrisonburg-Rockingham	Shoemaker River Dam #4C	179
Lexington-Rockbridge-Buena Vista	Goshen Dam	1,875
Lexington-Rockbridge-Buena Vista	Moores Creek Dam	55
Lexington-Rockbridge-Buena Vista	Natural Bridge Dam #5	4
Lexington-Rockbridge-Buena Vista	Robertson Dam	N/A
Lexington-Rockbridge-Buena Vista	Turner Pond Dam	5

Future Conditions

Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA), a NOAA-funded climate research program, publishes locality-level climate change projections showing that by 2070 each locality in the Central Shenandoah region will experience greater seasonal variability, more frequent and intense precipitation, warmer temperatures, and more extreme-heat days. Each change affects long-term water movement through the region's watersheds and drainage systems.

Rainfall

Rainfall is projected to increase across the entire region. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to rise by about 2 inches in nearly every participating locality, and by 2 to 3 inches in Waynesboro.

Extreme Heat

Extreme heat is projected to increase more sharply and to vary more by locality. Recent conditions range from almost no days at or above 95°F in Highland County to about 6 such days per year in Buena Vista. By 2070, the projected annual average ranges from 3 to 11 days in Highland County to 31 to 56 days in Buena Vista. This represents approximately 3 to 11 additional extreme-heat days per year in Highland County and 25 to 50 additional days in Buena Vista, with the other regional localities falling between those increases. Frost-free seasons are projected to lengthen by 2 to 6 weeks, depending on locality.

Design-Storm Intensity

In addition to increasing precipitation and temperatures, MARISA's Projected Intensity-Duration-Frequency Curve Data Tool projects that from 2020 to 2070, median projections show the 10-year storm deepening by 12 to 19 percent and the 100-year storm by 13 to 31 percent, depending on locality and emissions scenario. While the projections have substantial uncertainty, the trend indicates that storms will increase in intensity, which will cause issues for existing drainage infrastructure.



Town of Goshen

Chapter 3

Regional Capabilities, Needs, and Resilience Actions

Introduction

Chapter 3 examines how well the 17 participating localities and 1 university are equipped to manage flood and stormwater risk, where they share gaps, and how regional action can help close them. It draws on 2026 meetings with local staff, WSSI site visits, the 2026 Central Shenandoah Hazard Mitigation Plan (HMP), and the existing conditions data in Chapter 2.

The chapter has three parts:

- **Regional Capabilities.** Assesses the localities in floodplain administration, stormwater programs, project development, infrastructure and flood data, and emergency operations and debris management;
- **Regional Needs.** Identifies seven needs shared across the region; and
- **Regional Resilience Actions.** Presents the actions that respond to them.



Regional Capabilities

Capacity to administer and maintain floodplain, stormwater, and emergency programs depends largely on staff size. The counties and cities generally employ staff in engineering, public works, planning, and emergency management, while most towns operate with one or two administrative staff and a small public works crew. As a result, floodplain and stormwater issues are sometimes addressed on a reactive, as-needed basis based on current development, and there is limited time to develop updated ordinances or procedures.

Floodplain Administration

All localities in the Central Shenandoah region participate in the National Flood Insurance Program (NFIP), administer a floodplain management ordinance, and enforce the Virginia Uniform Statewide Building Code. These requirements set a baseline across the region. New and substantially improved buildings in mapped floodplains must meet elevation and construction standards, including at least 1 foot of freeboard (additional height above the base flood elevation) for residential construction.

Several localities in the region have adopted higher standards. Bath County (3 feet), Rockingham County (2 feet), and Elkton (2 feet) exceed the freeboard standard, and Elkton updated its floodplain regulations within the past year. Rockbridge County requires elevation certificates for all Zone A development and tracks floodplain determinations in GIS, both above the NFIP minimum.

Substantial damage and substantial improvement determinations are a particular challenge. Under NFIP rules, a building that is damaged or improved by 50 percent or more of its market value must be brought into compliance with current floodplain standards, which requires careful cost documentation, often in the hectic period after a flood. Larger localities are strengthening these procedures; Harrisonburg, for example, is developing a substantial damage and substantial improvement policy. Most smaller localities do not have written procedures.

Administering these standards is more difficult than adopting them. In most towns, floodplain administration falls to the town manager or another staff member with many other responsibilities, and Augusta County employs the region's only Certified Floodplain Manager (CFM). During this planning process, many local staff members expressed a need for more floodplain management training. In response, the Central Shenandoah Planning District Commission (CSPDC) coordinated a regional floodplain management workshop facilitated by the Virginia Department of Conservation and Recreation (DCR) in August 2026 for local staff.

Community Rating System (CRS)

The Community Rating System (CRS) is a voluntary Federal Emergency Management Agency (FEMA) program that rewards communities for floodplain management activities that exceed NFIP minimum standards, such as public outreach, higher regulatory standards, open space preservation, and flood warning. Communities are rated from Class 10 (no discount) to Class 1, and each class improvement increases the flood insurance discount for residents by 5 percent.

The Town of Bridgewater is the region's only CRS participant. At Class 8, Bridgewater residents receive a 10 percent discount on NFIP premiums. Statewide, the highest rating achieved is Class 5, which provides a 25 percent discount; five localities have reached that level, all in coastal Virginia.

For other localities in the region, joining CRS is a matter of weighing costs against benefits. Participation requires staff time to document activities and complete annual recertification, while the savings go only to residents who carry flood insurance. Because coverage is low across the region (see Chapter 2), the total benefit in most localities is expected to be modest. Still, many of the activities CRS rewards, such as higher regulatory standards, better floodplain records, and flood warning, support this plan regardless, and localities that adopt them may be well positioned to join in the future.

Stormwater Programs

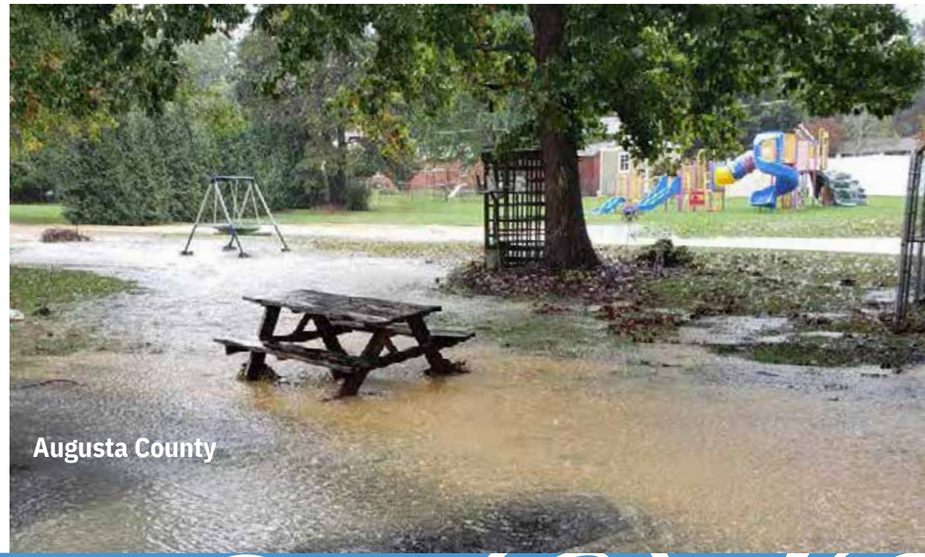
Stormwater management in the region depends largely on whether a locality holds a Municipal Separate Storm Sewer System (MS4) permit. Under the Clean Water Act and the Virginia Stormwater Management Act, localities within census-defined urban areas must hold an MS4 permit and run a stormwater program. That program includes mapping the storm sewer system, controlling runoff from new development, and reducing pollutants. Five participating localities, along with James Madison University (JMU), hold MS4 permits: Augusta County, Rockingham County, Harrisonburg, Waynesboro, and Bridgewater.

MS4 programs in the region vary widely in maturity. Harrisonburg has held a permit since the program expanded to smaller urban areas after the 2000 Census, and it now has the region's most developed program, with stormwater and floodplain staff across multiple departments. Similarly, Waynesboro is updating its stormwater projects for inclusion in its capital improvement plan. Rockingham County, by contrast, entered the program in 2025 and has not yet adopted stand-alone stormwater ordinances. Even in the most established programs, funding for project planning and construction remains limited.

MS4 permits are primarily water quality programs. Permit holders must reduce nitrogen, phosphorus, and sediment under the Chesapeake Bay Total Maximum Daily Load (TMDL) and meet local TMDL targets for impaired streams. These obligations also create an opportunity: projects that reduce both flooding and pollution can help MS4 localities meet two requirements with one investment.

The 12 non-MS4 localities confront a different situation. Without a permit requirement, most have no stormwater staff, system mapping, or dedicated budget, and small public works crews typically handle drainage problems as they arise. Lexington is an exception. The City developed a Stormwater Improvement Plan and a drainage system capital program despite not holding an MS4 permit.

In both groups, maintaining stormwater best management practices (BMPs) is a growing challenge. At JMU alone, staff maintain more than 120 stormwater facilities across campus, and the number of facilities across the region grows each time a new development or project is completed. Small-town public works crews are often unfamiliar with BMP maintenance, particularly for nature-based practices such as bioretention, constructed wetlands, and vegetated channels, whose plantings and soils are functional parts of the design.



Augusta County

Project Development and Funding

Localities identified 61 priority projects, 51 of them in non-MS4 localities. WSSI's project identification memos (Appendix A) document each project's location, issue, recommended improvements, planning-level cost estimate, and implementation barriers, giving localities a starting point for funding applications that most did not have before. Still, most projects need further engineering before construction: about half begin with a study or preliminary engineering, and few have an identified funding source. Projects that have reached preliminary design, such as Elkton's downtown drainage project, have no construction funding.

Due to a lack of staff capacity, most non-MS4 localities rely on CSPDC and other partners for grant writing, project development, or administration, and only the larger cities pursue implementation grants independently. For all localities, funding and local match requirements remain the most significant barriers to project implementation.

Harrisonburg, Waynesboro, and Lexington are the only participating localities that collect stormwater utility fees, demonstrating that dedicated revenue is achievable for cities. Even so, needs in each of the three cities outpace that revenue. Augusta County, the region's largest MS4 by land area, does not collect a stormwater utility fee but has a small annual budget of about $40,000 for drainage improvements, which covers only one or two small projects a year.

No participating county or town has a dedicated stormwater revenue source, and several towns draw on reserves accumulated over decades to address infrastructure problems. Even where dedicated funding exists, the local match required by most grant programs is itself a barrier, and even a small percentage match is a substantial cost for nearly every small town.

Infrastructure and Flood Data

Only larger localities have reliable infrastructure data. The MS4 localities maintain storm sewer maps as a permit requirement, and Lexington's capital program includes camera inspection of its buried drainage channels. Most smaller towns have no inventory of their pipes, culverts, and easements. For example, Broadway has difficulty locating stormwater infrastructure particularly on private property, and at least three manholes have been paved over.

Where systems are documented, much of the infrastructure is aging. Augusta County reports that corrugated metal pipe installed from the 1960s onward is corroding, and the majority of localities do not have plans or funding for systematic replacement. Few localities have assessed flood risk to their critical facilities. Wastewater treatment plants in Glasgow and Elkton, Broadway's wastewater pump station, Goshen's water pump house, and Harrisonburg's Maryland Avenue fire station all sit in flood-prone areas.

Infrastructure ownership is an issue in all localities, and particularly in small, non-MS4 localities that do not own their roads or most of their drainage infrastructure. The Virginia Department of Transportation (VDOT) maintains the roads and most associated drainage in the five counties and in towns that do not maintain their own roads, and most localities identified VDOT coordination as necessary to advance at least one priority. Railroads control key culverts and embankments, and private landowners hold many of the easements and drainage paths in older neighborhoods. Several priorities also cross jurisdictional lines, where watersheds, roads, or drainage basins span town, city, and county boundaries.

Emergency Operations and Debris Management

Currently, debris management and removal relies on a mix of locality staff, on-call contractors, fire departments, and local volunteers. However, localities are increasingly formalizing debris management and damage assessment procedures in their emergency operations plans (EOPs), which are updated every five years. Every participating locality is covered by an EOP. As Table 3.1 shows, most are prepared jointly at the county level or by a group of neighboring localities. Broadway is the only town with its own EOP, which could serve as a model for other small towns.

Three of the region's six EOPs include a debris management annex. Together, those three plans cover most of the region's population, but Bath County, Highland County and Monterey, and Broadway do not yet have an annex. Even where annexes exist, procedures may need further development; Rockingham County and town staff noted this for the Harrisonburg-Rockingham-JMU plan. Throughout this planning process, local staff identified a need to further develop debris management procedures and strengthen regional coordination.

Table 3.1 | Emergency Operations Plans and Debris Management Annexes

Plan	Localities	Debris Management Annex
Bath County EOP	Bath County	Not Yet
Highland County EOP	Highland County, Town of Monterey	Not Yet
Buena Vista-Lexington-Rockbridge EOP	Cities of Buena Vista and Lexington, Rockbridge County, Towns of Glasgow and Goshen	Yes
Staunton-Augusta-Waynesboro EOP	Cities of Staunton and Waynesboro, Augusta County, and the Town of Craigsville	Yes
Harrisonburg-Rockingham-JMU EOP	City of Harrisonburg, Rockingham County, Towns of Bridgewater, Dayton, Elkton, Grottoes, Mount Crawford, and Timberville, and James Madison University	Yes
Town of Broadway EOP	Town of Broadway	Not Yet

Regional Needs

Based on the capability assessment data, there are seven key needs shared across the region. Each need applies to multiple localities, exceeds what most localities can address alone, and can be advanced in part through regional coordination. The needs are numbered for reference and are not listed in priority order. Each applies to some or most participating localities, and their relative importance varies by locality.

Need 1: Project Development Capacity and Funding

Localities need engineering, cost estimating, permitting, and grant administration support to advance identified problems into fundable projects. Lack of funding is a primary issue for construction and long-term maintenance, and this need is most acute in the towns and in counties, which are least able to meet grant match requirements. This need includes:

- planning-level designs and cost estimates;
- grant application and administration support;
- strategies to reduce or share local match burdens;
- funding approaches for improvements on VDOT-maintained infrastructure;
- recurring funding for maintenance, which most grant programs do not cover.

The project identification memos and 10% design concepts prepared for this plan provide a planning-level cost estimate for each priority project and advance one priority project for each participant that developed projects through this planning process (see Chapter 4 and Appendix A). Most projects still require further engineering to compete for funding, and some exceed the scale of any single grant program.

Need 2: Infrastructure Condition and Flood Risk Data

Localities need reliable information on the location and condition of their infrastructure and on where flooding occurs. Without system inventories and condition assessments, localities cannot identify problems, prioritize repairs, or plan replacement of aging infrastructure. Without accurate flood maps, they cannot define flood risk or apply floodplain standards where flooding actually occurs. This need includes:

- GIS stormwater inventories and condition assessments;
- karst investigations where sinkholes and subsurface drainage affect stormwater performance;
- detailed flood studies where current maps lack flood elevations or omit known flooding areas, with outreach to affected property owners on how new maps may change insurance and building requirements;
- flood incident records;
- projected design-storm rainfall data for sizing new infrastructure;
- shared data standards that allow localities and CSPDC to combine information across shared watersheds.

Better data strengthens grant competitiveness, because documented flood history, mapped infrastructure, and quantified exposure support stronger project justifications and benefit-cost analyses. Flood incident records are especially important in this region because most recent flooding falls below federal disaster thresholds and outside NFIP claims records.

Need 3: Maintenance and Replacement of Existing Drainage Systems

Localities need the staff, equipment, funding, and permitting pathways to maintain existing channels, culverts, and stormwater facilities and to replace aging infrastructure before it fails.

Debris, sediment, vegetation, and aging pipe reduce the capacity of drainage systems throughout the region. Examples include log jams at the Mill Creek and Calfpasture River confluence in Goshen, sedimentation at Cabin Creek in Bath County, and debris trapped at Broadway's Heritage Park pedestrian bridge. Several locality priorities could be addressed through routine maintenance rather than new construction, so maintenance is the most cost-effective way to protect existing systems. Many of these maintenance needs involve ditches and culverts along state-maintained roads, where a request to VDOT may resolve the problem at little cost to the locality.

However, maintenance alone will not sustain these systems, because much of the region's drainage infrastructure is approaching the end of its service life. Augusta County expects to replace much of its corrugated metal pipe within 20 years, and Lexington and Bridgewater are working to replace deteriorated pipe and culverts in older neighborhoods. Few localities have capital plans or funding for systematic replacement. As a result, failures are typically addressed as emergencies rather than planned projects, at greater cost and disruption.

Maintenance and replacement capacity depends directly on staff capacity and knowledge. In most towns, a crew of two to five public works employees maintains all town infrastructure, from streets and water lines to drainage. Drainage work competes with every other daily demand and is often deferred until a flood forces it. Crews may also be unfamiliar with the maintenance requirements of stormwater BMPs, particularly nature-based practices, whose plantings and soils are functional parts of the design.

The nature-based projects recommended in this plan will add facilities that small town crews have not maintained before. Without facility-specific maintenance procedures, these projects risk losing function soon after construction, as occurred at Glasgow's Town Hall bioretention facility. Waynesboro's facility-specific maintenance procedures provide a model other localities can adapt. This need includes:

- recurring maintenance funding;
- capital plans and funding for replacing aging pipe and culverts;
- access to shared equipment and contracted services;
- clear permitting pathways for in-stream debris and sediment removal;
- maintenance agreements for privately owned systems;
- long-term maintenance plans for the nature-based projects in this plan.

Need 4: Floodplain Management Staffing, Procedures, and Training

Localities need the staff capacity, written procedures, standards, and training to administer floodplain and emergency programs consistently. In most towns, these duties fall to one or two staff members with many other responsibilities. Shared templates, model ordinances, regional training, and regional technical support can extend that capacity. This need includes:

- a centralized regional webpage with flood and stormwater data, grant, training, and policy information;
- stormwater and floodplain ordinance updates that address development in flood-prone areas;
- substantial damage and substantial improvement procedures;
- post-disaster damage assessment procedures that support timely, documented substantial damage determinations;
- access to CFM review;
- debris management plans and town-level emergency procedures;
- role-based training for floodplain administrators and public works crews.

Existing training and certification programs include the Virginia Floodplain Management Association (VFMA), the Association of State Floodplain Managers' CFM program, DCR's Floodplain Management Program, and the Chesapeake Bay Landscape Professional certification.

Need 5: Interagency and Cross-Jurisdictional Coordination

Localities need working arrangements with the regional agencies, neighboring localities, and landowners that control or shape the infrastructure behind many priority needs. This need includes coordination with:

- the VDOT Staunton District and its residency offices on road drainage and stormwater design for state-maintained roads;
- the Harrisonburg-Rockingham and Staunton-Augusta-Waynesboro Metropolitan Planning Organizations (HRMPO and SAWMPO) on incorporating flood and stormwater considerations into long-range transportation plans, corridor studies, and project selection;
- the Virginia Department of Environmental Quality (DEQ) Valley Regional Office on MS4 permits, in-stream permitting, and wastewater facilities;
- the DCR Dam Safety Program and dam owners and operators on dam safety, operations, and removal;
- JMU, a separate MS4 within Harrisonburg, on shared drainage and stream restoration;
- railroads on culverts and embankments;
- neighboring localities on shared watersheds and boundary projects;
- private landowners on easements.

Transportation planning offers an opportunity to address flooding before problems are constructed. Road and corridor projects determine where runoff is collected, conveyed, and discharged, and many of the region's recurring flooding problems are along state roads.

Dams add a further layer of shared responsibility. Moores Creek Dam, Lexington's historic water supply dam, affects both the City and Rockbridge County. Similarly, Augusta County's Elkhorn Lake and Todd Lake flood control dams protect the Calfpasture River watershed.

Need 6: Critical Facilities and Emergency Access

Localities need to protect the facilities and access routes that communities depend on during and after a flood, along with warning systems that give residents time to act. Several flood-exposed critical facilities are located in the region (see Chapter 2), but few localities have evaluated these facilities in detail.

Access and warning present a parallel need, because road flooding isolates entire communities. Flash floods in the region's steep watersheds arrive with little warning. Bath County identified emergency alerting as its most important non-structural need, citing limited cell coverage across a large, mountainous county, and Bath and Highland Counties have jointly applied for funding to expand their flood warning network. This need includes:

- facility-specific flood vulnerability evaluations;
- continuity-of-operations planning for water, wastewater, and public safety services;
- evaluation of protection options, including floodproofing, elevation of equipment, backup systems, and relocation where protection is not practical;
- expanded real-time stream gages and public alerting systems, particularly on smaller streams;
- identification of communities that lose road access during floods, and protection of or alternatives to those access routes;
- evacuation and sheltering support for residents without transportation.

Need 7: Nature-Based Solutions and Water Quality

Localities need more information, partnerships, and project screening to expand nature-based approaches that reduce flooding and improve water quality. These approaches include riparian buffers, stream restoration, floodplain and wetland storage, bioretention, and tree canopy.

No systematic method identifies where new nature-based improvements would provide the greatest benefit on a regional scale. Potential partners for expanding these practices include the soil and water conservation districts, the USDA Natural Resources Conservation Service (NRCS), the Virginia Department of Forestry, the Virginia Outdoors Foundation (VOF) and regional land trusts, and watershed groups such as Friends of the North Fork.

Nature-based practices also serve the region's water quality obligations. MS4s must achieve nitrogen, phosphorus, and sediment reductions under their MS4 permits and the Chesapeake Bay TMDL. Projects that deliver both flood reduction and pollutant reduction allow MS4 localities to meet two obligations with one investment, and they can qualify for water quality funding, such as DEQ's Stormwater Local Assistance Fund (SLAF), in addition to flood funding. This need includes:

- a regional inventory and map of existing nature-based practices;
- identification of the areas that would benefit most from nature-based improvements;
- tree canopy and planting assessments, particularly in towns with recurring drainage problems;
- expanded riparian buffer and streambank improvements through partnerships with soil and water conservation districts, landowners, and federal land managers;
- permanent protection of floodplains and riparian corridors through conservation easements;
- screening of priority flood projects for pollutant-reduction credit under MS4 TMDL Action Plans;
- pairing of flood and water quality funding sources;
- long-term management of acquired floodplain open space.

Regional Resilience Actions

The following eight actions correspond to the regional needs identified, all of which are intended to be realistic and reasonable. Each action is organized around a single deliverable that localities, CSPDC, and partner agencies could pursue as funding and capacity allow. Deliverables can be completed in phases or in part, and the studies and assessments are intended to identify new projects for the regional project pipeline (Action 1). The actions are voluntary. Inclusion in this plan does not obligate any locality, CSPDC, or partner agency to undertake an action or commit funds.

CSPDC's role in each action reflects its current capacity. "Existing role" identifies work CSPDC already performs, such as grant support, convening localities, GIS, and staffing the Harrisonburg-Rockingham Metropolitan Planning Organization (HRMPO) and SAWMPO, including work supported through DEQ Watershed Implementation Plan funding. "If funded" identifies work that depends on securing additional funding, such as Community Flood Preparedness Fund capacity-building grants. Several actions include both, with the specific components noted. "Supporting" identifies actions that would be led by localities or other agencies, with CSPDC assisting where possible.

Actions are numbered for reference and are not listed in priority order. The Needs column refers to the seven regional needs described above. The Timeline column indicates the general period in which an action could begin if funding and capacity are available: Near (0–2 years), Mid (3–5 years), or Long (more than 5 years). Timelines are planning estimates, not commitments. Where an action builds on the HMP, the related HMP action is noted.

Table 3.2 highlights potential funding sources for the regional and locality resilience actions in this plan. Program availability, eligibility, and match requirements change over time, so localities should confirm current terms with the administering agency before applying.



Rockingham County

Table 3.2 | Potential Funding Sources

Abbreviation	Program	Administering Agency	Typical Use
CBT	Chesapeake Bay Trust grants	Chesapeake Bay Trust	Small green infrastructure, restoration, and planting projects
CDBG	Community Development Block Grant	DHCD	Infrastructure serving low- and moderate-income areas
CFPF	Community Flood Preparedness Fund	DCR	Capacity building, planning, studies, and flood projects
Communications grants	Emergency communications grant programs	VDEM and federal partners	Alerting and radio communications equipment
CSPDC	CSPDC staff time	CSPDC	Coordination, grant support, and GIS within existing programs
DEQ WIP	Chesapeake Bay Watershed Implementation Plan funding	DEQ	Projects and planning that advance local Chesapeake Bay WIP goals
DSFPPAF	Dam Safety, Flood Prevention and Protection Assistance Fund	DCR	Dam safety repairs, studies, and flood prevention project
DWSRF	Drinking Water State Revolving Fund	VDH	Drinking water facility improvements
FMA	Flood Mitigation Assistance	FEMA and VDEM	Acquisition, elevation, and floodproofing of NFIP-insured properties
HMGP	Hazard Mitigation Grant Program	FEMA and VDEM	Mitigation projects following federal disaster declarations
HSIP	Highway Safety Improvement Program	VDOT	Safety improvements at locations with crash history
Local funds	General fund, stormwater utility fees, bonds, and staff time	Localities	Local projects and match
MPO planning funds	Federal metropolitan planning funds	HRMPO and SAWMPO	Transportation planning and studies
NRCS	Conservation and Emergency Watershed Protection programs	USDA NRCS	Riparian buffers, conservation practices, and post-flood debris removal
Rural Transportation Planning funds	Rural Transportation Planning program	VDOT and CSPDC	Transportation planning outside the MPO areas
SLAF	Stormwater Local Assistance Fund	DEQ	Stormwater projects that reduce nutrient and sediment pollution
USDA RD	Water and Environment, Rural Development	USDA Rural Development	Water, wastewater, and stormwater facilities in rural communities
VCWRLF	Virginia Clean Water Revolving Loan Fund	DEQ	Wastewater and stormwater facility improvements
VDEM EMPG	Emergency Management Performance Grant	VDEM	Emergency operations and debris management planning
VDOF UCF	Urban and Community Forestry grants	Virginia Department of Forestry	Tree canopy assessments and planting
VDOT	VDOT maintenance and Revenue Sharing	VDOT	Drainage on state-maintained roads
VOF	Virginia Outdoors Foundation	Virginia Outdoors Foundation	Conservation easements
WQIF	Water Quality Improvement Fund	DEQ	Nonpoint source pollution reduction, including TMDL implementation

Table 3.3 | Regional Resilience Actions

#	Action	Deliverable	Key Steps	Needs	Potential Partners	CSPDC Role	Timeline	Related HMP Action
1	**Maintain a regional flood and stormwater project pipeline.** Keep the project lists developed for this plan current and move projects toward funding.	Annual project pipeline document updated and sent to participating localities.	• Meet with each locality annually to review its needs and priority projects, recording completed work, new problems, and flooding since the previous meeting, drawing on existing local records, VDOT data, and NOAA storm event data. • Identify projects ready for upcoming grants and advance toward application. • Combine similar small projects, phase large projects, and coordinate projects that cross jurisdictional boundaries. • Help localities resolve barriers to grant eligibility and incorporate plan projects into comprehensive plans, capital improvement programs, budgets, and emergency operations plans.	1, 5	Localities; DCR; DEQ; VDEM; DHCD; VDOT	Existing role (through DEQ WIP funding)	Near	6.2; 6.8; 6.10
2	**Conduct a multi-locality stormwater infrastructure inventory.** Map and assess stormwater infrastructure for several localities at once, which is more efficient than separate local efforts.	Regional stormwater infrastructure inventory (GIS dataset and summary report)	• Develop a common GIS data standard covering pipes, culverts, inlets, outfalls, ditches, easements, ownership, and condition. • Inventory the systems of localities that identified this need, such as Augusta County, Bath County (Hot Springs), Bridgewater, Broadway, Dayton, Grottoes, and Timberville, along with other interested localities. • Provide the data to each locality for maintenance and funding applications, and add problem locations identified during the inventory to the regional project pipeline.	2, 3	Localities; DCR	If funded	Near	6.3
3	**Complete a regional aging infrastructure and maintenance assessment.** Identify aging flood-related infrastructure across the region, rank replacement needs by locality, and give localities practical tools for maintaining existing systems.	Regional aging infrastructure and maintenance assessment, with replacement priorities by locality	• Building on the Action 2 inventory, identify aging flood-related infrastructure in each locality, including stormwater pipes and culverts, road crossings, and water and wastewater components exposed to flooding or infiltration, such as pump stations, intakes, and sewer lines along eroding streams. Rank replacement needs by condition, risk, and consequence of failure, and add priority replacements to the regional project pipeline. • A permitting pathway for in-stream debris and sediment removal. • Identify facility-specific maintenance procedures for stormwater BMPs and nature-based practices, based on Waynesboro's approach.	3	Localities; DCR	If funded	Mid	3.7; 4.3; 4.10
4	**Develop a floodplain and emergency management toolkit and resources webpage.** Provide model documents localities can adopt or adapt, and bring plan resources together in one place.	Toolkit of model documents, hosted on a CSPDC environmental flood and stormwater resources webpage	• A CSPDC environmental resources webpage that hosts the toolkit together with the plan, maps, training and grant calendars, and links to state and federal programs. • Model stormwater and floodplain provisions for new development, including subdivision stormwater standards and drainage analysis for growth areas as requested by localities. • A model substantial damage and post-disaster damage assessment procedure, including cumulative improvement tracking as requested by localities. • A town emergency operations plan template and a debris management annex template for towns and counties without them as requested by localities.	4	Localities; DCR; DEQ; VDEM; county emergency managers	Existing role (through DEQ WIP funding)	Mid	2.1; 4.5; 5.1; 5.4

#	Action	Deliverable	Key Steps	Needs	Potential Partners	CSPDC Role	Timeline	Related HMP Action
5	**Coordinate, promote, or encourage regional floodplain, stormwater, and maintenance training.** Provide recurring, practical training matched to the roles of local staff.	Annual workshops	• An annual workshop covering floodplain, stormwater, and maintenance issues. • Exam, certification, and education sessions covering topics such as the Certified Floodplain Manager exam preparation, FEMA L-273, and CRS participation. • Practical training for public works crews on maintaining stormwater BMPs.	3, 4	Localities; DCR; VFMA; DEQ	Existing role (annual workshop); if funded (other training)	Near	4.3; 6.11; 6.13
6	**Complete a regional transportation flood vulnerability assessment.** Identify and rank flood-prone state roads, crossings, bridges, and rail culverts that localities do not own.	Regional transportation flood vulnerability needs assessment and incorporate into MPO planning documents.	• Identify flood-prone state road crossings and access corridors from locality priorities, VDOT road closure data, and document bridge and rail issues. • Incorporate the findings into HRMPO and SAWMPO long-range plans and project studies, and into CSPDC's Rural Transportation Planning program.	5, 6	VDOT Staunton District; HRMPO; SAWMPO; Norfolk Southern; localities	Existing role (MPO and rural transportation planning)	Near	–

#	Action	Deliverable	Key Steps	Needs	Potential Partners	CSPDC Role	Timeline	Related HMP Action
7	**Complete a regional critical facility and emergency access assessment.** Identify the facilities and communities most exposed to flood disruption and the options for protecting them.	Regional critical facility and emergency access assessment	• Apply a standard flood vulnerability checklist to the water, wastewater, public safety, and government facilities identified in the locality profiles, and rank protection options with funding sources. • Identify communities that lose road access during floods and develop alternate-access and emergency staging plans with county emergency managers. • Identify any new flood warning efforts that may be necessary.	6	Facility owners; county emergency managers; VDEM; VDOT; VDH Office of Drinking Water; DEQ	If funded	Mid	4.8; 4.11; 5.1; 5.8; 6.6; AU-28
8	**Complete a nature-based solutions and riparian prioritization study.** Identify where nature-based practices can reduce flooding and improve water quality, and connect localities with the partners that fund them.	Regional nature-based solutions and riparian prioritization study	• Inventory existing nature-based practices and acquired floodplain open space, and identify and rank opportunity areas for riparian buffers, streambank stabilization, floodplain reconnection, wetland storage, and tree canopy. • Screen priority projects for nitrogen, phosphorus, and sediment reductions that support MS4 TMDL Action Plans. • Connect priority sites with the soil and water conservation districts, NRCS, the Virginia Outdoors Foundation, and land trusts, and add ready projects to the regional project pipeline (Action 1).	7	SWCDs; NRCS; VOF; land trusts; Virginia Department of Forestry; DEQ; MS4 localities	Existing role (through DEQ WIP funding)	Mid	3.2; 3.6; 3.10; 4.14; 6.9

Chapter 4
Community Profiles

Introduction

Chapter 4 presents profiles for the 17 participating counties, cities, and towns and for James Madison University (JMU). Each profile describes the locality's setting, flood history, existing and future conditions, and needs, and it closes with the locality's resilience actions. Together, the profiles provide the local detail behind the regional needs and actions in Chapter 3.

Profiles are organized by county-level subareas.Each county profile is followed by the towns within it and the independent cities it surrounds. The approach to resilience action and project development depended on each participant's Municipal Separate Storm Sewer System (MS4) permit status and existing planning efforts. Six plan participants hold MS4 permits: Augusta and Rockingham Counties, the Cities of Harrisonburg and Waynesboro, the Town of Bridgewater, and JMU. All six administer stormwater programs; however, they are at varying levels of planning and project readiness. Harrisonburg, Waynesboro, and JMU have adopted MS4 program plans that already identify priority projects. Their profiles summarize and reference existing source documents rather than duplicating already identified projects and completed plans.

Fourteen participants developed projects through this planning process. This group includes the region's non-MS4 localities and the MS4 permit holders of Augusta County and Bridgewater, which benefited from further project evaluation as part of this planning process. For each of these participants, the plan identifies flood and stormwater issues, develops a list of candidate projects, and prepares a 10% design concept for the priority project. Project lists appear in each profile's resilience actions, and design concepts are in Appendix A. Rockingham County, also an MS4 permit holder, identified areas of concern rather than specific projects, so its profile documents those areas and its actions focus on studies and program development.

Each profile follows the same structure:

- **Community Profile.** Describes the locality's location, watersheds, and setting.
- **Flood History.** Summarizes major and recent flood events. Detailed hazard histories appear in Appendix E of the 2026 Central Shenandoah Hazard Mitigation Plan (HMP).
- **Existing Conditions.** Summarizes vulnerable populations, infrastructure, and natural resources, as shown on the accompanying maps.
- **Future Conditions.** Applies Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) climate projections to local conditions.
- **Needs.** Describes the structural and non-structural conditions and gaps that drive local flooding, organized by theme. The themes correspond to the regional needs identified in Chapter 3.
- **Resilience Actions.** Includes a map of the locality's priority projects and a table of locality actions. Each action is linked to the related regional action in Chapter 3 and to any related HMP action. Appendix A describes the priority projects and design concepts in detail.

JMU's profile is abbreviated. Because the campus shares Harrisonburg's watersheds, climate, and flood history, it refers to the Harrisonburg profile for those topics and focuses on campus-specific conditions.

Locality Resilience Actions

Each profile closes with a table of locality actions. Actions were selected based on existing conditions analysis, needs each locality identified during the 2026 locality meetings, and staff capacity, with the goal of setting realistic, practical actions the locality can achieve.

The first action in each table covers the locality's priority projects, which are listed in the locality's ranked order, shown on the locality map, and described in Appendix A. For larger localities with more staff capacity and funding, including select MS4 localities and JMU, most actions draw on findings from existing plans, which this plan references to avoid duplicating that work. Other needs are addressed through the regional actions in Chapter 3, and potential funding sources are listed in Appendix E. Actions are voluntary, numbered for reference only, and not listed in priority order.

Data Availability

Most data layers used in the community profiles, including Federal Emergency Management Agency (FEMA) flood zones, social vulnerability, and conserved lands, are available across the region, but a few are not. Table 4.1 shows where a layer is missing from a profile. A layer is missing for one of two reasons: either there is nothing to map, or the data has not yet been created. For example, a locality with no high hazard potential dams has no dam inundation zone to map, while another locality may have a dam inundation zone that has not yet been digitized.

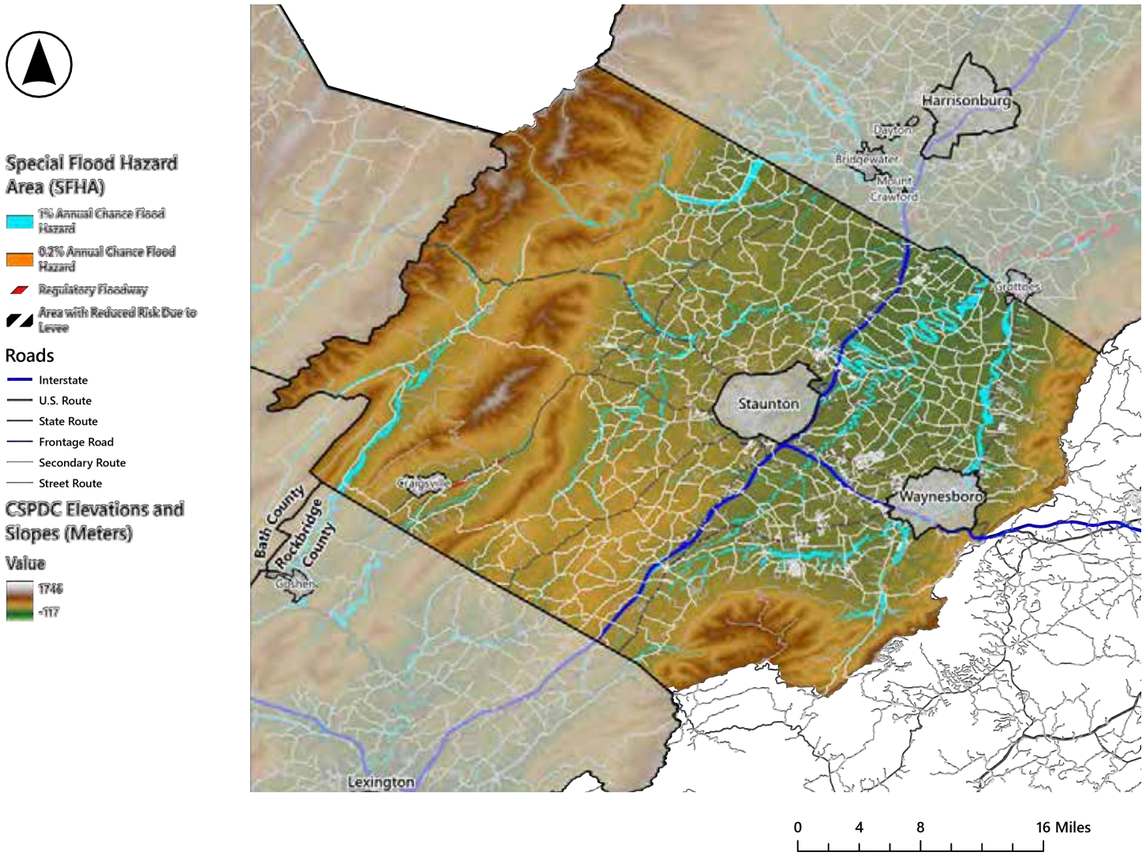
Table 3.2 | Data Availability by Profile

Data Available by Locality	Augusta County	Bath County	Highland County	Rockbridge County	Rockingham County	City of Lexington	City of Harrisonburg	City of Waynesboro	Town of Bridgewater	Town of Broadway	Town of Dayton	Town of Elkton	Town of Glasgow	Town of Goshen	Town of Grottoes	Town of Mount Crawford	Town of Timberville
Bridges and Culverts SFHA							n/a					n/a					
Cons Lands and SFHA																	
Critical Facilities SFHA (DEM)																	
Eco Cores SFHA											n/a						
Elevation and SFHA																n/a	
HHDams and SFHA			n/a						n/a								
Land Cover and SFHA																	
SVI																	
Vehicle % and SFHA																	
VDOT Standing Water		n/a							n/a								

Augusta County *At A Glance*

Augusta County is located in the center of the region and borders Albemarle, Bath, Highland, Nelson, Rockbridge, and Rockingham Counties and Pendleton County, West Virginia. With about 970 square miles of land, Augusta County is the second largest county in the state, the largest county in the region, and the second most populous county in the region. Most of the County drains to the South Fork of the Shenandoah River in the Potomac basin through the South, Middle, and North Rivers. The western portion drains to the James River basin through the Calfpasture and Little Calfpasture Rivers, so the County contains contributing headwater streams of both basins.

Map 4.1
Augusta County Locality Introduction



MS4
community

78,872
total population

24,612
acres in the 500 year floodplain

181
flood insurance policies in force

Flood History

Causes and Recurring Problems

Steep slopes, narrow stream valleys, and a dense network of tributaries produce rapid runoff during intense or prolonged rainfall, and flood risk extends across the County rather than concentrating in one area. Today, the County's most notable flooding issues occur along the mountain slopes in the Stuarts Draft area and western parts of the County, and also in subdivisions built from the 1960s through the 1990s. The subdivisions have flat, grass-lined drainage easements and aging pipe, and they sit largely outside mapped floodplains, where few residents carry flood insurance.

Major Events

In June 1949, extreme rainfall caused major flooding along the North River and heavily damaged Stokesville and Mount Solon. The November 1985 Election Day Flood damaged homes and roads along the Middle River in Frank's Mill, Fort Defiance, and Verona, and washed out bridges in the Buffalo Gap area. Road damage reached about $18 million in 2019 dollars. During Hurricane Fran in September 1996, National Guard troops evacuated residents near Mount Solon and Churchville, 29 roads closed, and two people died crossing the flooded Middle River. Hurricane Isabel in 2003 brought 20.6 inches of rain to the Sherando area.

Recent Flooding

No countywide flood comparable to 1985 or 1996 has occurred since, but intense local storms continue to cause damage. In 2018, Hurricane Florence flooded the Jennings Branch and Churchville area. In September 2024, Hurricane Helene cut off access along the Mount Torrey Road corridor between Sherando and Lyndhurst. During a July storm in 2025, about 7 inches of rain fell in one hour, flooding Morris Mill Road and Wayne Avenue in Stuarts Draft.

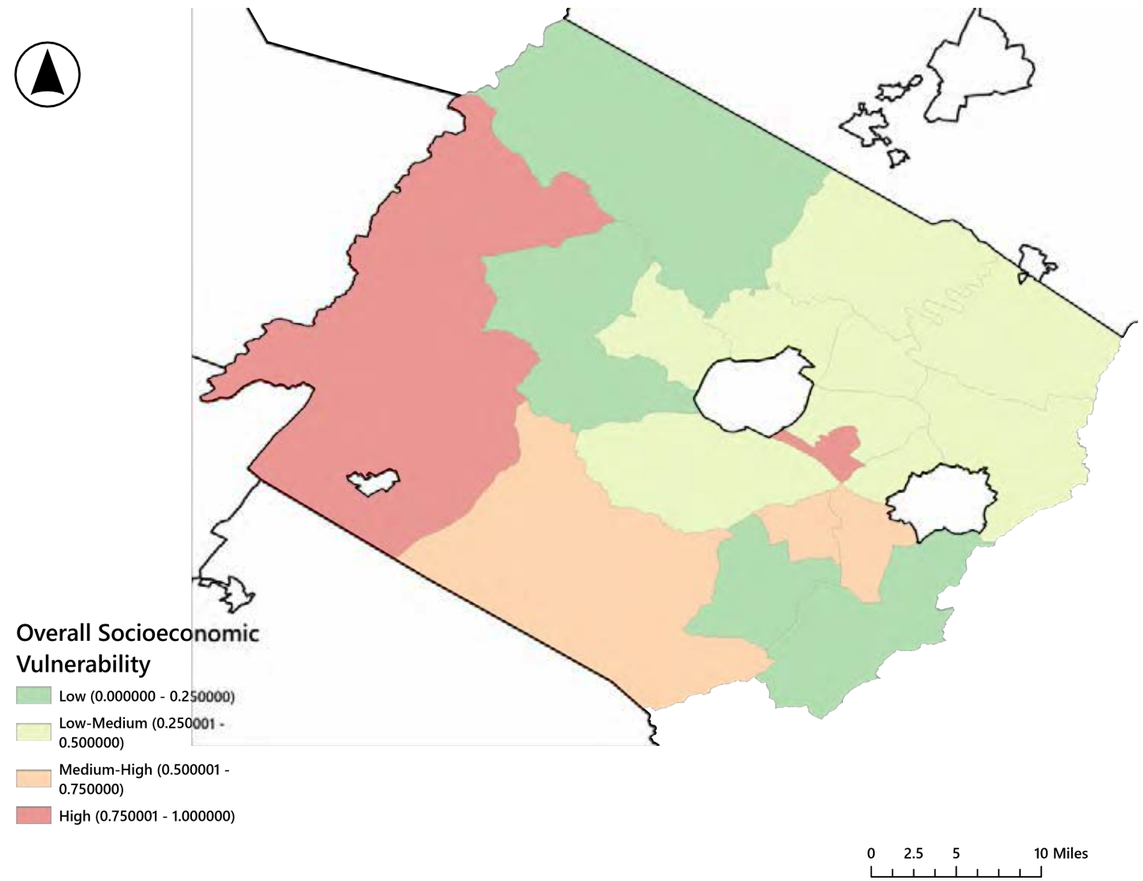


Existing Conditions

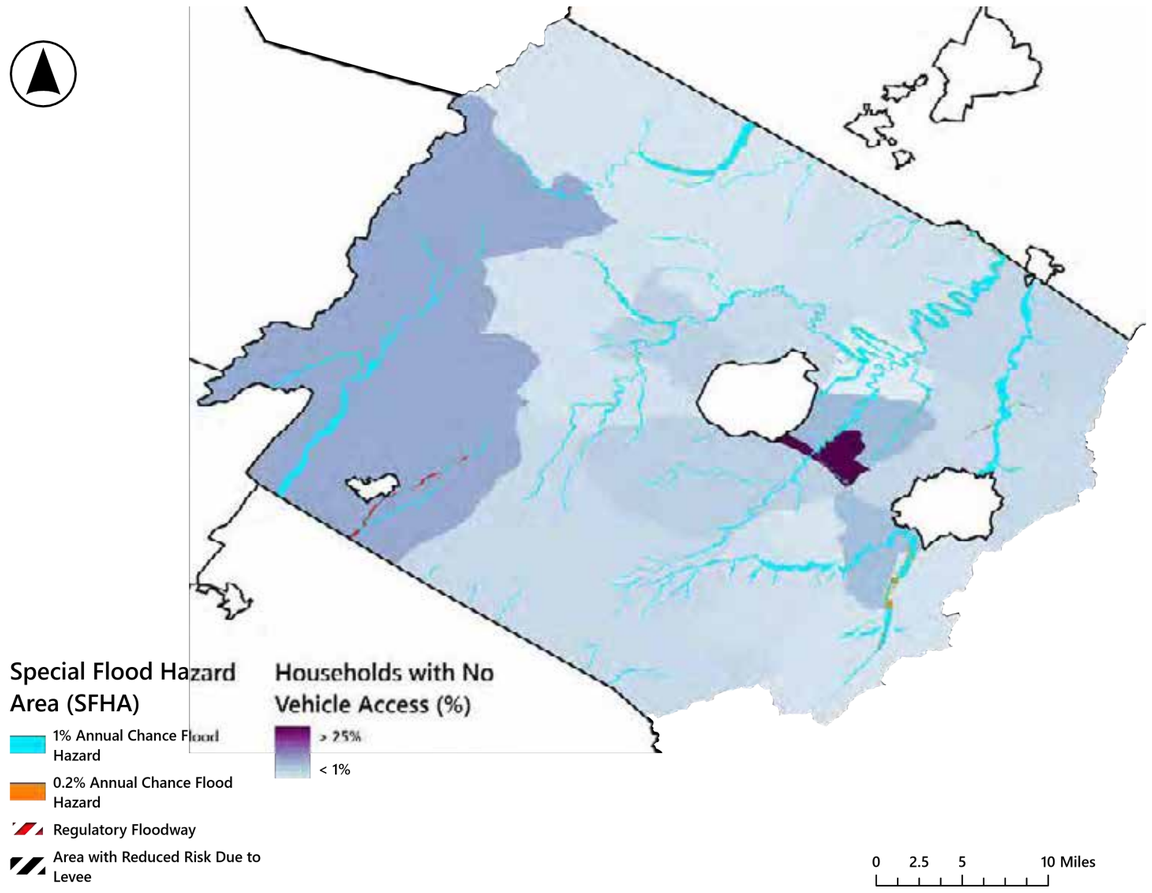
Vulnerable Populations

Social vulnerability is greatest in portions of western and southwestern Augusta County, while households without a vehicle are more concentrated around the Staunton–Waynesboro corridor and in scattered rural areas.

Map 4.2
Augusta County Social Vulnerability Ranking by Census Tract



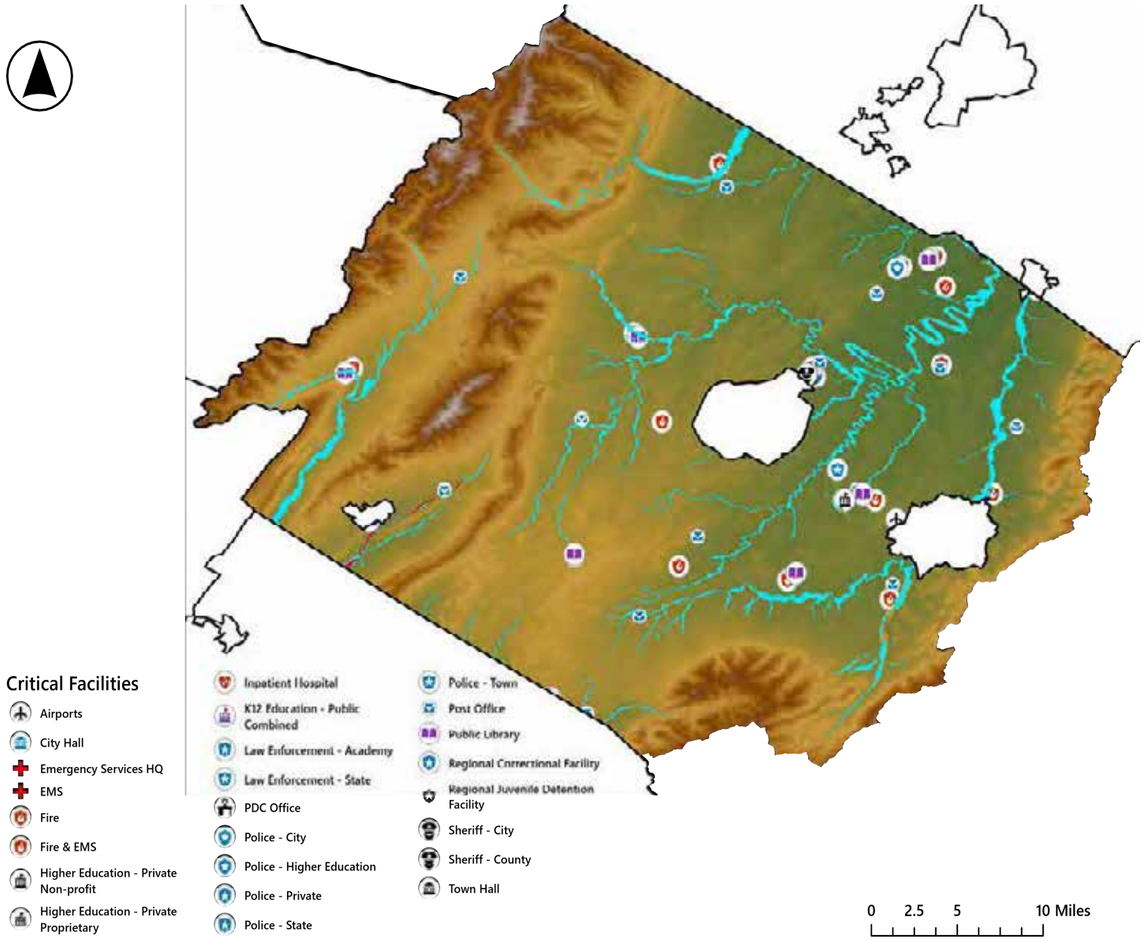
Map 4.3
Augusta County Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



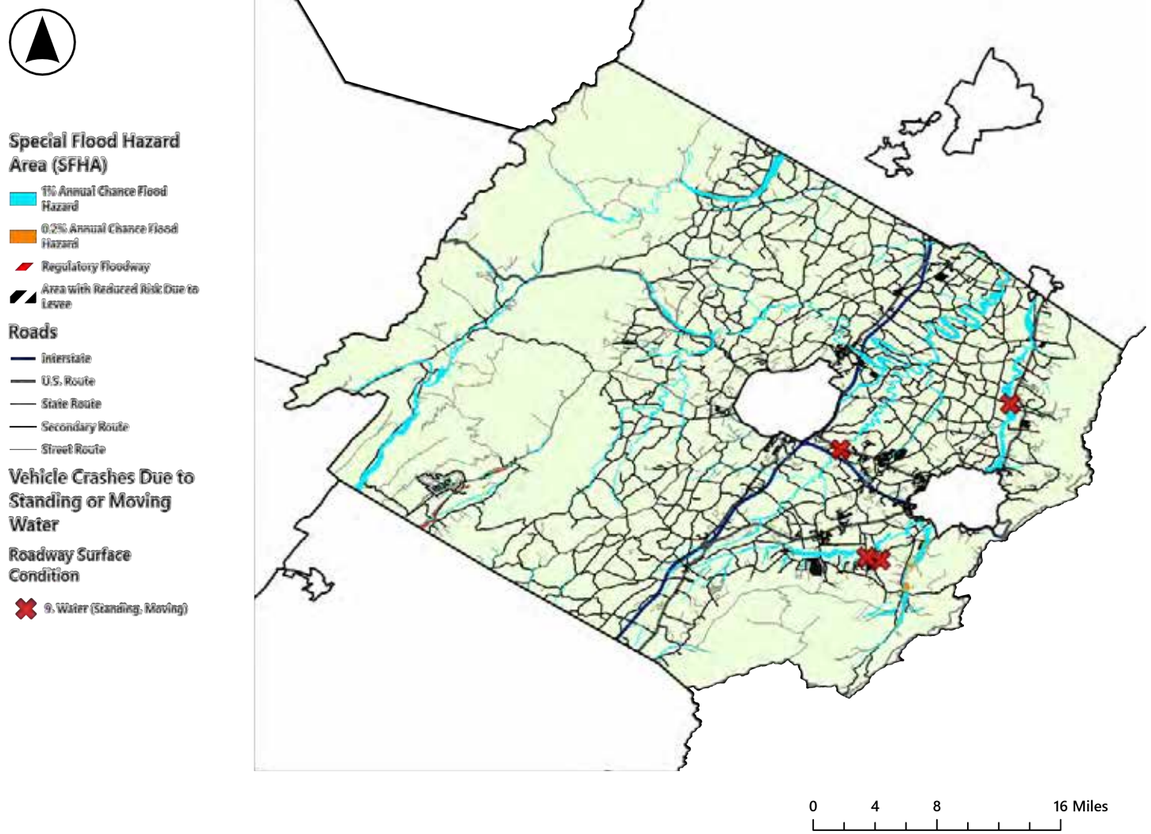
Infrastructure

Most critical facilities are outside the mapped floodplain, but the County's transportation network repeatedly crosses rivers and tributaries. Bridge condition and crash locations are distributed along these valley routes, and several dam inundation areas follow the same river corridors. Key crossings include the Patton Farm Bridge over the South River and the Norfolk Southern railroad culverts near Princess Anne Lane and Wayne Avenue, which cause deep flooding during heavy rain. The Hotchkiss Road bridge over Jennings Branch spans only about 80 feet of a 200- to 300-foot floodplain and backs floodwater up through Churchville, particularly when debris clogs the opening. Todd Lake is maintained by Headwaters Soil and Water Conservation District (SWCD) along with the other structures they maintain. There are 16 total Flood Control Dams in the area. Fifteen are physically located in Augusta County and 1 (Jones Hollow) is located in the City of Waynesboro. Augusta County maintains 1 (Mills Creek), the City of Staunton maintains 1 (Elkhorn Lake), the Department of Corrections maintains 1 (Poor Creek), the US Forest Service maintains 1 (Upper Sherando), and the Headwaters SWCD maintains the remaining 11. FEMA data identify 12 repetitive-loss properties and 1 severe repetitive-loss property in the County.

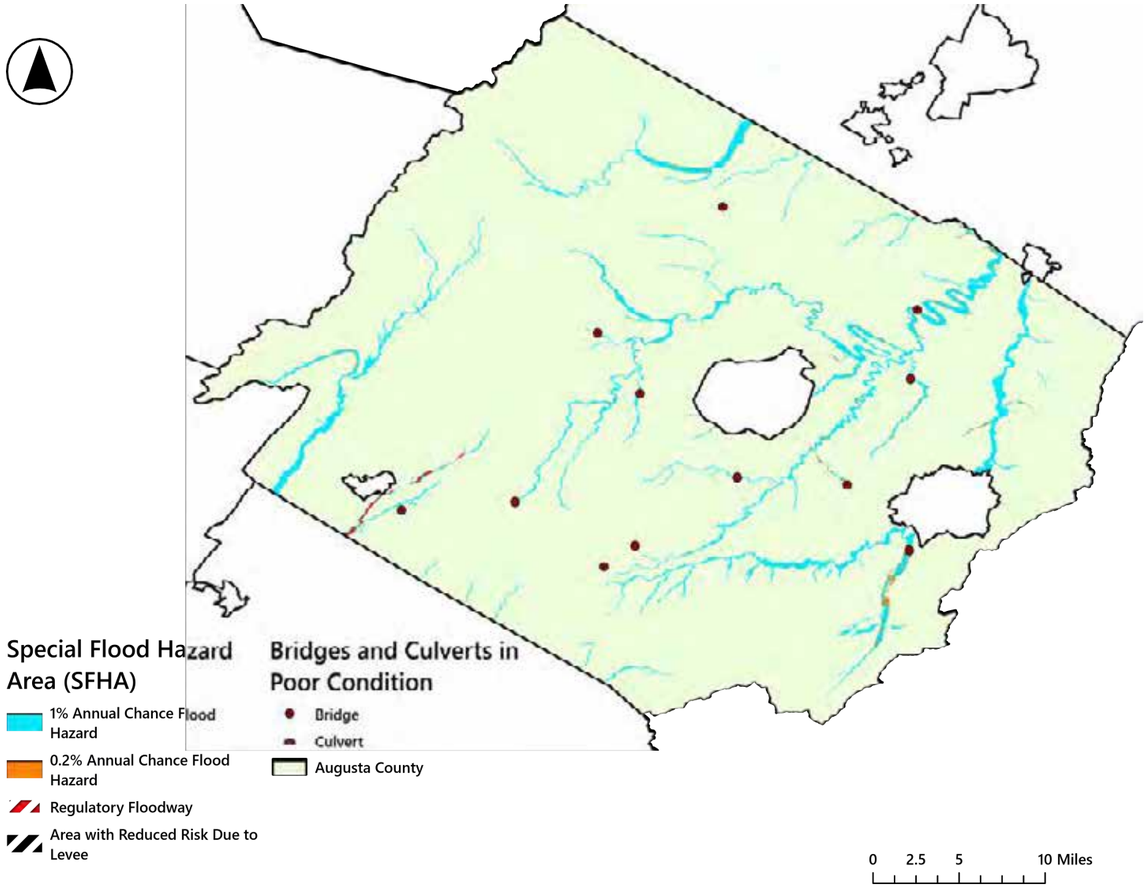
Map 4.4
Augusta County Special Flood Hazard Areas, DEM, and Critical Facilities



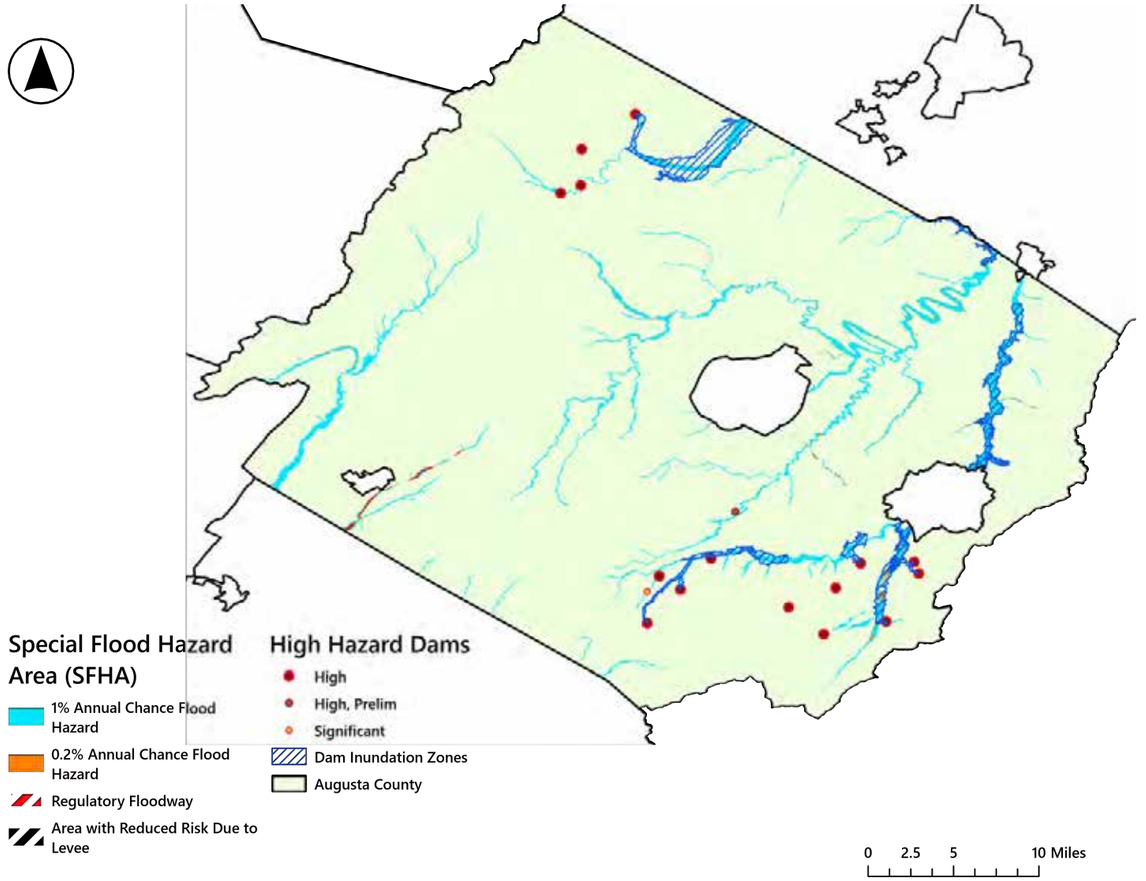
Map 4.5
Augusta County Crashes Due to Standing or Moving Water (VDOT), Roads, and Special Flood Hazard Areas



Map 4.6
Augusta County Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



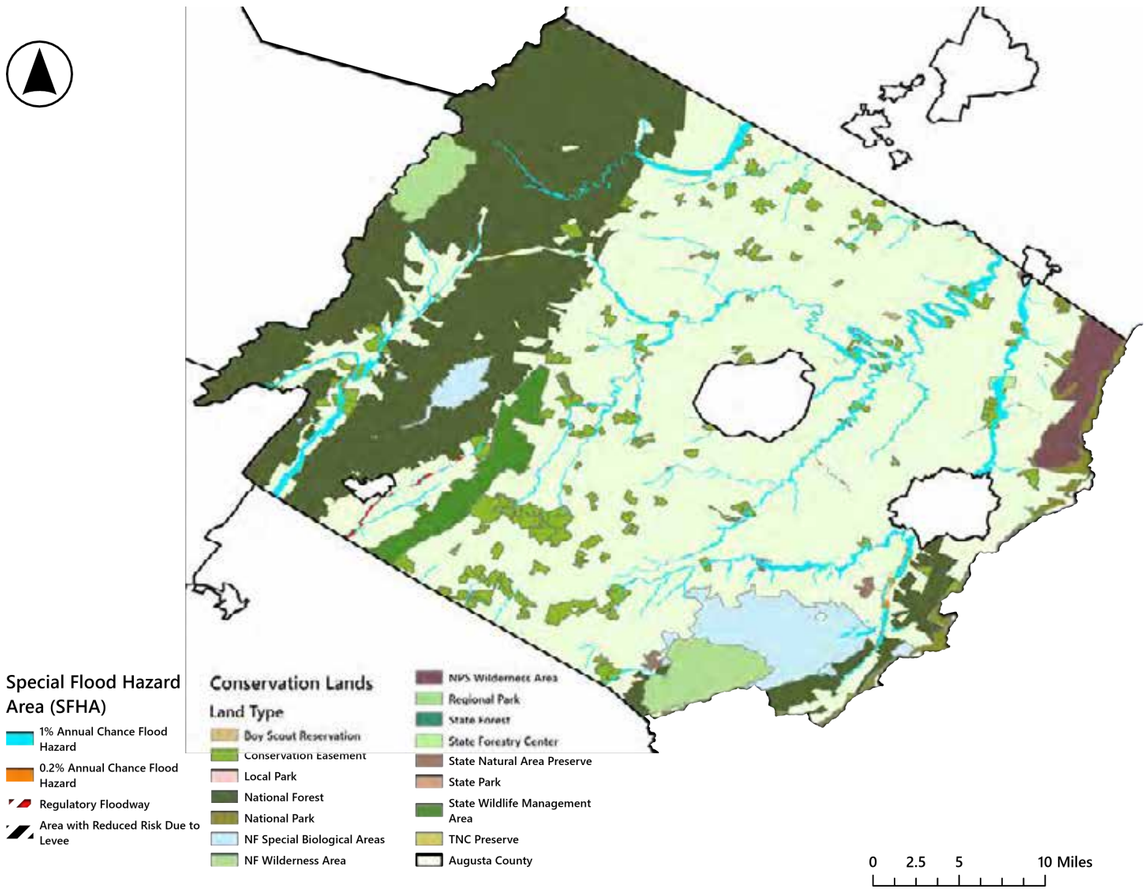
Map 4.7
Augusta County Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



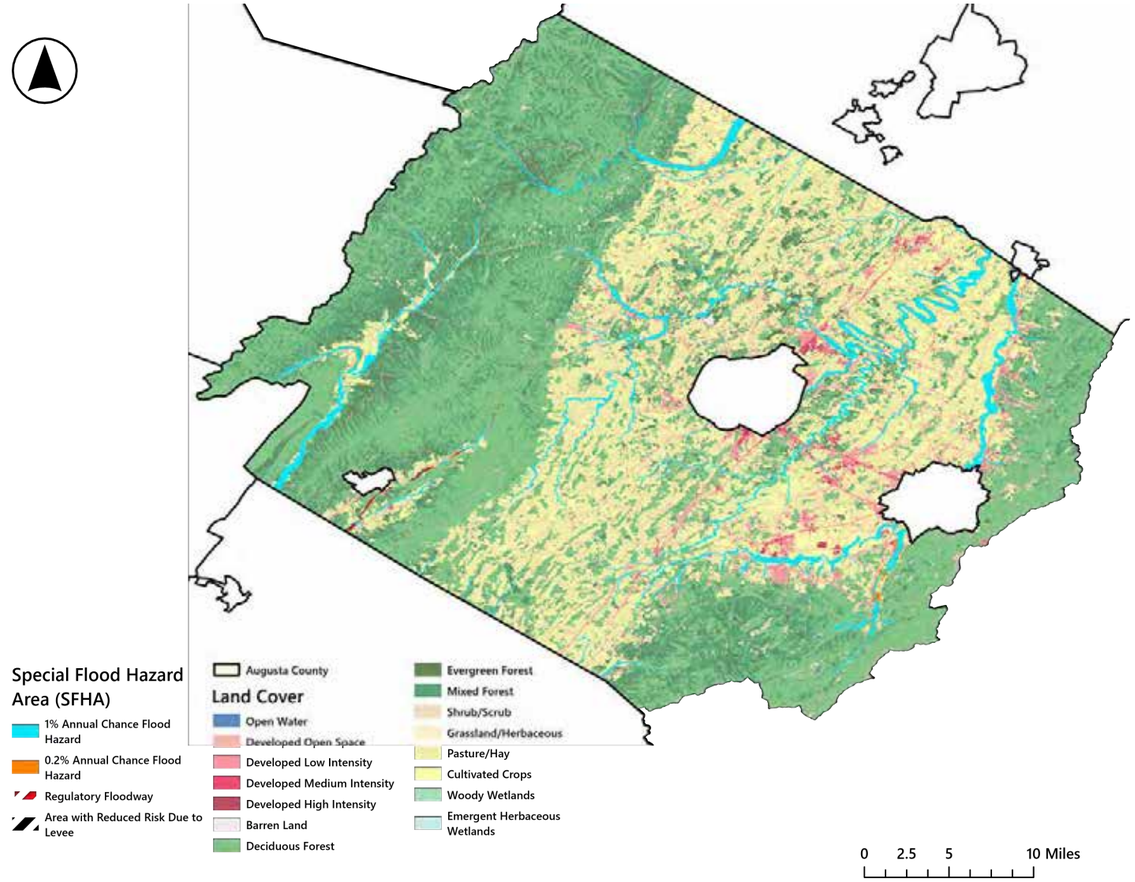
Natural Resources

Public land, primarily the George Washington National Forest and Shenandoah National Park, covers about 35 percent of Augusta County, the second-highest share among the region's counties after Bath County. Large conserved lands and high-value ecological cores occupy the County's mountain margins, but many valley-bottom floodplains are agricultural or developed and have less formal protection. This leaves gaps between protected uplands and the river corridors that store floodwater and convey runoff.

Map 4.8
Augusta County Conservation Easements and Special Flood Hazard Areas



Map 4.9
Augusta County Land Cover and Special Flood Hazard Areas



Future Conditions

MARISA projects that Augusta County will average approximately 14 to 31 days per year at or above 95°F by 2070, compared with about one day per year historically. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 5 weeks. More frequent heavy rainfall would place additional pressure on undersized culverts, aging drainage systems, low-lying roads, and developed areas near the County's rivers and streams. In karst areas, rapid infiltration and subsurface flow may complicate drainage improvements and increase the importance of site-specific investigation.

Needs

Augusta County's most problematic flooding issues are from aging, undersized drainage in older subdivisions. Repair needs far exceed the County's designated budget and staff capacity. Flooding associated with alluvial fan and upstream forest debris in National Forest Areas are most apparent in Stuarts Draft and along the Allegheny Mountains to the West.

Drainage and Stormwater Capacity

Subdivisions platted between the 1960-2000, including Ridgeview Acres, Augusta Farms, Harshbarger, and the Weyers Cave and Dices Spring Road area, rely on flat, grass-lined easements and failed pipes. In Augusta Farms and Ridgeview Acres Subdivisions, standing water persists in easements for months. Concrete ditch improvements there alone would cost an estimated $1-2 million. In Stuarts Draft, flat topography and soils that flood once saturated combine with lost drainage outlets to produce severe flooding.

Aging Infrastructure and Maintenance

Corrugated metal pipe installed from the 1960s onward is corroding from the bottom up, and in many pipes the invert no longer exists. Systematic replacement needed within 20 years, and currently limited funding exists. The County, in conjunction with property owners, HOA's, and POA's, assists with maintenance where possible, despite having limited resources and funding.

Stream and Channel Conditions

Streambank erosion and channel capacity problems affect Jennings Branch near Churchville and Broad Draft tributary in West Augusta. At Churchville, the narrow Hotchkiss Road bridge and debris that collects there worsen flooding upstream. During a 2026 storm, Broad Draft eroded 25 feet of riverbank in 24 hours.

Critical Facilities and Access

Flooding isolates communities and cuts off emergency access in several areas:

- When the Little Calfpasture River floods, State Route 42 overtops and isolates Craigsville and Augusta Springs.
- Flooding along the Mount Torrey Road corridor blocks access between Sherando and Lyndhurst. Residents of Creekside Drive mobile home park along Back Creek must be notified to evacuate when the creek floods.
- Dices Spring Road floods completely at a low dip during high flows.
- The Patton Farm Road low water bridge preserves access across the South River frequently floods requiring coordination with VDOT to ensure detours and traffic delays are communicated to the residents.

Data and Planning

The County's stormwater infrastructure is largely unmapped, and staff reconstruct easement locations from site plans dating to the 1940s. Many areas of the County in mapped SFHAs appear inaccurate and due to be updated. The County worked as a Cooperating Technical Partner with FEMA in the 2010's to restudy the Back Creek Watershed in the Lyndhurst/Sherando Area. The USACE has recently surveyed bridges and culverts in the South River watershed as part of a basin wide effort to remap the Shenandoah Basin.

Staffing and Coordination

The County has no public works department and maintenance staff handle drainage alongside facilities and grounds. The County has an approximately $40,000 annual drainage account which funds only one or two minor projects. Several priority needs depend on Norfolk Southern, VDOT, utilities, and property owners. Debris management relies on an on-call contractor, maintenance staff, and VDOT, coordinated through the joint Staunton-Augusta-Waynesboro EOP and debris management annex.

Resilience Actions

Table 4.2 | Augusta County Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A. The 10% design concept addresses the Ridgeview Acres area.	Mid	CSPDC; property owners	Regional 1; HMP AU-12
2	**Inventory County-maintained drainage infrastructure and plan for pipe replacement.** Record the location and condition of pipes and easements, beginning with subdivisions with known failures, and use the results to schedule replacement of corroding corrugated metal pipe.	Mid	CSPDC; DCR	Regional 2, 3
3	**Coordinate with Norfolk Southern on the Mil-Mar railroad culverts** near Princess Anne Lane and Wayne Avenue, which the County cannot replace without the railroad's participation.	Long	Norfolk Southern	Regional 6
4	**Plan for communities isolated by flooding.** Formalize evacuation notification for the Creekside Drive mobile home park, and develop alternate-access plans for Craigsville and Augusta Springs (State Route 42) and the Mount Torrey Road corridor.	Near	VDOT; Augusta County Emergency Management	Regional 7; HMP AU-28

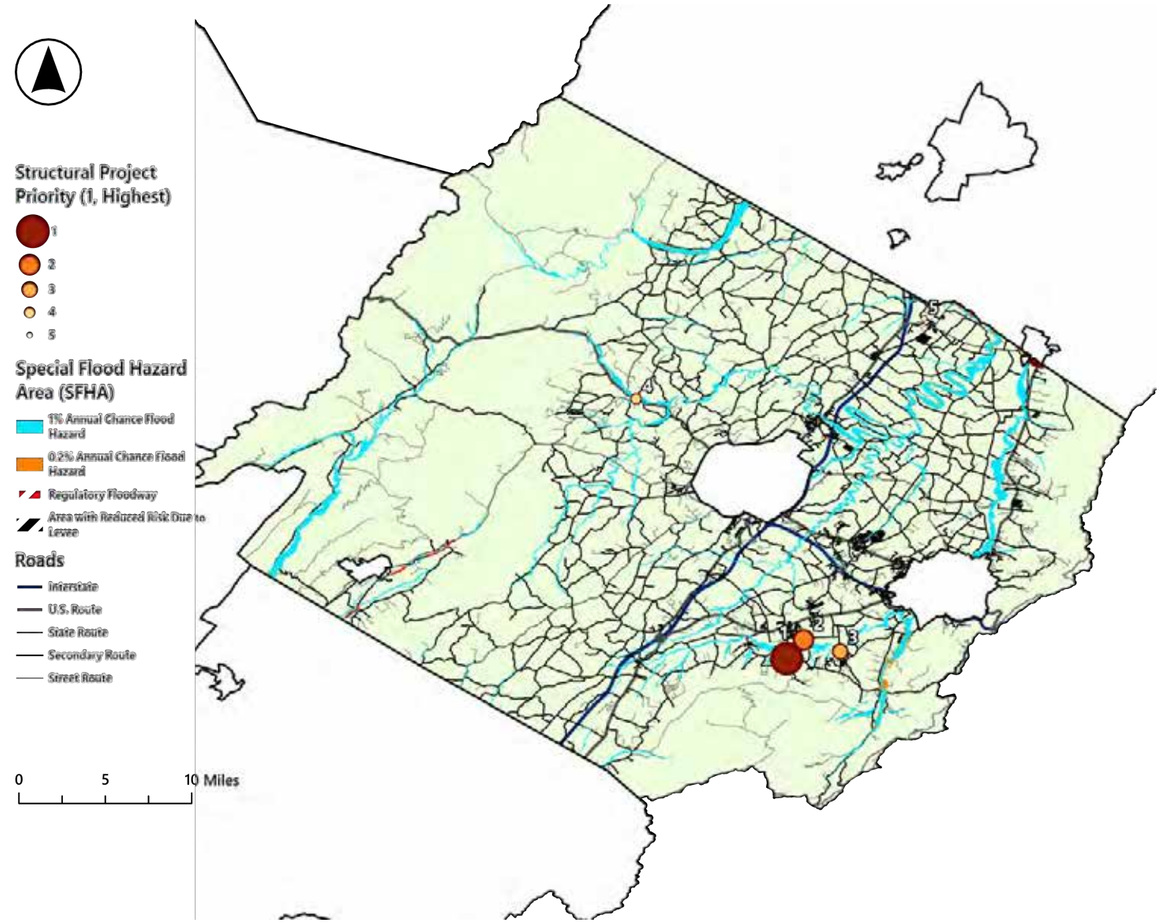
Additional related HMP actions: AU-14 (abandoned structures in floodplains), AU-15 (stream remediation), AU-16 (TMDL Action Plan projects), and AU-17 and AU-18 (dam gauges and exercises).

Table 4.3 | Augusta County Priority Projects

Priority	Project	Severity
1	Falling Rock Drive and Sugar Camp Lane Drainage Easement Reconstruction — Ridgeview Acres Subdivision*	HIGH
2	Mil-Mar Subdivision / Princess Anne Lane — Norfolk Southern Railroad Culvert Upsizing (Stuart's Draft)	HIGH
3	Patton Farm Bridge — South River Crossing Replacement	HIGH
4	Hotchkiss Bridge Extension and Jennings Branch Upstream Stream Improvements — Churchville	HIGH
5	Weyers Cave and Dices Springs Area Subdivision Drainage Improvements	HIGH (relative to population affected)

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

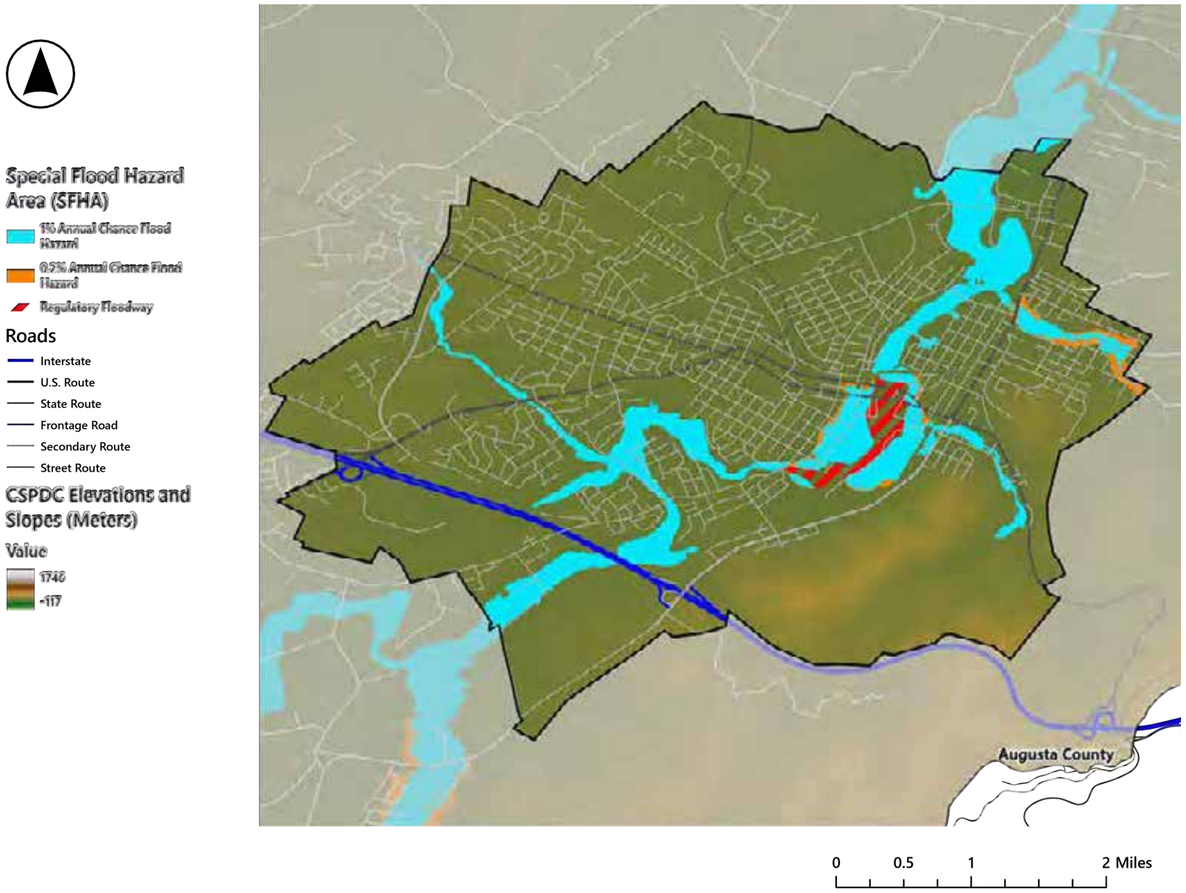
Map 4.10 | Augusta County Priority Projects



City of Waynesboro *At A Glance*

The City of Waynesboro is an independent city surrounded by Augusta County. It sits at the foot of the western slope of the Blue Ridge Mountains along the South River and is the region's third largest city by population. More than 99 percent of the City drains to the South River, which flows north through Waynesboro and joins the North River near Port Republic to form the South Fork of the Shenandoah River in the Potomac basin. Several tributaries join the South River within the City, including Pratts Run, Baker Springs, Steele Run, and Rockfish Run, which drains Jones Hollow. Within the City, the river passes through three U-shaped valleys separated by narrow gorges. Development occupies both banks, which concentrates the City's flood exposure along the river corridor.

Map 4.11
City of Waynesboro Locality Introduction



MS4
community

23,953
total population

1,014
acres in the 500 year floodplain

111
flood insurance policies in force

Flood History

Causes and Recurring Problems

Waynesboro's flood risk stems from early industrial and residential development within the natural floodplain of the South River. Flooding concentrates in the downtown commercial district, Club Court, Ridgeview Park, the Arch and Market Avenue corridor, and along the Jones Hollow tributary. Tributary backwater adds to river flooding in some locations.

Major Events

Hurricane Camille in 1969 drove the South River above 15 feet. During Tropical Storm Agnes in 1972, downtown and Club Court were evacuated. The November 1985 Election Day Flood produced the highest water levels on record. It damaged 140 homes, 32 mobile homes, 41 businesses, and the City's sewage treatment plant, with losses exceeding $7 million in 2019 dollars. Floods in January 1996, from snowmelt, and September 1996, from Hurricane Fran, again flooded the downtown business district.

Recent Flooding

Hurricane Isabel in 2003 crested the South River at 13.46 feet, well above the 9.5-foot flood stage, and caused about $1.39 million in damage. In 2018, Hurricane Florence flooded basements, and the City distributed sandbags and opened emergency shelters. Hurricane Helene caused additional flooding in 2024. While recent events have generally resulted in less severe damage compared to earlier floods, continued development pressures, coupled with recurring high-flow events, highlight the persistent exposure of the community to flood risk.

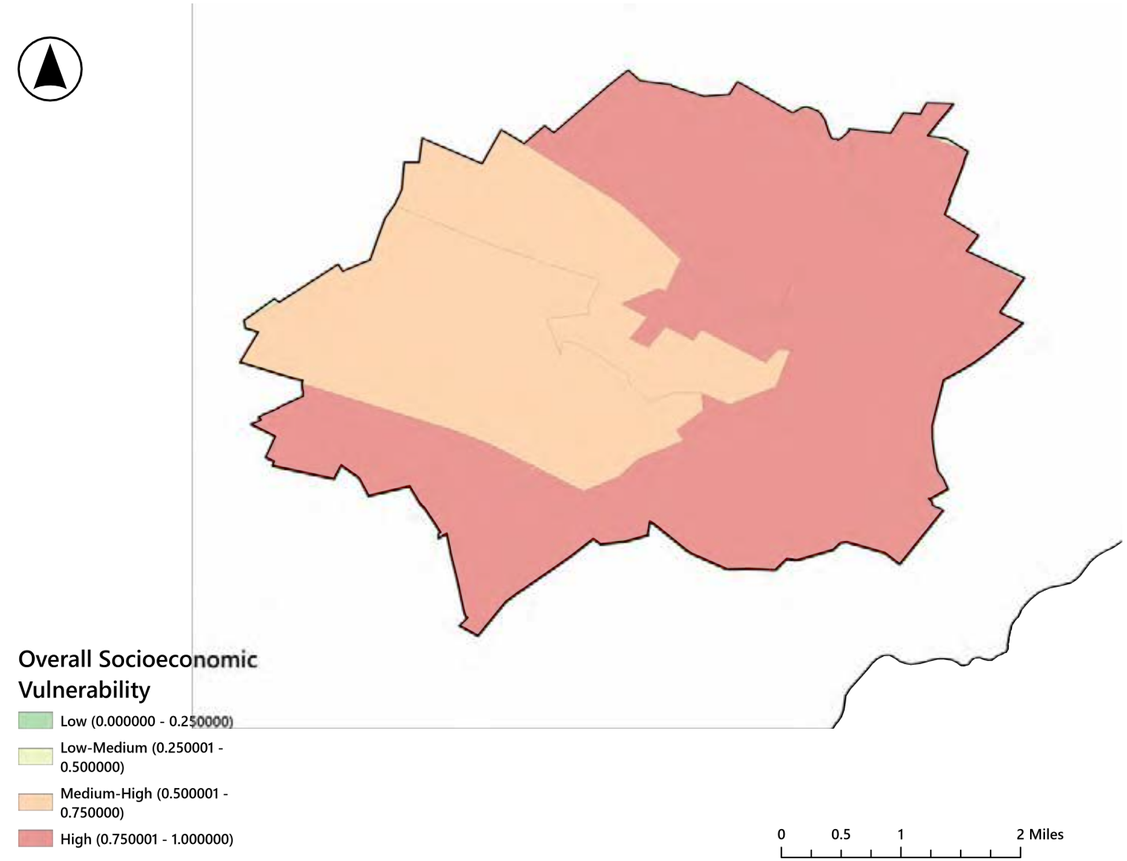

City of Waynesboro

Existing Conditions

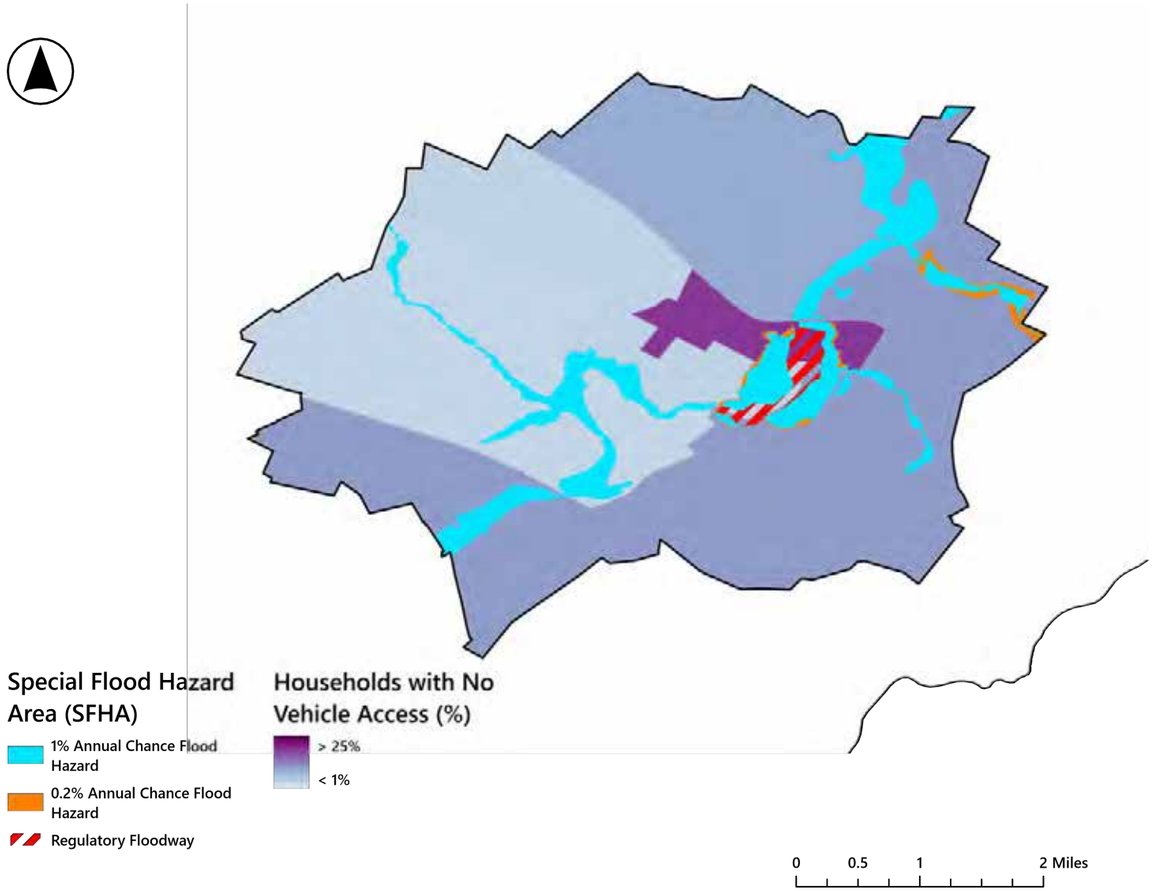
Vulnerable Populations

The City's more socially vulnerable and vehicle-limited households are concentrated in central and eastern neighborhoods near the South River corridor. Because the same area contains mapped flood exposure and important destinations, residents may experience both greater direct impacts and greater difficulty evacuating or reaching assistance.

Map 4.12
City of Waynesboro Social Vulnerability Ranking by Census Tract



Map 4.13
City of Waynesboro Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



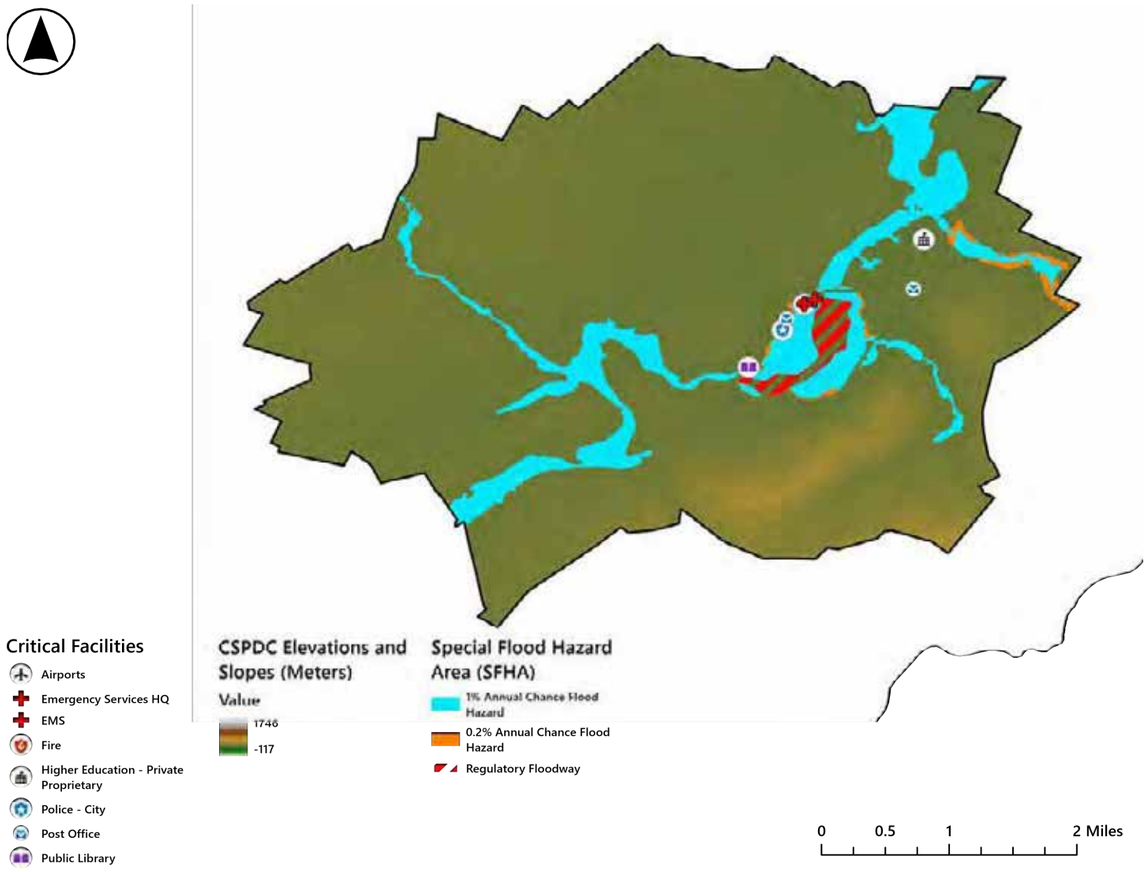
Infrastructure

The South River is the City's dominant infrastructure risk corridor. The mapped floodplain passes through the developed urban core near critical facilities, road crossings, and locations with bridge-condition or crash concerns; dam inundation mapping reinforces this same corridor. A disruption can therefore affect several systems at once, including access, emergency response, utilities, and nearby buildings.

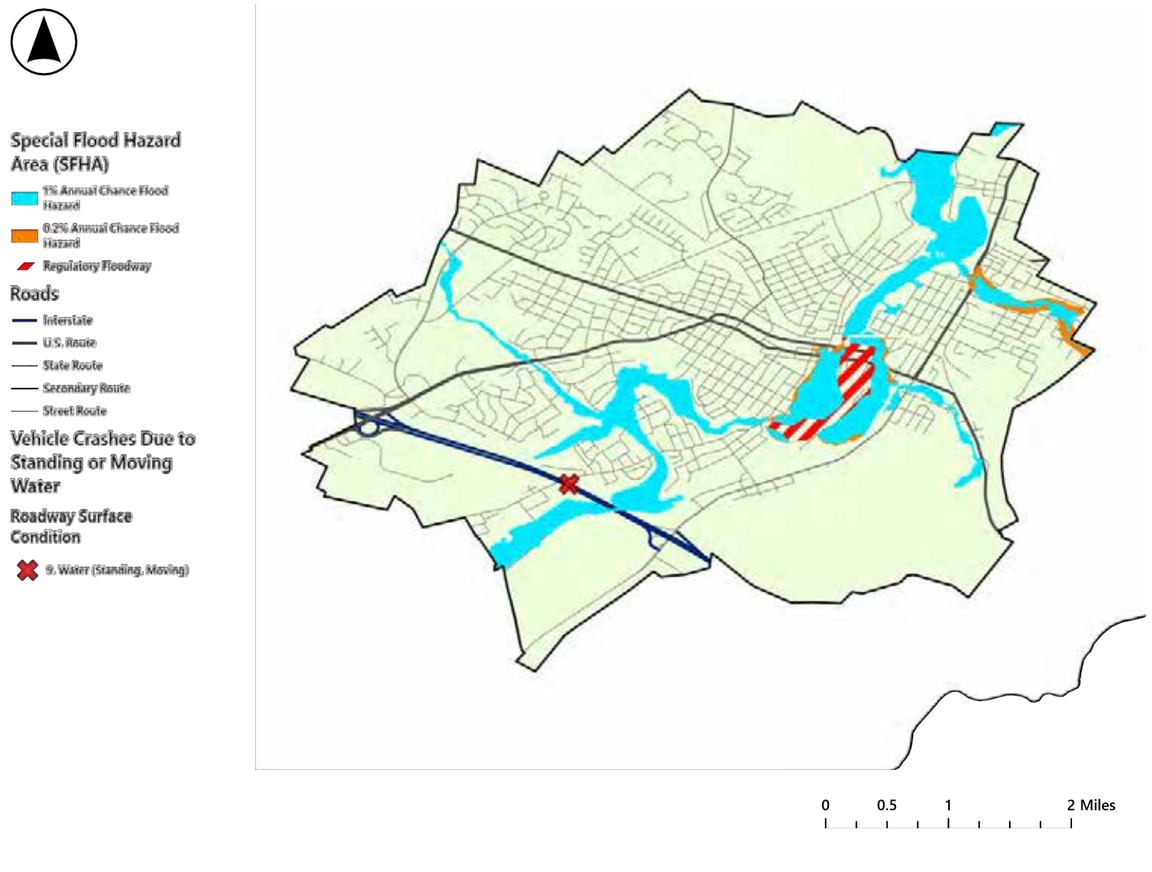
Waynesboro has the highest concentration of repetitive-loss properties in the region, with 39 repetitive-loss and 12 severe repetitive-loss properties. The City owns Jones Hollow Dam, which is reported to be in good condition.

The City inspects its public stormwater management facilities annually and added 19 new public facilities to its inventory in the 2025–26 permit year. Another 37 privately owned facilities operate under maintenance agreements, and City staff inspect each private facility at least once every five years.

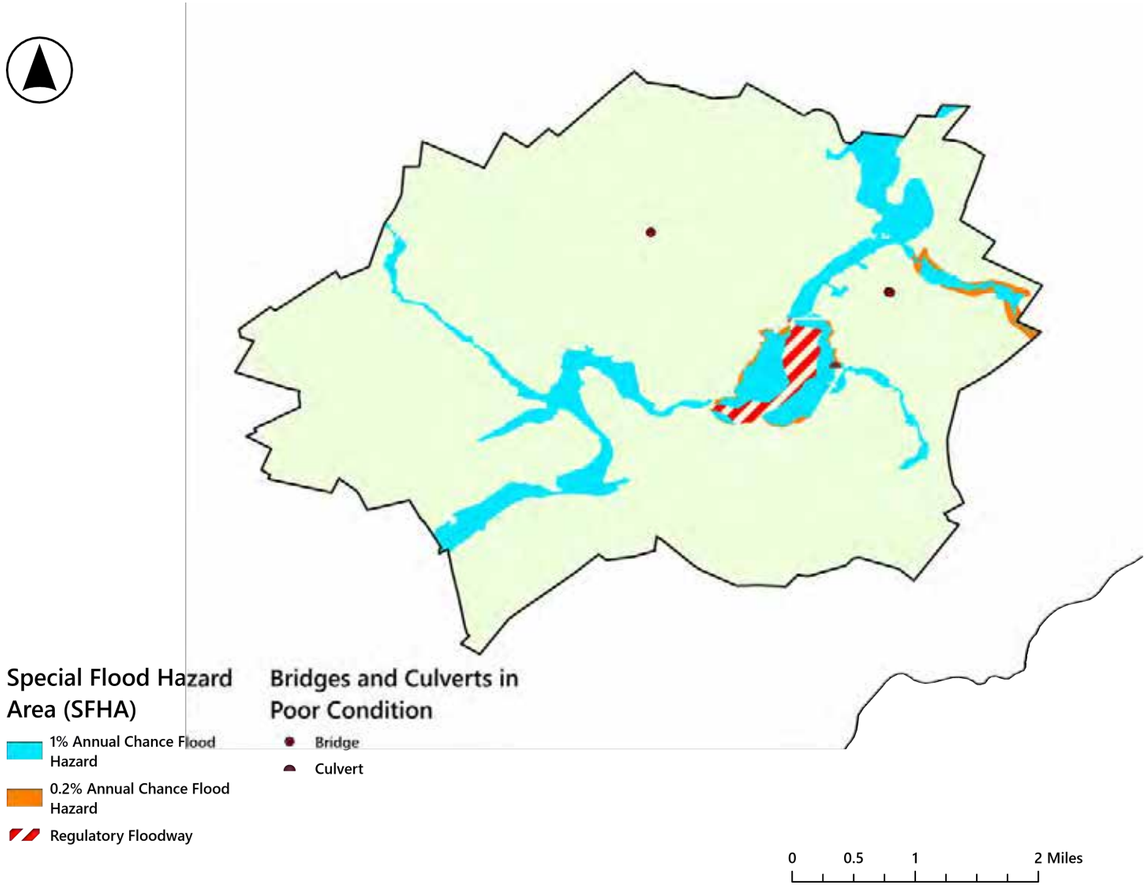
Map 4.14
City of Waynesboro Special Flood Hazard Areas, DEM, and Critical Facilities



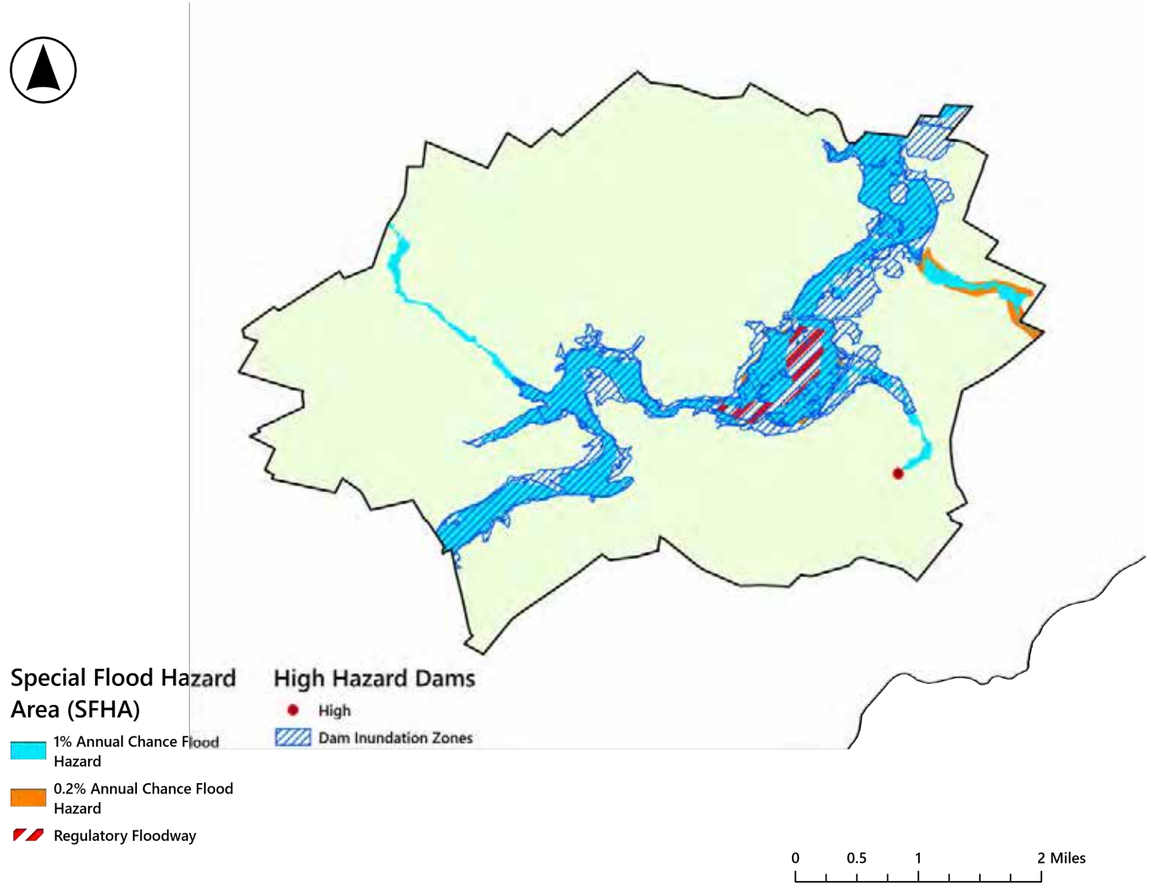
Map 4.15
City of Waynesboro Crashes Due to Standing or Moving Water (VDOT), Roads, and Special Flood Hazard Areas



Map 4.16
City of Waynesboro Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



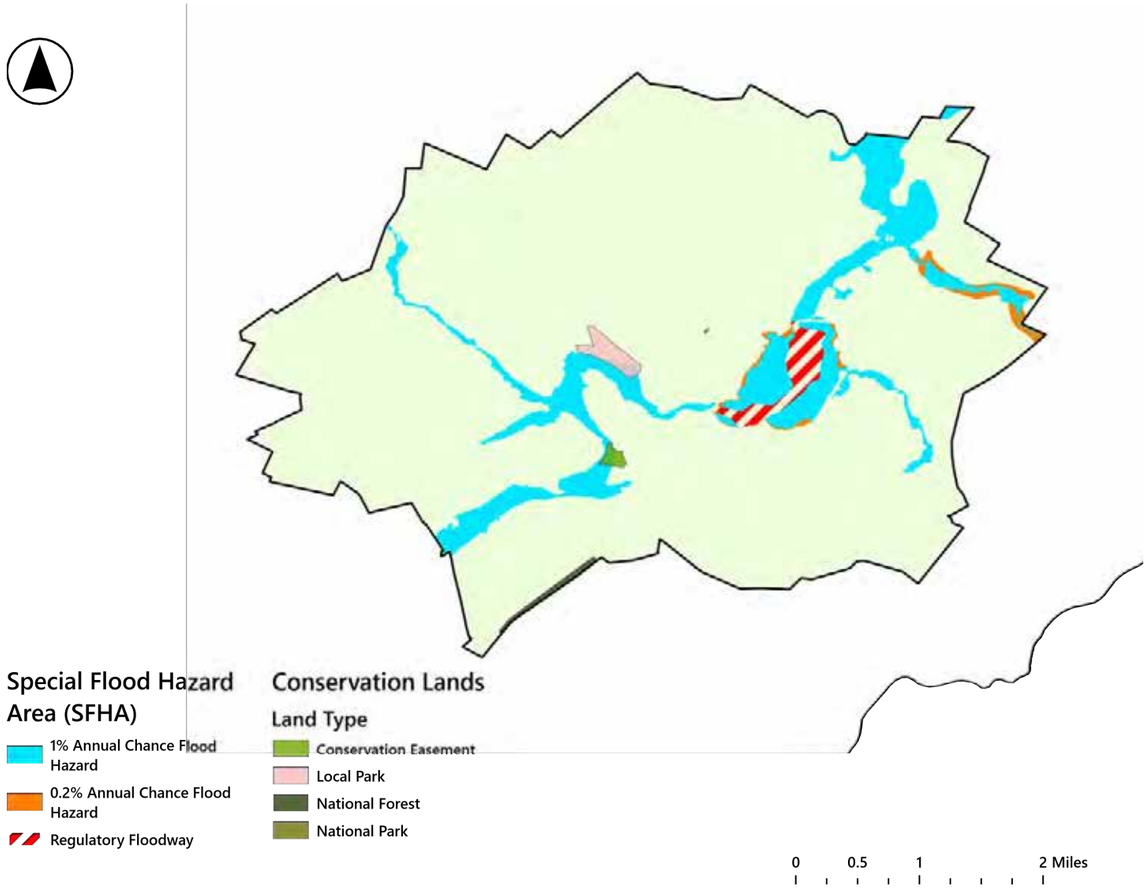
Map 4.17
City of Waynesboro Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



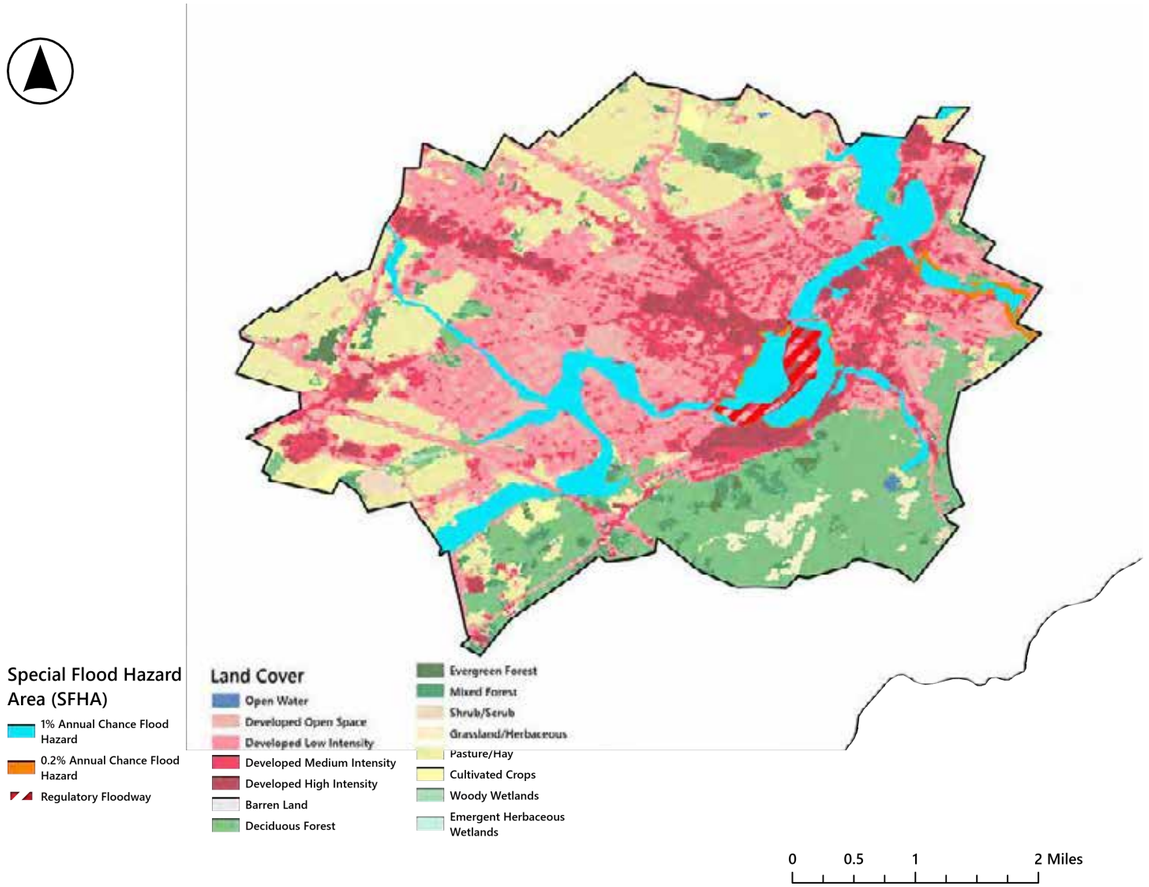
Natural Resources

Waynesboro has limited conserved land within the City, and development closely borders much of the South River. Larger ecological cores lie mainly toward the southeastern edge and are not well connected to the urban floodplain. The City has constructed three wetlands as part of its MS4 program and is preparing a fourth. Its Loth Springs Natural Area project daylighted a buried spring so that it flows overland to the South River and added a constructed wetland, meadow, and riparian buffer with 391 newly planted trees. The City also maintains the Mulberry Run Wetland, and the Parks and Recreation Department planted 114 additional trees during the 2025–26 permit year.

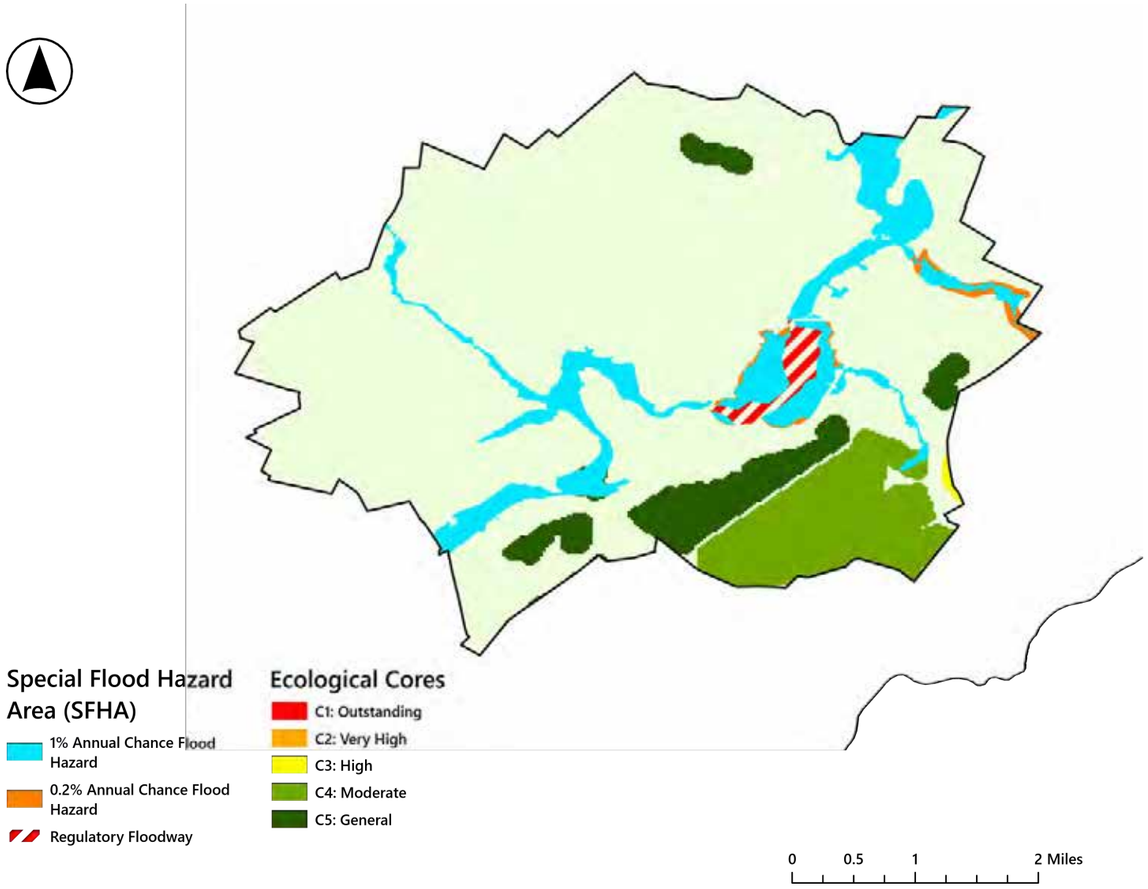
Map 4.18
City of Waynesboro Conservation Easements and Special Flood Hazard Areas



Map 4.19
City of Waynesboro Land Cover and Special Flood Hazard Areas



Map 4.20
City of Waynesboro Ecological Cores and Special Flood Hazard Areas



Future Conditions

MARISA projects that Waynesboro will average approximately 19 to 39 days per year at or above 95°F by 2070, compared with about two days per year historically. The City's urban heat-island effect may intensify heat exposure and cooling demand. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by approximately 2 to 3 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall would increase runoff into the South River and tributary drainage systems, increasing pressure on culverts, stormwater infrastructure, and repeatedly flooded neighborhoods.

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Needs

Waynesboro's needs center on advancing its stormwater capital projects and reducing repeated riverine losses. These efforts depend on resolving gaps in floodplain administration capacity.

Drainage and Stormwater Capacity

The City's stormwater capital improvement plan update is reprioritizing the outstanding projects from its 2006 project list; the projects in the update are listed at the end of this profile. Known problem areas include the Arch Avenue and South Lane neighborhood and the North Elkin and East Main Street corridor, both lower-income areas with road and probable basement flooding. Other problem areas are the Tree Street area and downstream flooding near Club Court. Projects in lower-income areas qualify for the Community Flood Preparedness Fund's (CFPF's) reduced 10 percent match.

Repetitive Loss and Riverine Exposure

Waynesboro's repetitive-loss concentration reflects decades of development along the South River. The City has acquired properties in Club Court in the past, and staff are informally discussing a voluntary buyout where acquisition may prove more cost-effective than a structural project.

Critical Facilities and Access

The wastewater treatment plant's flooding appears to have been resolved by raising its levee to the BFE. The City plans to install real-time monitoring at Jones Hollow Dam and integrate it with the Virginia Department of Emergency Management's (VDEM's) statewide flood intelligence network. The former I-FLOWS gage network has ended, and the South River Science Team now maintains the gages on the South River.

Maintenance

The City's Stormwater Maintenance Crew completed 104 maintenance tasks on ditches and stormwater facilities during the 2025–26 permit year. Through an annual contract, the City cleaned 7,800 feet of storm pipe and 86 structures and removed 27 tons of sediment. The crew is adding a flush truck transferred from the sanitary sewer crew, which will let it clean storm lines in-house in addition to contracted work. The City also plans to convert one existing facility to a constructed wetland and extended detention basin to reduce streambank erosion.

Staffing and Procedures

The City has had no Certified Floodplain Manager (CFM) since a consultant relationship ended. The City's floodplain overlay district requires new and substantially improved structures to be elevated to or above the BFE, and the City has no written procedure for making and tracking substantial damage and substantial improvement determinations. The City, Staunton, and Augusta County share a joint emergency operations plan that includes a debris management annex.

The City has strong capacity in other areas and administers its own erosion and sediment control and stormwater management programs, with a dedicated administrator, inspector, and plan reviewer, and it adopted an updated erosion and stormwater management ordinance in July 2024. During the 2025–26 permit year, it issued 64 land disturbance permits, including three residential subdivisions, and it plans to lower the threshold for erosion and sediment control review from 10,000 to 2,000 square feet. It maintains a GIS map of its storm sewer system and continues to expand it, adding more than 300 inlets, manholes, and outfalls in the 2025–26 permit year. The City collects a stormwater utility fee, maintains facility-specific maintenance procedures for green infrastructure, has two staff certified as Chesapeake Bay Landscape Professionals, and intends to pursue CFPF grants in-house.

Resilience Actions

Table 4.4 | City of Waynesboro Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Complete the stormwater capital improvement plan update and advance its priority projects.**	Near	City Engineering Consultant	Regional 1; HMP WA-9
2	**Establish Certified Floodplain Manager capacity and document floodplain procedures.** Pursue staff certification for CFM.	Near	DCR; VFMA	Regional 4, 5; HMP WA-4
3	**Evaluate becoming a CRS participating community** by conducting an assessment of the benefits of program participation in relation to staff capacity.	Near	DCR; VFMA; Wetlands Watch; Town of Bridgewater	Regional 4, 5
4	**Install real-time monitoring at Jones Hollow Dam** and integrate it with VDEM's flood intelligence network.	Near	VDEM	Regional 7; HMP WA-10, WA-11

Additional related HMP actions: WA-2 (Staunton-Augusta-Waynesboro emergency operations plan)



City of Waynesboro

Table 4.5 | City of Waynesboro Stormwater Capital Improvement Plan Projects

#	Location	Description
1	Market Avenue, West 12th and West 14th Streets	Conduct feasibility study and conceptual design to address recurring street flooding at W 12th and W 13th Streets through curb and gutter connections and potential subsurface drainage improvements
2	Glenwood Boulevard	Replace undersized culvert with improved low-flow and overflow conveyance structures, subject to downstream feasibility analysis, to reduce roadway flooding and emergency access disruptions
3	North Bayard Avenue, Bath Avenue, & 5th Street	Install stormwater conveyance channels along N Augusta Avenue and permeable pavement on N Bayard Avenue to reduce street, yard, and basement flooding and direct runoff to the existing 5th Street storm sewer.
4	North Augusta Avenue, North Bayard Avenue, & 7th Street	Upgrade existing stormwater pipes, inlets, and conveyance channels along N Augusta Avenue and evaluate stormwater management practices to reduce street and yard flooding.
5	Randolph Avenue	Improve the existing drainage channel along the railroad between Hopeman Parkway and Stuart Street and evaluate downstream culvert capacity or alternative stormwater management practices to reduce residential flooding.
6	New Hope Road (Wayne Hills)	Evaluate installation of a 24-inch storm sewer along New Hope Road or upgrades to railroad drainage channels and downstream culverts to alleviate street and business flooding, considering utility and site constraints.
7	Bookerdale Road (West)	Upgrade drainage channels on both sides of Bookerdale Road to provide 10-year storm capacity and reduce roadway, parking lot, and residential yard flooding.
8	Park Road & Laurel Avenue	Install a piped conveyance system along S Ellison Circle and Park Road, from Hall Lane to Linden Avenue, to redirect runoff from inadequate backyard drainage channels and reduce flooding.
9	North Elkin Avenue	Install a piped conveyance system along N Elkin Avenue between 8th Street and E Main Street to collect runoff and reduce residential yard flooding.
10	Washington Avenue	Conduct feasibility study and conceptual design to address inadequate drainage from Windsor Road by establishing drainage easements and evaluating a public stormwater management facility at 1020 Jefferson Avenue.
11	Lovers Lane & Northgate Avenue	Install a piped conveyance along Ashby Drive and Lovers Lane and improve the downstream open channel to redirect runoff and reduce residential flooding.
12	Bookerdale Road (East)	Evaluate piped drainage, open-channel improvements, and detention pond retrofits to manage runoff affecting residential properties.
13	300 Block of 13th Street	Assess watershed drainage, encourage private stormwater management, and evaluate a grass channel to reduce intersection flooding.

Source: City of Waynesboro 2026 Stormwater Capital Improvement Plan.

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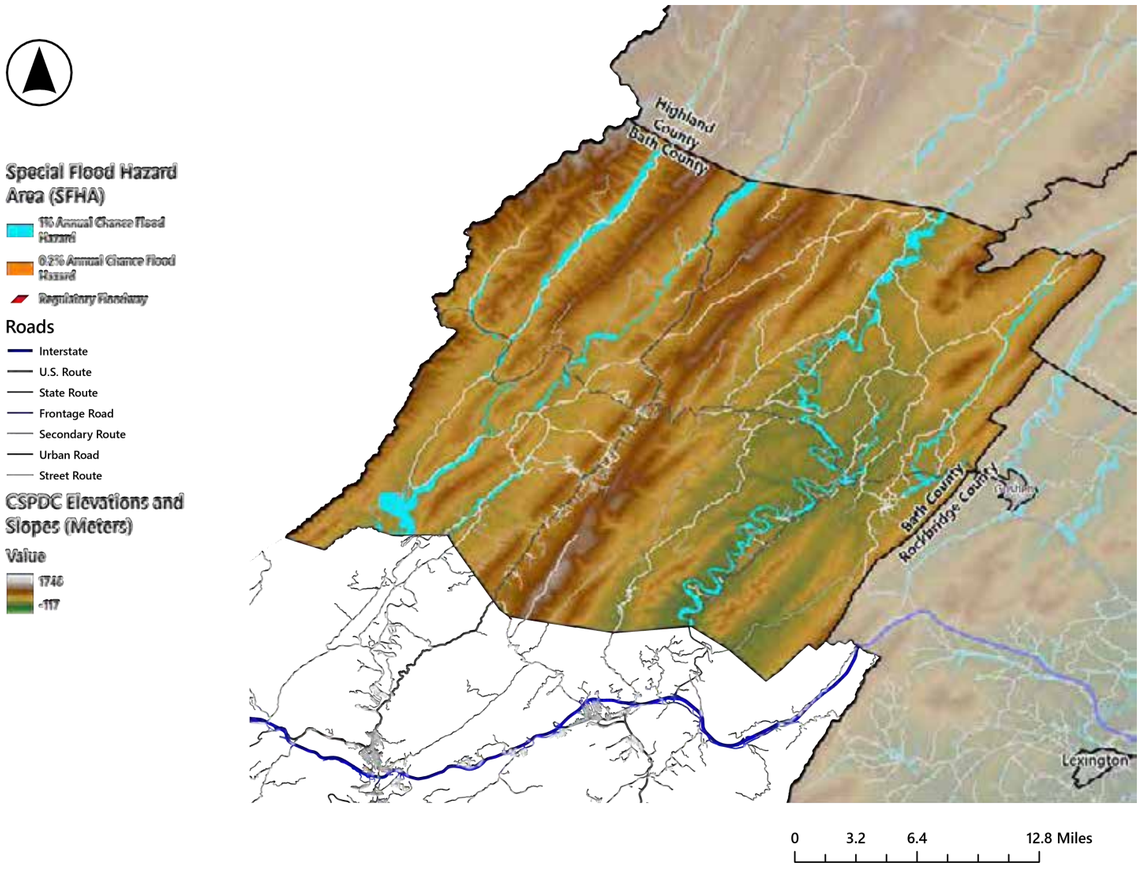
Bath County *At A Glance*

Bath County is located in the Allegheny Mountains along the region's western edge and borders Highland, Augusta, Rockbridge, and Alleghany Counties and Pocahontas and Greenbrier Counties in West Virginia. With about 530 square miles of land, it is the region's smallest county by area after Highland County. The County is also one of the least populous counties in Virginia.

All of Bath County lies within the James River drainage basin, and the County's major watersheds are the Jackson, Bullpasture, and Cowpasture Rivers. The Jackson River originates in Highland County, drains the western half of Bath County, and is the County's major river; most of the County's development lies within its watershed. Lake Moomaw was created in 1979 with the completion of Gathright Dam on the Jackson River. The lake covers 2,530 acres at its maximum conservation pool elevation of 1,582 feet.

The Cowpasture River also originates in Highland County and flows south through the entire length of Bath County. It and its tributaries drain about 236 square miles of the County's central and southeastern sections. Mill Creek and its tributaries drain about 8 percent of the County in the northeastern corner, flowing south into the Maury River in Rockbridge County.

Map 4.21 | Bath County Locality Introduction



4,212
total population

12,728
acres in the 500 year floodplain

21
flood insurance policies in force

Flood History

Causes and Recurring Problems

Steep mountain terrain and narrow valleys make flash flooding Bath County's most common flood hazard, particularly along smaller tributaries. Roads, homes, and businesses concentrate on the same valley floors that carry floodwater, so even localized storms close roads and damage property. The village of Hot Springs floods repeatedly because several drainage areas converge on Hot Springs Run in a fully developed valley. The long-term record shows that flash floods recur frequently despite the County's small population and limited development.

Major Events

In March 1936, regional storms flooded the Jackson and Cowpasture Rivers, shutting down transportation and causing extensive damage from high water and landslides. The November 1985 Election Day Flood caused about $6 million in damage across the County. It washed out bridges, damaged homes, farms, and water and wastewater systems, and flooded portions of Hot Springs, including the Homestead resort. Rain combined with snowmelt in January 1996 pushed some streams to or beyond 100-year flood levels, and Hurricane Fran caused further flooding later that year.

Recent Flooding

In April 2011, heavy rain flooded downtown Hot Springs and damaged roads, homes, and the Warm Springs Pools. Later that month, flooding washed out Route 614 in front of the Burnsville Volunteer Fire Department. In May 2018, about 5 inches of rain fell in less than two hours, closing the Jackson River Turnpike and Route 687 and damaging homes, an auto shop, and roads. In May 2020, heavy rain closed sections of State Route 39 and US Route 220.

County staff describe flooding in Bath County as localized compared with neighboring localities. Hot Springs is the exception, with a documented, recurring pattern.

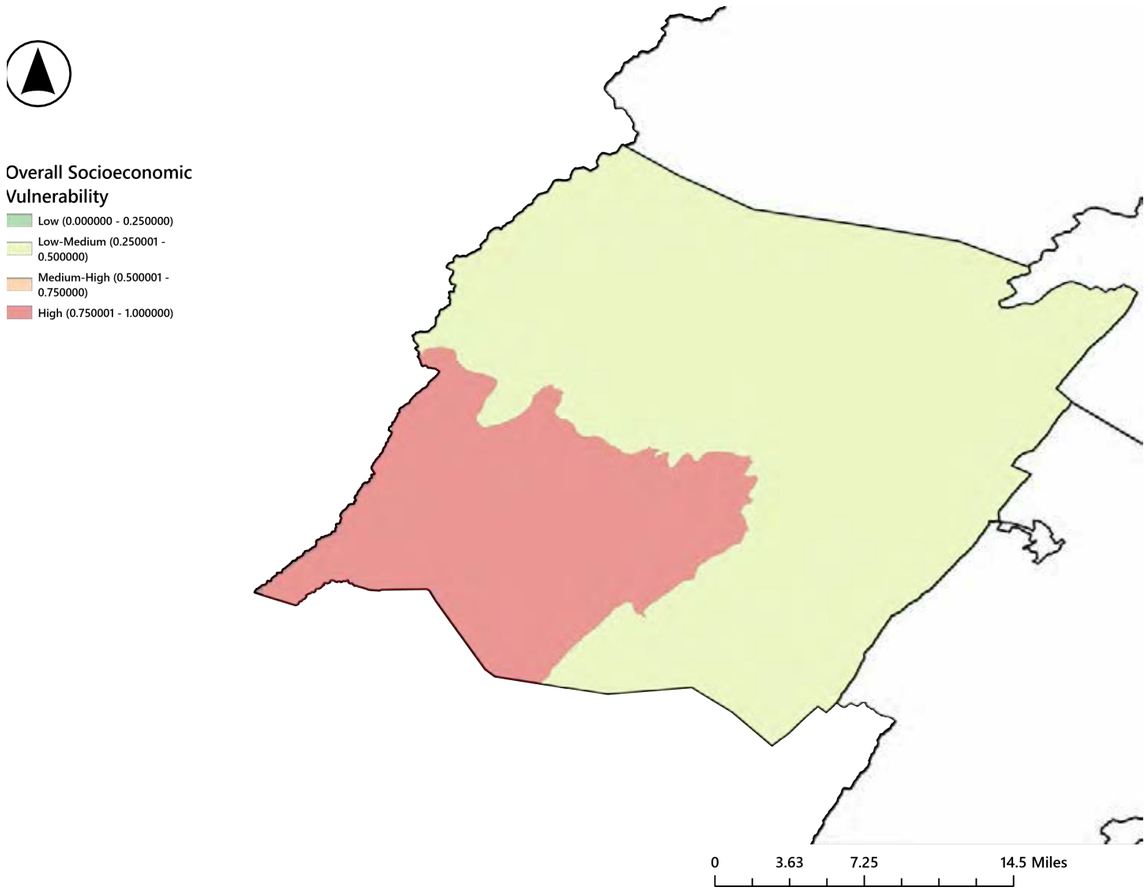


Existing Conditions

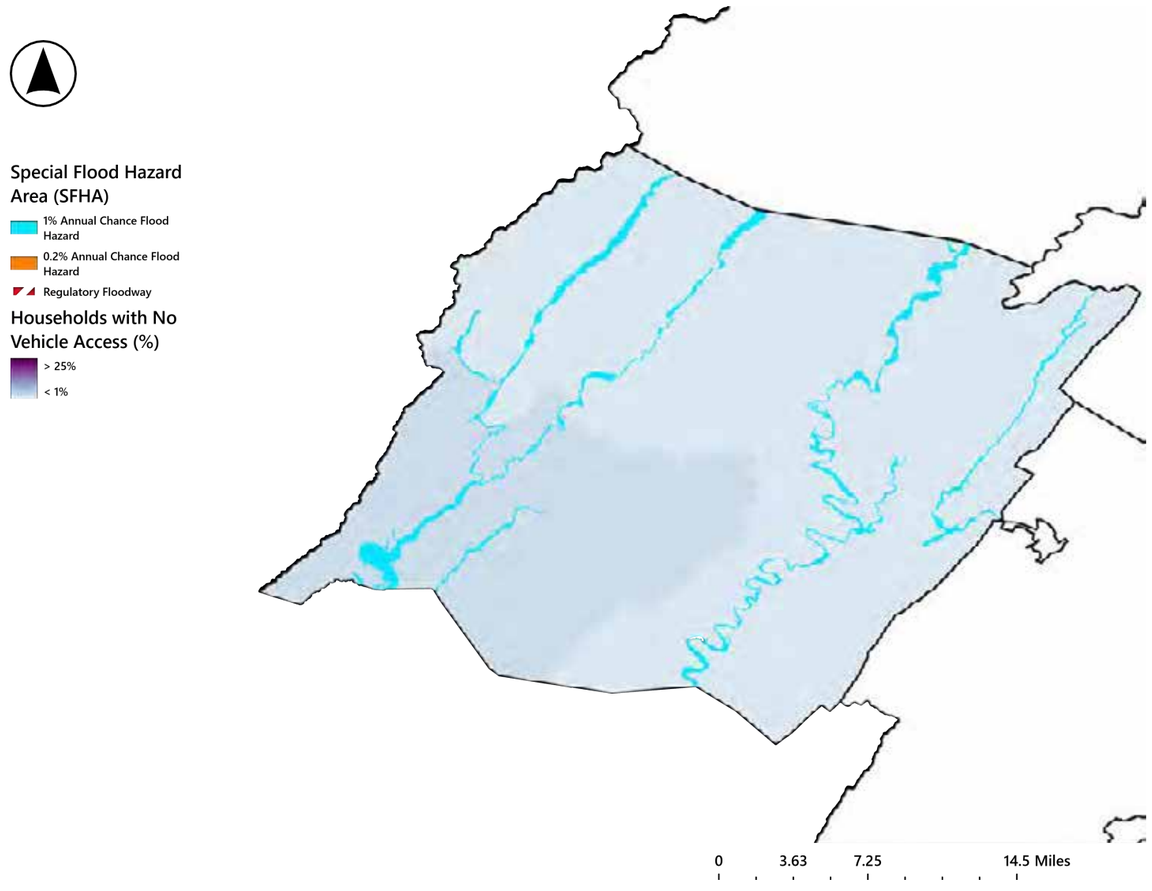
Vulnerable Populations

The highest mapped social vulnerability occurs in the southwestern portion of Bath County. Household vehicle limitation is not strongly concentrated, but the County's dispersed population, long travel distances, mountainous terrain, and limited road network can turn modest transportation constraints into isolation during flooding.

Map 4.22
Bath County Social Vulnerability Ranking by Census Tract



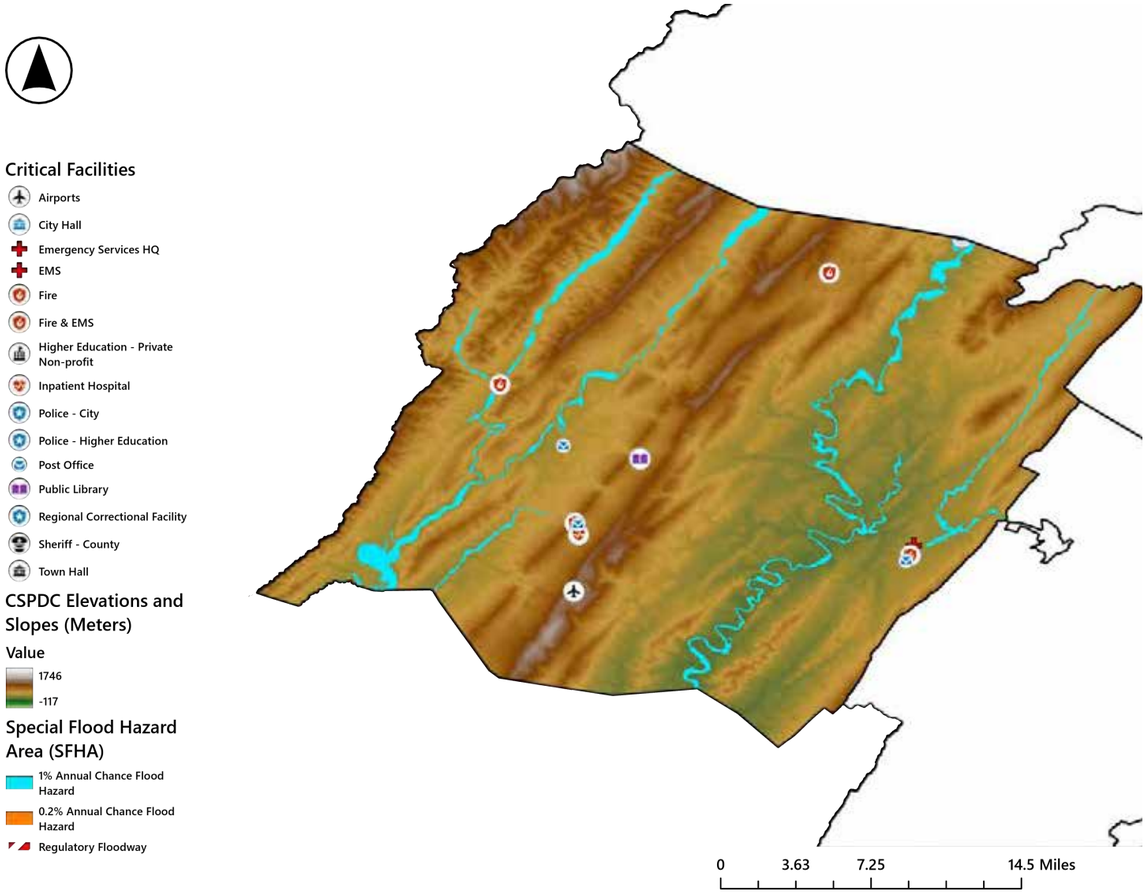
Map 4.23
Bath County Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



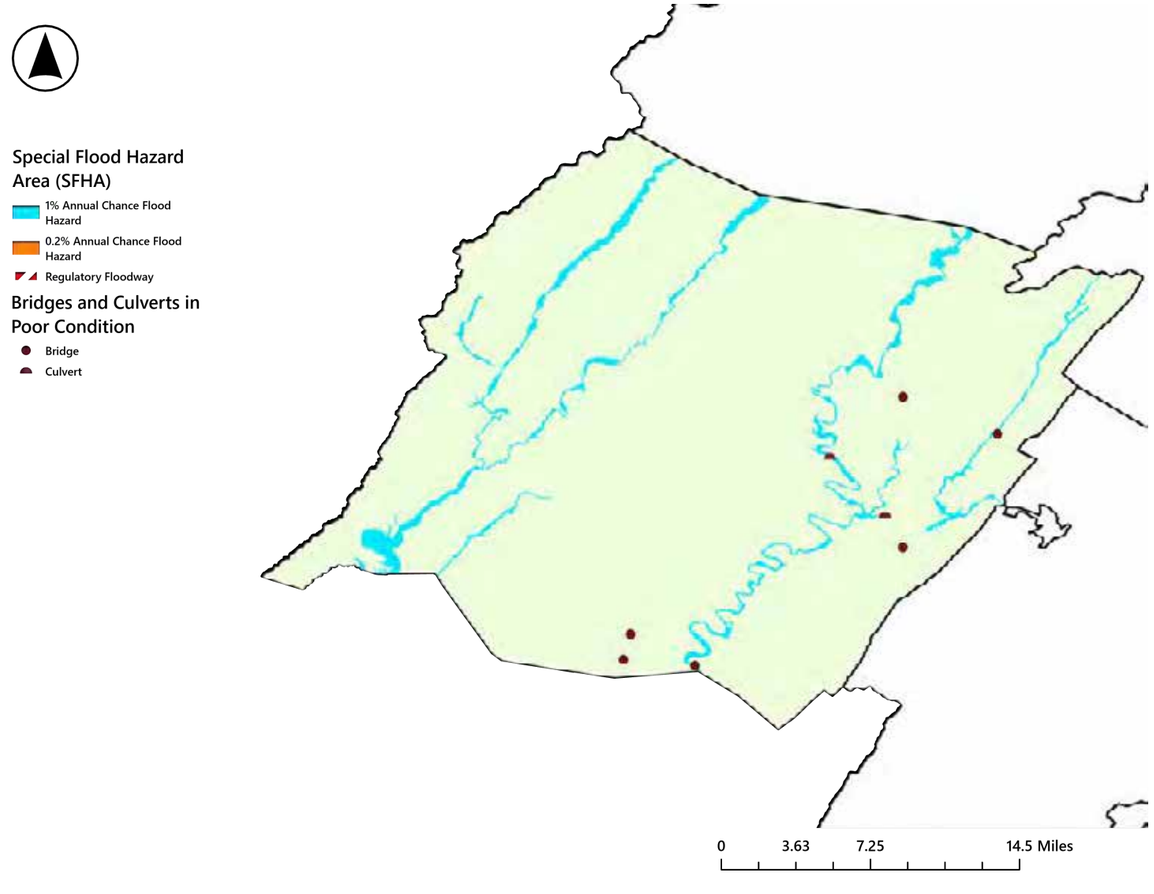
Infrastructure

Critical facilities and primary roads are concentrated in narrow valley floors alongside rivers and streams. Few mapped bridges are in poor condition, but the network has limited redundancy, so closure of even one crossing or valley route can substantially lengthen response and evacuation travel. The County has two repetitive-loss properties and no severe repetitive-loss properties.

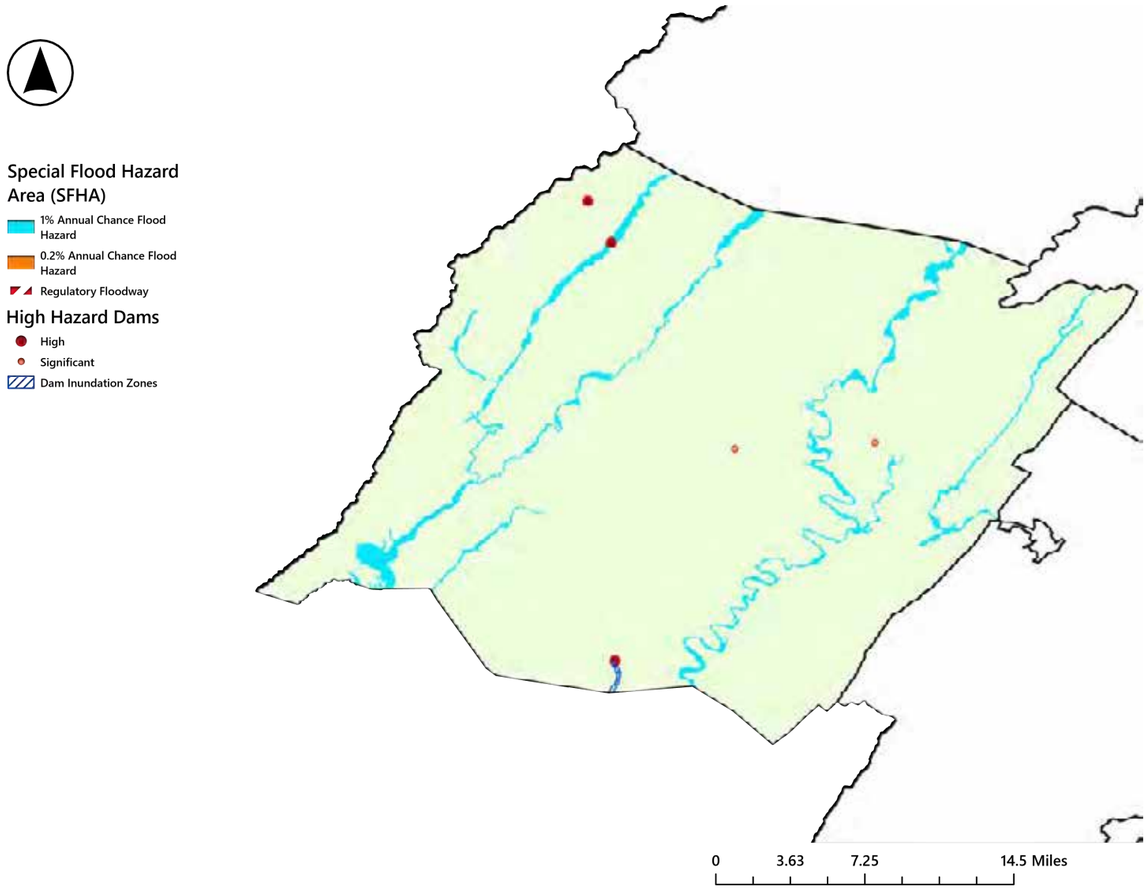
Map 4.24
Bath County Special Flood Hazard Areas, DEM, and Critical Facilities



Map 4.25
Bath County Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



Map 4.26
Bath County Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



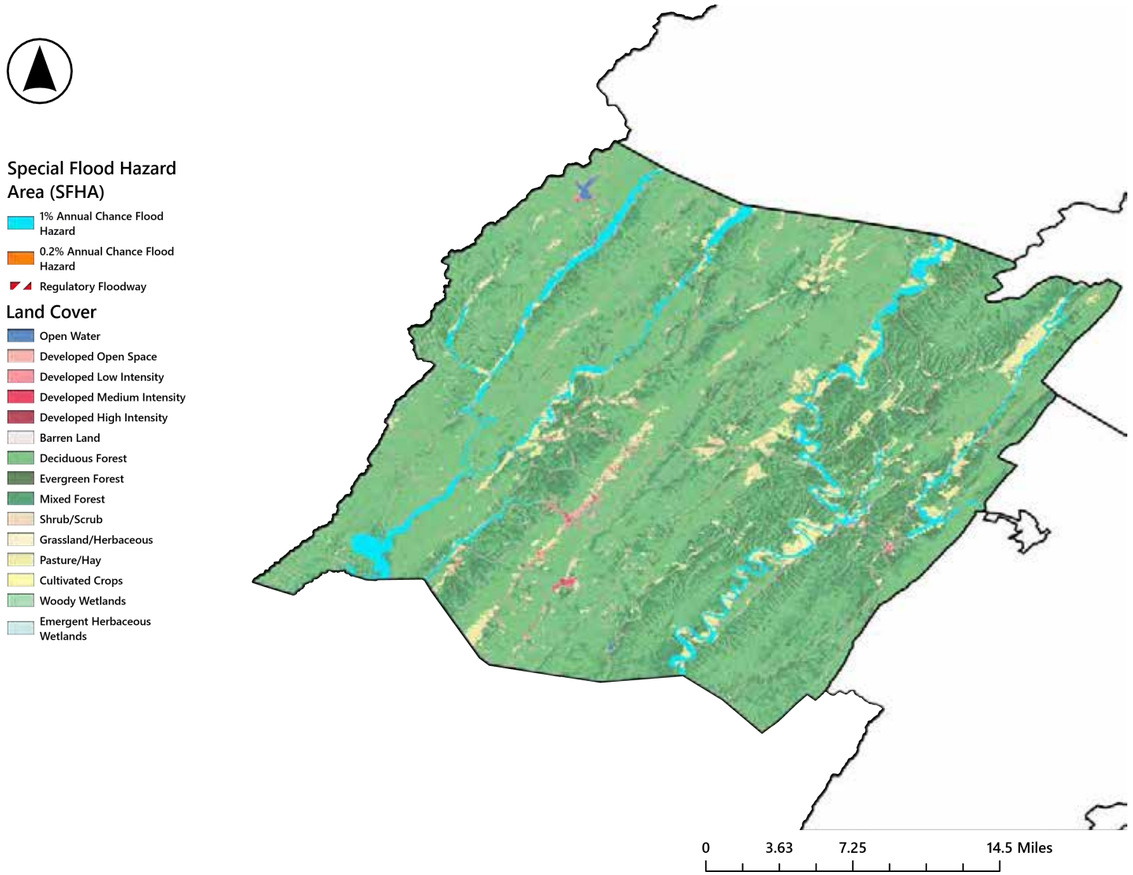
Natural Resources

Public land, including national forest, the Gathright Wildlife Management Area, and Douthat State Park, covers about 56 percent of Bath County, the highest share among the region's counties. Development and transportation, however, are concentrated in the same narrow valleys occupied by floodplains.

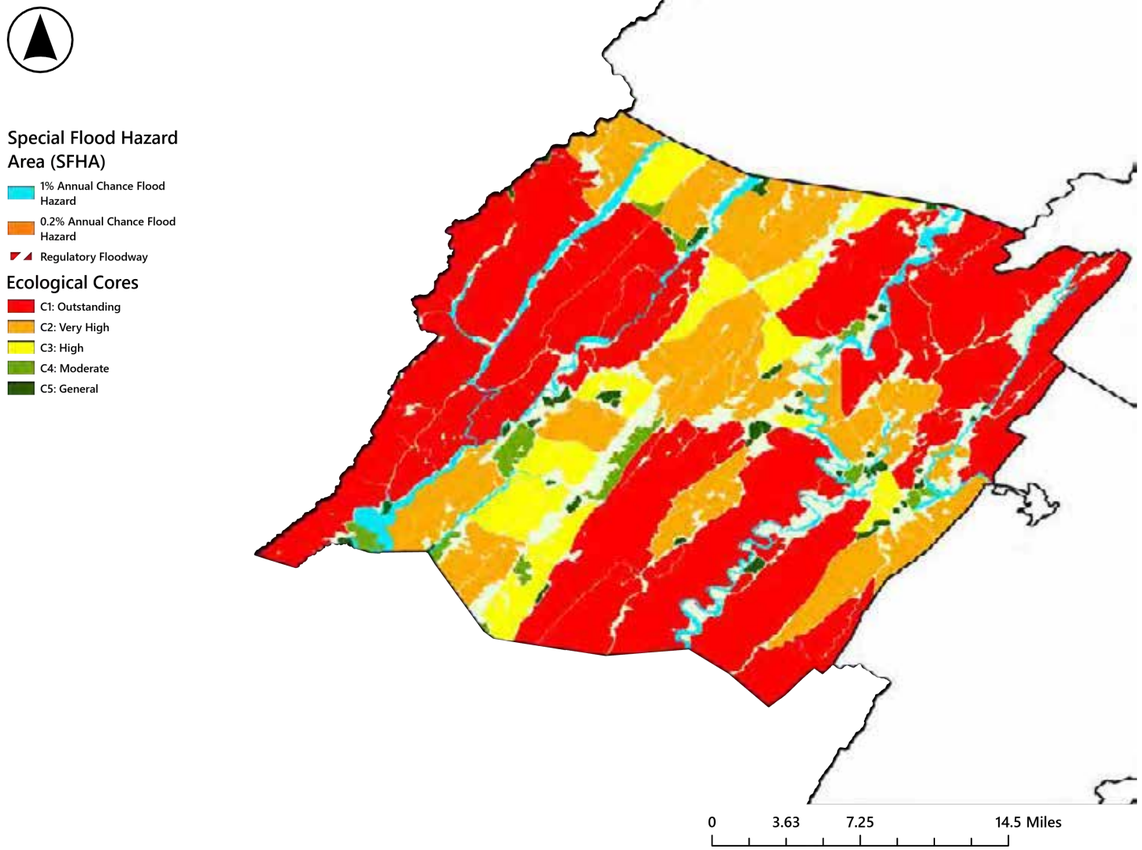
Map 4.27
Bath County Conservation Easements and Special Flood Hazard Areas



Map 4.28
Bath County Land Cover and Special Flood Hazard Areas



Map 4.29
Bath County Ecological Cores and Special Flood Hazard Areas



Future Conditions

MARISA projects that Bath County will average approximately 9 to 23 days per year at or above 95°F by 2070, compared with about one day per year historically. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 2 to 5 weeks.

In the County's narrow mountain valleys, heavier rainfall can concentrate quickly in streams such as Hot Springs Run and increase the likelihood of road closures, drainage failures, and building flooding. Greater rainfall variability may also affect private wells, septic systems, stream temperature, and emergency access in areas with few alternate routes.

Needs

Bath County's flooding needs center on the recurring flooding in Hot Springs and on emergency warning across a large, rural county with limited staff and financial capacity.

Drainage and Stormwater Capacity

Hot Springs Run floods Main Street during heavy rain and can affect structures along the road. Three sources of runoff converge in the village:

- runoff from the direction of US Route 220;
- runoff from the Homestead golf course, which collects behind the former Sam Snead Tavern;
- stormwater pipes under Main Street, which clog frequently and whose discharge points are uncertain.

Buildings line both sides of the narrow valley, leaving little room for channel widening, detention, or floodplain reconnection. Along US Route 220 near Bath County High School, runoff from Roseloe Hill crosses the highway during heavy rain.

Stream and Channel Conditions

Sediment has filled Cabin Creek along Lower Yard Road in Millboro, reducing channel capacity and causing flooding near the railroad trestle. Dredging would restore capacity, but a federally protected aquatic species in the creek makes in-stream work challenging.

Streambank erosion is widespread after major storms, but most eroding banks lie on national forest, state park, or private land outside County jurisdiction. Where stabilization is warranted, County staff favor properly installed large riprap over gabion baskets, which deteriorate and can raise streambed elevations.

Emergency Warning and Access

County staff identified emergency alerting and public warning as the County's most important non-structural need. Limited cell coverage across a large, mountainous county restricts alerting, and the County is pursuing grant funding for radio towers and communications equipment. Bath and Highland Counties have jointly applied for Hazard Mitigation Grant Program (HMGP) funding to expand their flood warning network.

Staffing and Coordination

The County's Emergency Manager serves as the primary contact for emergency management, hazard mitigation, and related planning. The County relies on the Central Shenandoah Planning District Commission (CSPDC) for grant writing, plan development, and technical assistance. Bath County maintains its own emergency operations plan, which is due for a five-year update and has no debris management annex.

Resilience Actions

Table 4.6 | Bath County Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC	Regional 1; HMP BA-12
2	**Clear and map the Main Street stormwater pipes in Hot Springs,** confirm their discharge points, and establish a routine cleaning schedule.	Near	VDOT	Regional 2
3	**Obtain communications equipment for emergency alerting** in areas of the County with limited cell coverage, such as radio towers.	Mid	Highland County; VDEM	Regional 7; HMP BA-17
4	**Update the emergency operations plan and add a debris management annex** during the scheduled five-year update.	Near	VDEM	Regional 4

Additional related HMP actions: BA-5 and BA-13 (combined notification with Highland County and regional warning system), BA-9 (property-level mitigation), BA-10 (revision of Flood Insurance Rate Maps), and BA-11 (natural systems flood mitigation).



Bath County

Table 4.7 | Bath County Priority Projects

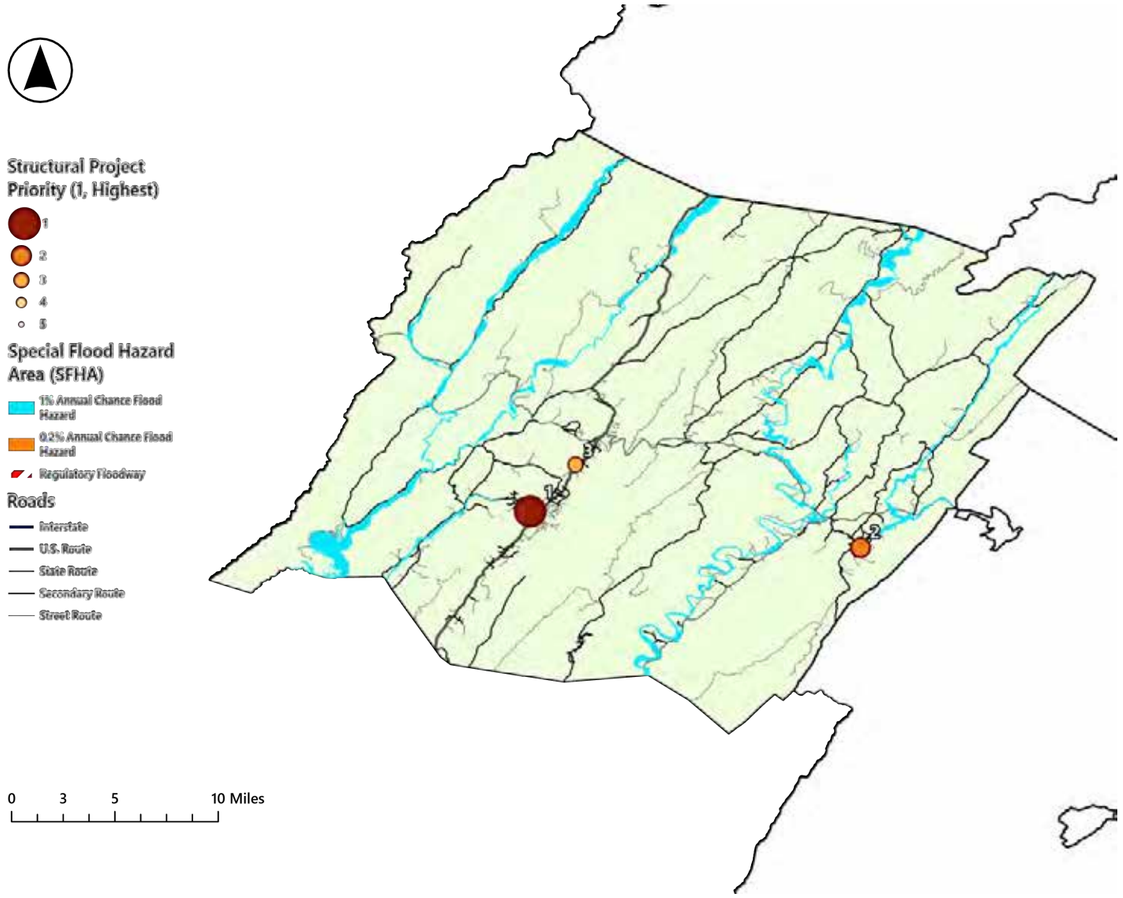
Priority	Project	Severity
1	Hot Springs Main Street Flooding Along Hot Springs Run*	HIGH
2	Lower Yard Road and Cabin Creek Channel Sedimentation Improvements	HIGH
3	Route 220 and Roseloe Lane Drainage Convergence Near Bath County High School	LOW TO MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*



Bath County

Map 4.30 | Bath County Priority Projects

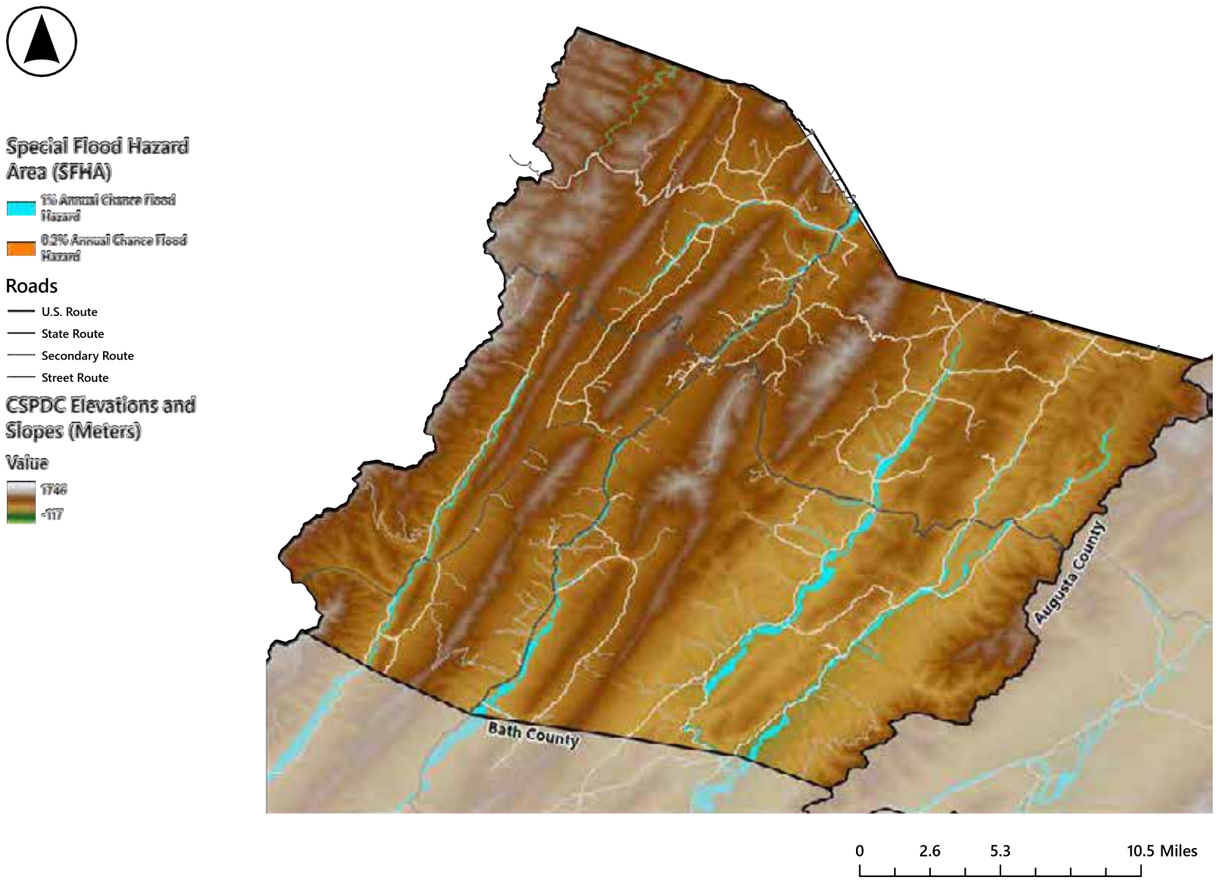


Highland County *At A Glance*

Highland County is located along the West Virginia border in the Allegheny Mountains and is Virginia's least populous county and is the smallest county by land area in the region. The County also has the highest mean elevation of any county east of the Mississippi River. The Town of Monterey is located within the County. The County contains the headwaters of both the Potomac and James River systems: the South Branch of the Potomac River rises near Hightown, and the Jackson, Cowpasture, and Bullpasture Rivers, headwater streams of the James, rise within the County.

The South Branch of the Potomac River and two of its main tributaries, Straight Fork and Laurel Fork, drain the County's northwestern section. In this section, steep, rough mountain terrain produces streams with steep gradients, narrow floodplains, and wide variation in flow. The Cowpasture River drains the eastern section, which also has rough mountain terrain, steep gradients, and narrow floodplains. The Jackson and Bullpasture Rivers drain the central and southern sections; their gradients are steep, but their floodplains are fairly wide and their flows vary less. Back Creek, a tributary of the Jackson River, drains the rugged southeastern section of the County and has wide variation in flow.

Map 4.31 | Highland County Locality Introduction



2,300
total population

5,080
acres in the 500 year floodplain

19
flood insurance policies in force

Flood History

Causes and Recurring Problems

Highland County floods primarily from flash flooding, extended intense rain, or rapid snowmelt. These floods rise with little warning and often recede within two hours, and they damage roads, stream corridors, and farm fields more often than buildings. Because the County is sparsely populated, flood damage is less visible and less consistently documented than in more developed areas, and most flood damage has affected agricultural land.

Major Events

The November 1985 Election Day Flood was the worst in the County's history. It damaged 50 homes and 300 farms, and losses totaled about $5 million, including $2.25 million in road damage and $1.67 million in agricultural losses. The Cowpasture River rose eight feet above Route 614. Floodwaters washed out the State Route 84 bridge over Back Creek at Mill Gap and broke McDowell's water lines. In April 1993, up to 6 inches of localized rain caused more damage in some areas than the 1985 flood. In January 1996, a record 30-inch snowfall melted under heavy rain, causing about $1.3 million in damage. Four months later, 6 inches of rain in four hours triggered a landslide that closed US Route 220 south of Monterey.

Recent Flooding

Winter storms in February 2003 and severe storms in June 2006 brought flooding and mudslides that led to federal disaster declarations, and the County was included in the 2012 federal disaster declaration for Hurricane Sandy. In April 2011, flooded roads and power outages led the Board of Supervisors to declare a local disaster.

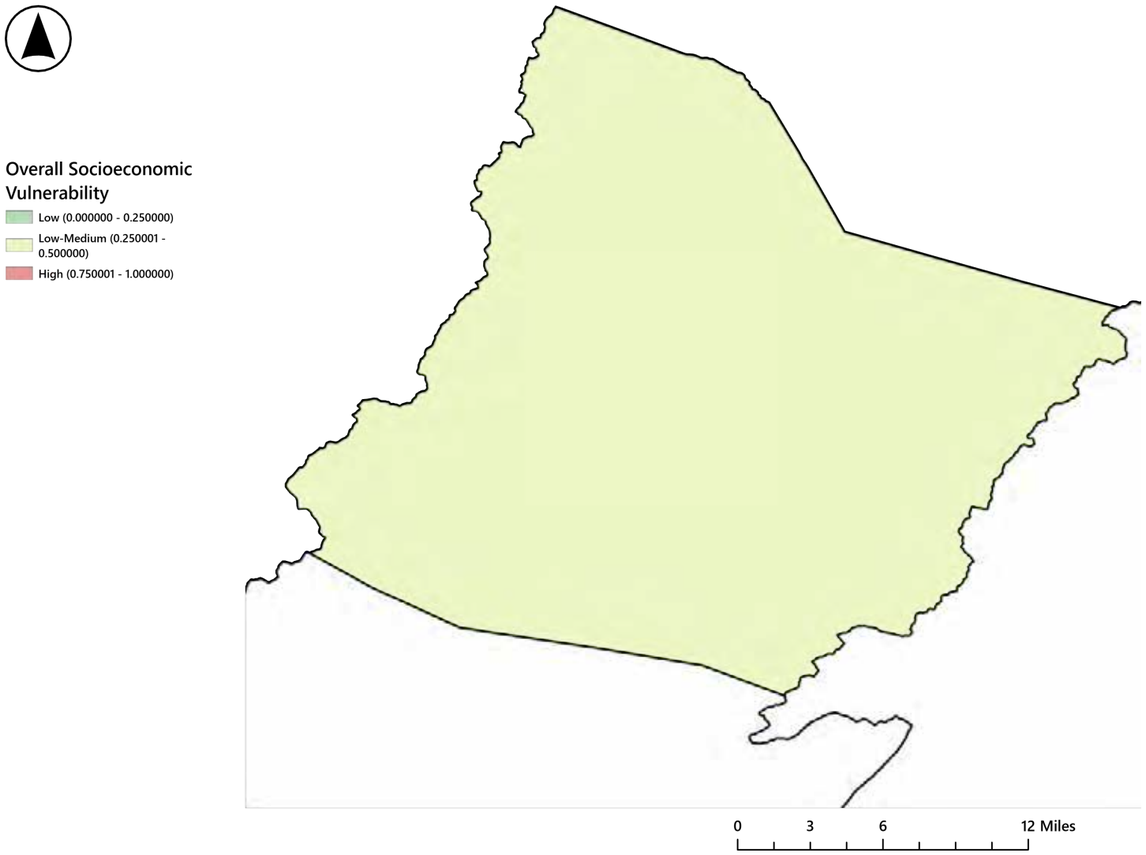


Existing Conditions

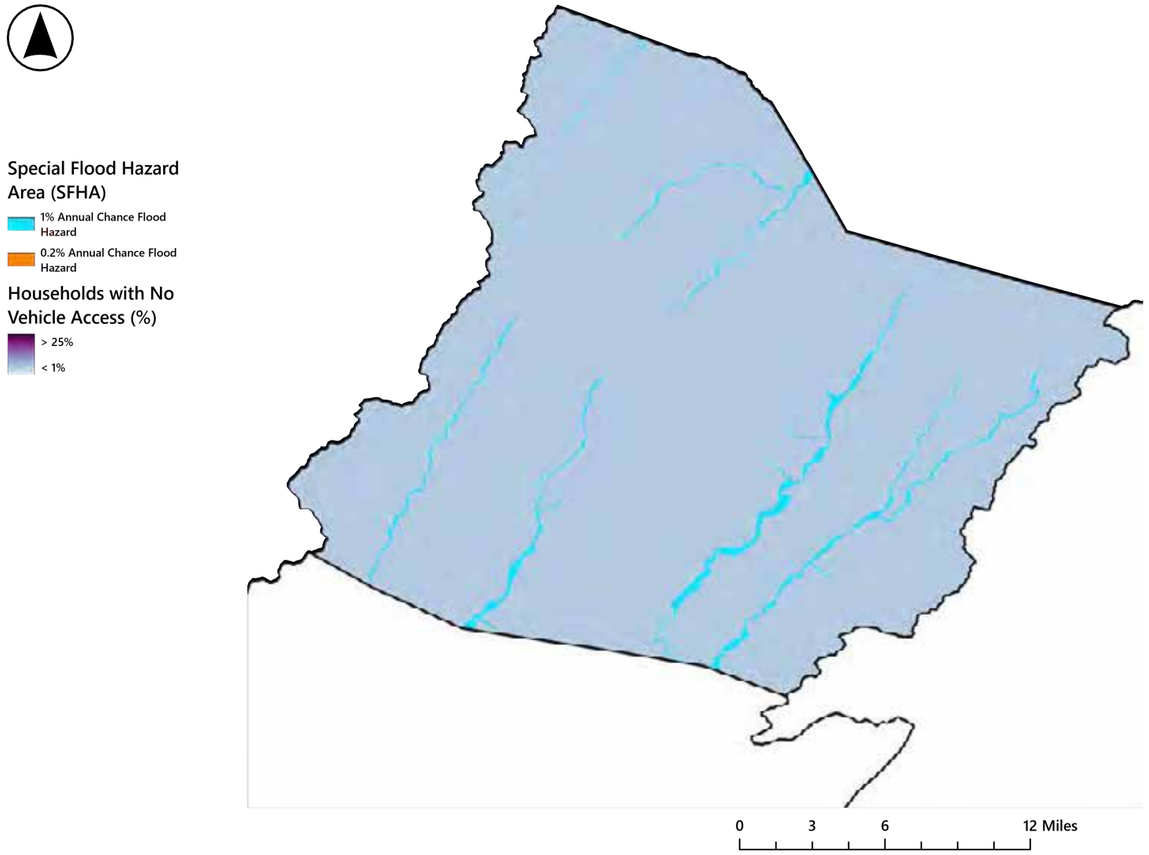
Vulnerable Populations

The maps do not show a pronounced concentration of high social vulnerability or households without vehicles. They do not, however, capture the full effect of remoteness: residents are dispersed, services are distant, and many trips depend on a small number of mountain and valley routes.

Map 4.32
Highland County Social Vulnerability Ranking by Census Tract



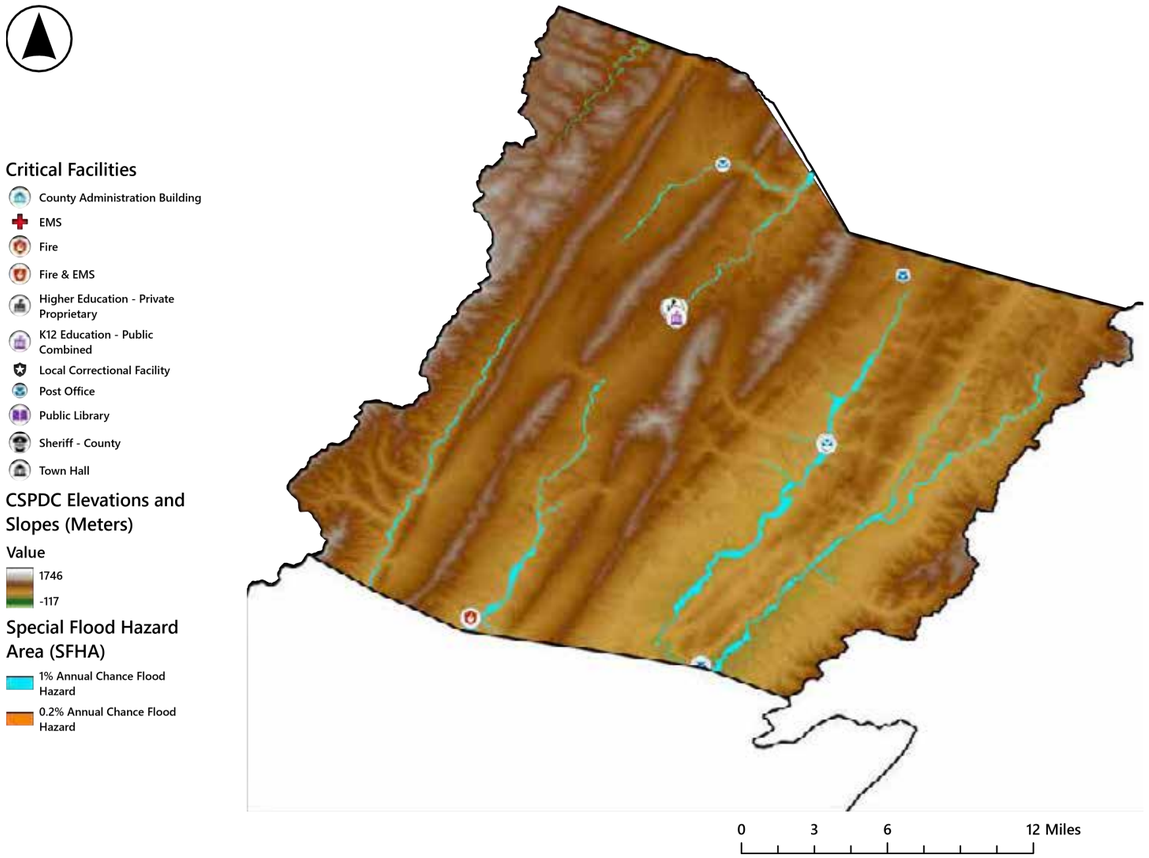
Map 4.33
Highland County Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



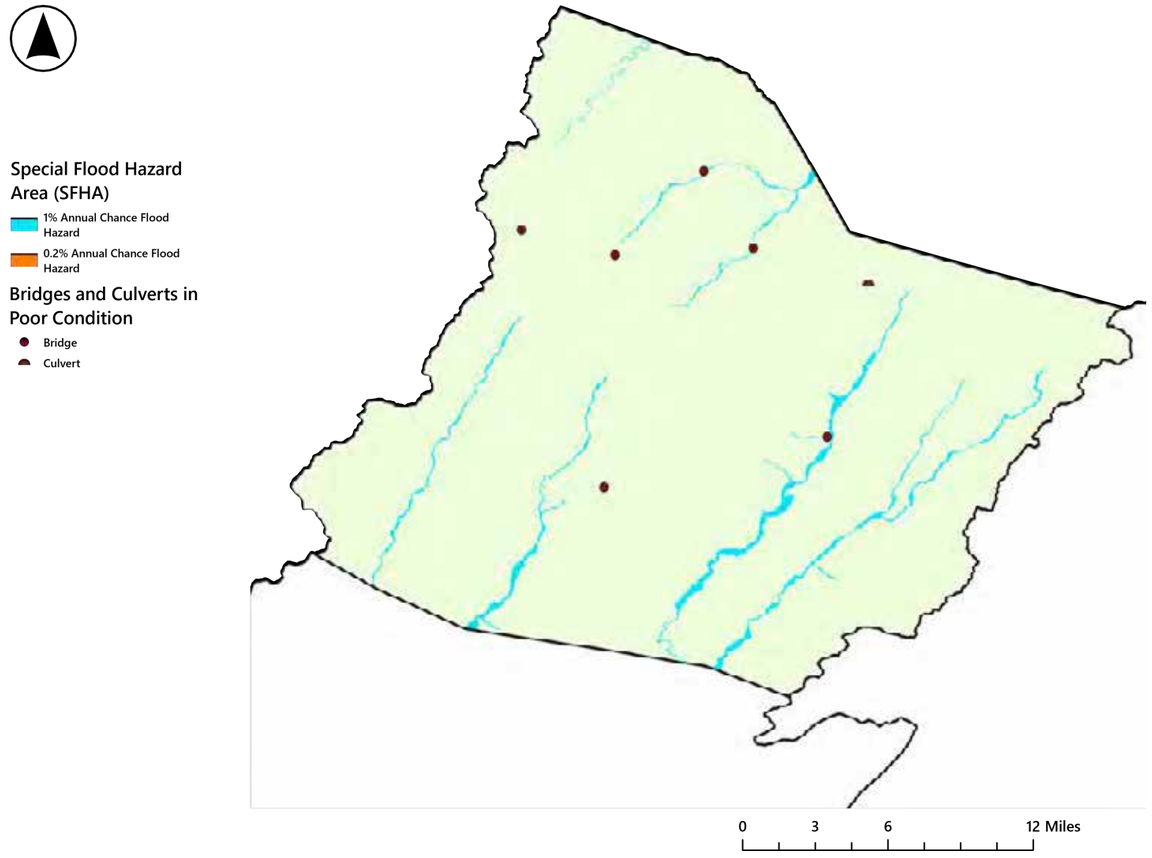
Infrastructure

Facilities, roads, and crossings are sparse and largely confined to river valleys. This reduces the number of assets directly exposed but increases the consequence of failure because alternate routes and substitute facilities are limited. Several bridge-condition concerns occur on this constrained network. The County has no repetitive-loss properties.

Map 4.34
Highland County Special Flood Hazard Areas, DEM, and Critical Facilities



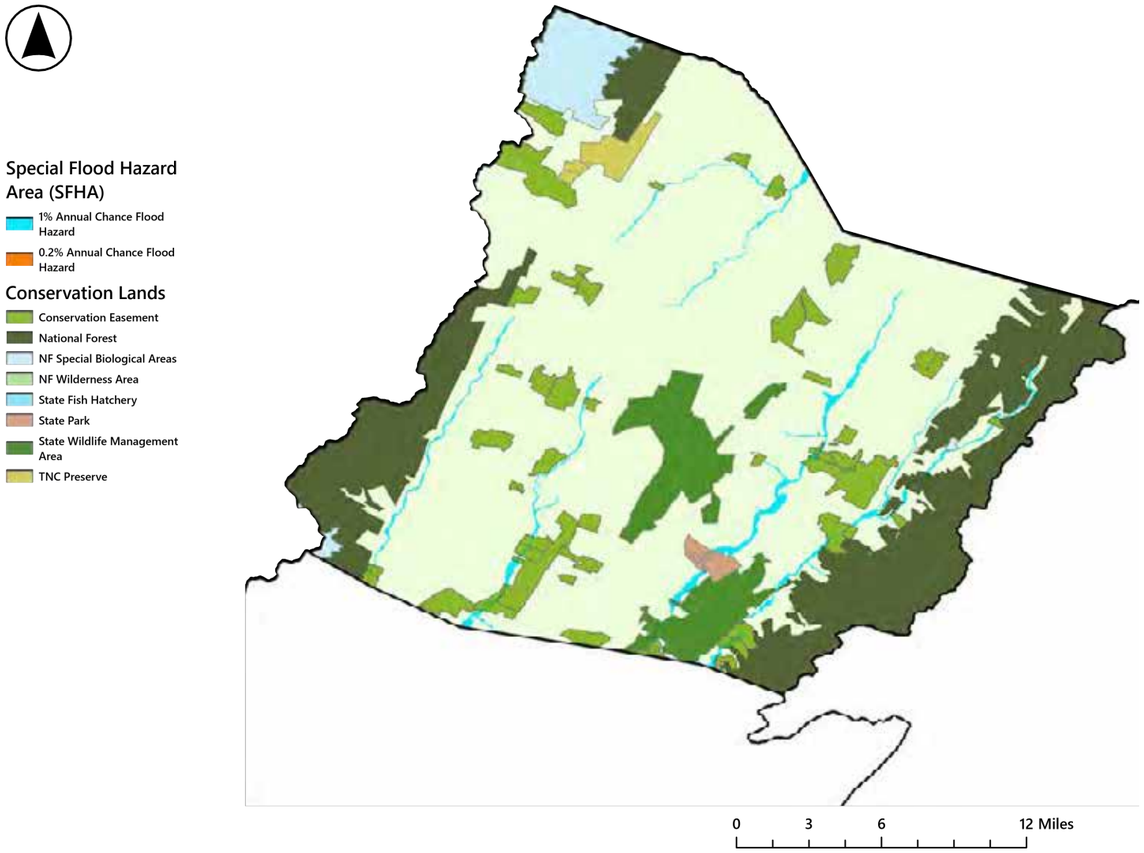
Map 4.35
Highland County Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



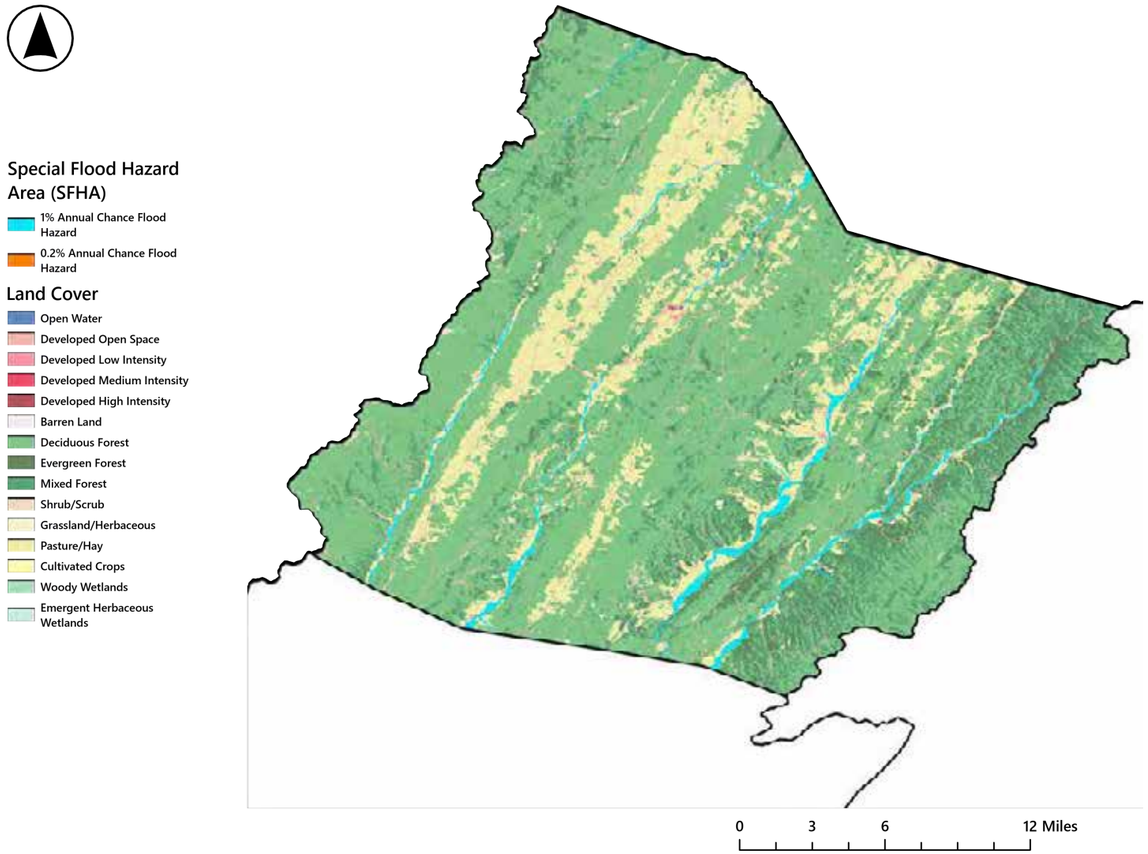
Natural Resources

Highland County's broad forest cover and high-value ecological cores are major resilience assets that slow runoff and protect steep headwaters. Maintaining forested slopes and continuous stream buffers is therefore both a conservation strategy and a direct means of protecting downstream farms, roads, and communities.

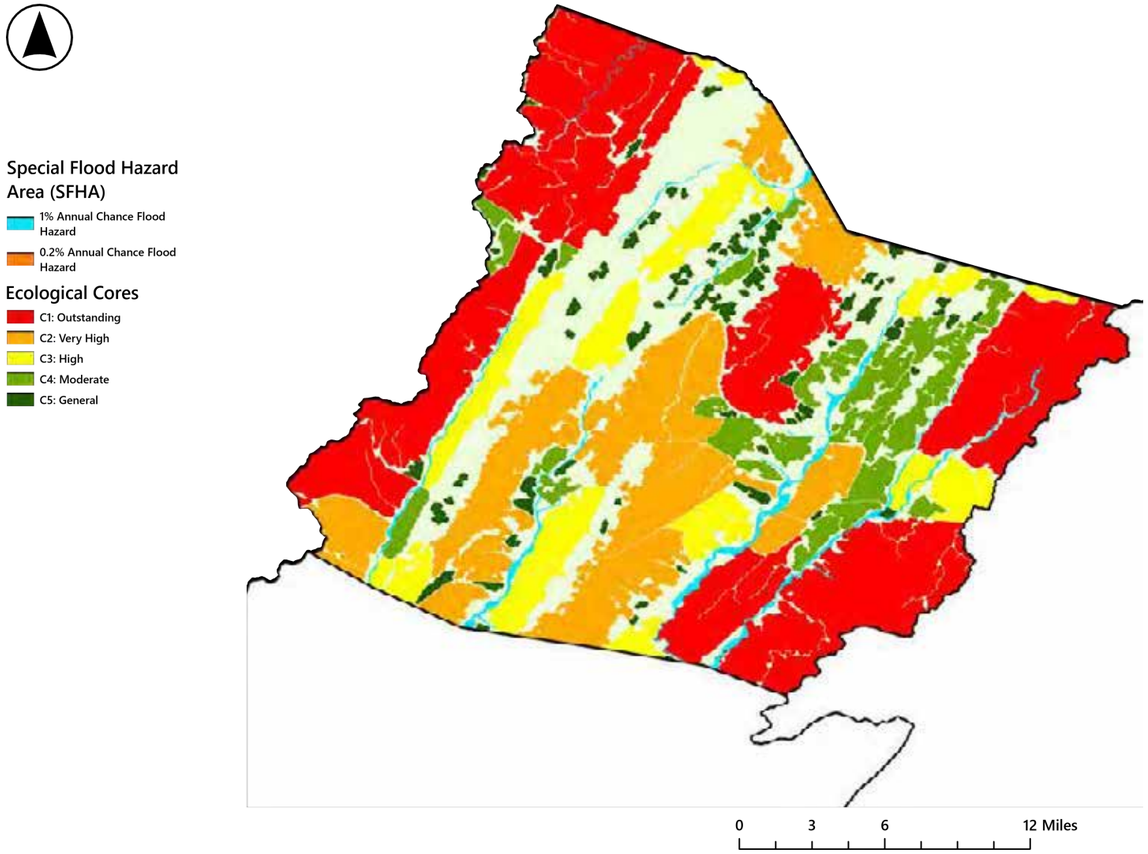
Map 4.36
Highland County Conservation Easements and Special Flood Hazard Areas



Map 4.37
Highland County Land Cover and Special Flood Hazard Areas



Map 4.38
Highland County Ecological Cores and Special Flood Hazard Areas



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Future Conditions

MARISA indicates that days at or above 95°F, historically rare in Highland County, may average approximately 3 to 11 days per year by 2070. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 5 weeks.

Heavier rainfall on steep headwater watersheds could accelerate runoff, streambank erosion, culvert overtopping, landslides, and loss of access along roads that parallel or cross mountain streams. Warmer water and shifting seasons may also affect cold-water habitat, farming, forestry, and outdoor recreation.

Needs

Highland County's needs center on roads that run alongside or cross steep mountain streams. Erosion and overtopping on these roads threaten access for residents and emergency services.

Road and Stream Corridors

Several state roads run at nearly the same elevation as adjacent stream banks. Bedrock prevents lowering stream channels at most of these sites:

- **Mill Gap Road near Valley Center Road** Hillside tributaries overwhelm undersized culverts under the road, flooding it with up to two feet of water and leaving large rocks in the roadway. East Back Creek also has eroding banks along the corridor.
- **Bluegrass Valley Road** Near New Hampden, a headwater stream of the South Branch of the Potomac River overtops the road during heavy rain.
- **Valley Center Road** The Jackson River floods the road with up to two feet of water and leaves large rocks in the roadway.
- **Cowpasture River Road (Route 614)** The river channel has migrated toward the road over time, and VDOT reports overtopping during storms as small as the 2-year event.

Drainage and Floodplain Storage

At the Frog Pond area on US Route 220 South, a concrete block culvert cannot carry flows from the surrounding low, wet bottomland, and water regularly overtops the highway. The bottomland already functions much like a wetland. Upsizing the culvert combined with wetland or floodplain storage may be feasible, depending on the willingness of the owners of at least two private parcels.

Emergency Warning and Access

Flooded or failed roads lengthen emergency response times in a County where response times are already long:

- A full failure of Mill Gap Road would reroute emergency vehicles through Meadowdale and US Route 250, adding about 25 minutes.
- Flooding on Bluegrass Valley Road forces residents onto an eight-mile detour on Straight Creek Road, adding about 20 minutes.

Because flash floods arrive with little warning, real-time monitoring is the County's main tool for advance notice. Bath and Highland Counties have jointly applied for HMGP funding to expand their flood warning network.

Staffing and Coordination

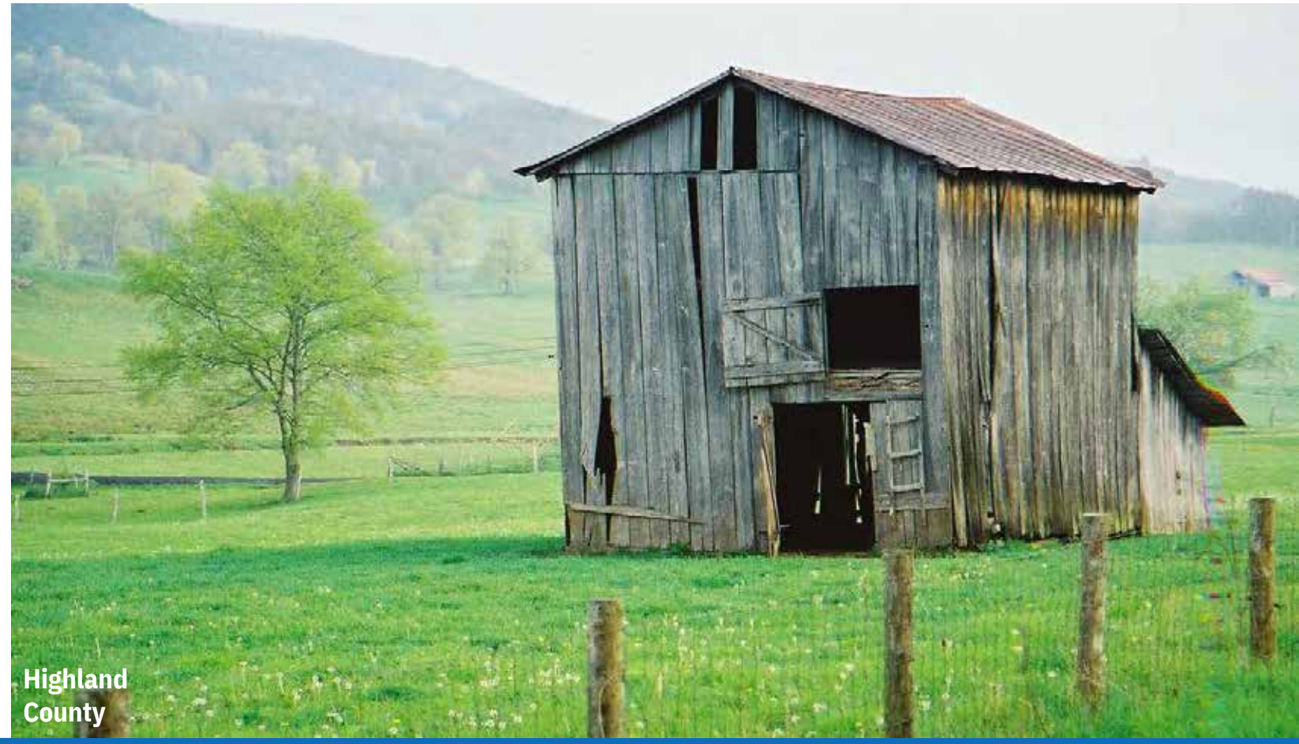
Highland County has very limited staff and relies on CSPDC and other partners for grant writing, planning, and technical assistance. The County's emergency operations plan lacks a debris management annex. Streambank erosion is widespread after major storms, but most eroding banks lie on private farmland or national forest land outside County responsibility. The regulatory status of a small private dam on a tributary near Bluegrass Valley Road remains unresolved.

Resilience Actions

Table 4.8 | Highland County Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	VDOT Staunton District; CSPDC	Regional 1, 6; HMP HI-9
2	**Prepare access plans for corridors where flooding cuts off residents,** including Mill Gap Road and Bluegrass Valley Road, and pre-plan emergency staging.	Near	VDOT; Highland County Emergency Management	Regional 7
3	**Develop a debris management annex** for the emergency operations plan.	Near	VDEM	Regional 4

Additional related HMP actions: HI-3 (emergency sheltering), HI-4 and HI-10 (combined notification and regional warning system with Bath County), HI-7 (NFIP compliance), and HI-15 (communications equipment tests).



Highland County

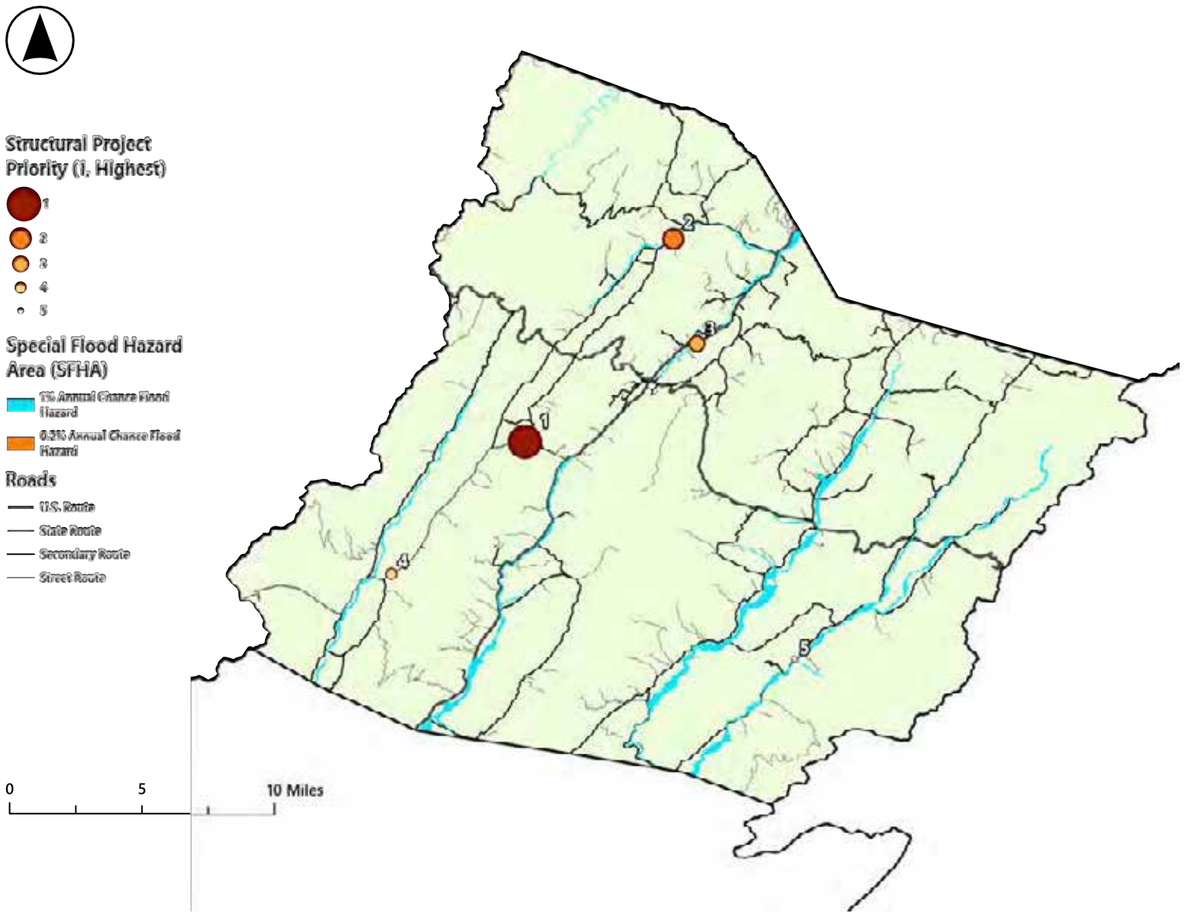
Table 4.9 | Highland County Priority Projects

Priority	Project	Severity
1	Mill Gap Road Stream Bank Erosion and Road Undermining*	HIGH
2	Bluegrass Valley Road and New Hampden Area Stream Overtopping and Road Flooding	HIGH
3	Frog Pond and US Route 220 South Culvert and Wetland Area Flooding	MODERATE
4	Mill Gap near Valley Center Road Flooding	MODERATE
5	Cowpasture River Road Channel Migration and Roadway Overtopping	MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*



Map 4.39 | Highland County Priority Projects

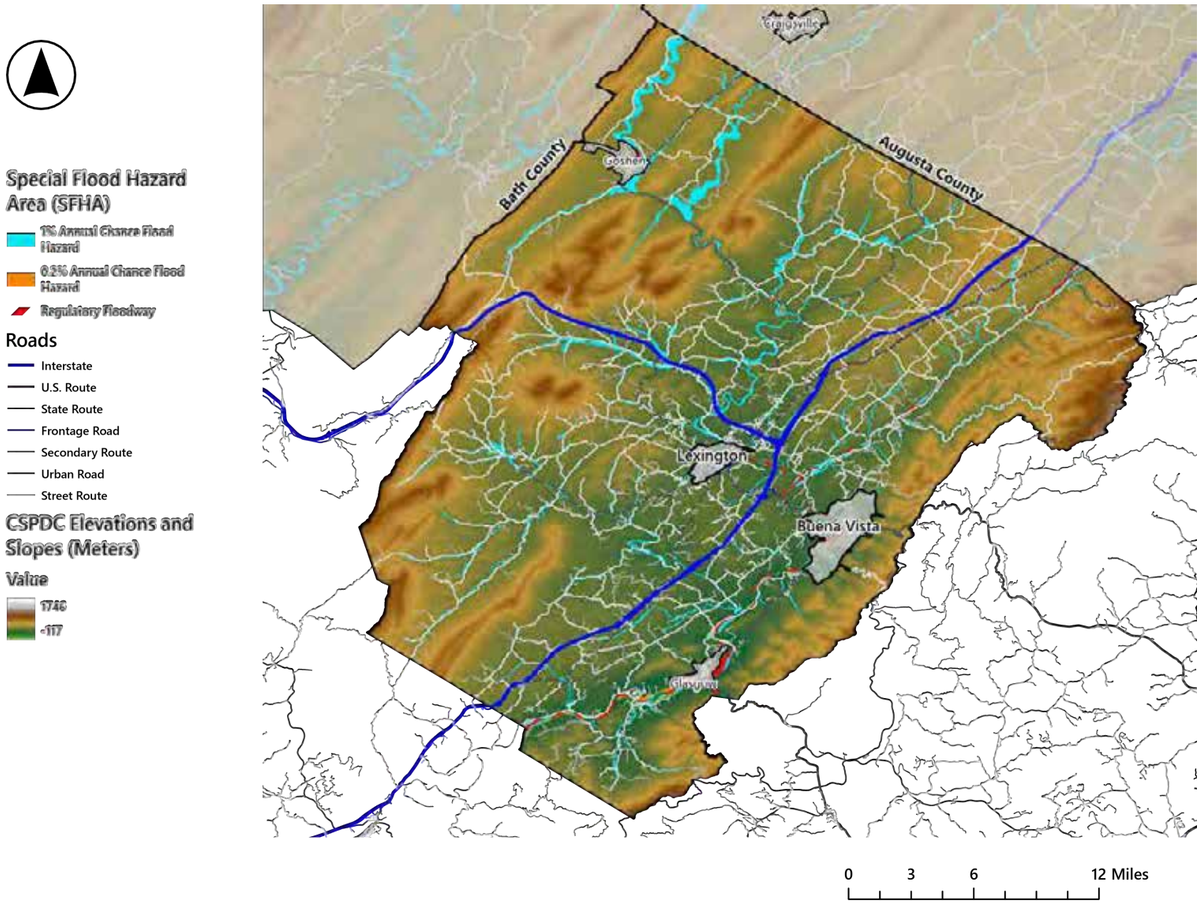


Rockbridge County *At A Glance*

Rockbridge County is located in the southern part of the region and borders Augusta, Bath, Alleghany, Botetourt, Amherst, and Nelson Counties. The County surrounds the independent Cities of Lexington and Buena Vista and includes the Towns of Glasgow and Goshen. With about 600 square miles of land, Rockbridge is the region's third-largest county by area.

The entire County lies within the James River drainage basin. The Maury River is one of the few rivers in Virginia that both begins and ends within a single locality. It forms within the County and travels about 50 miles past Goshen, Lexington, and Buena Vista to Glasgow, where it joins the James River, which crosses about 10 miles of the County's southeastern portion. Buffalo Creek, the South River, the Little Calfpasture River, and the Calfpasture River originate in the surrounding mountains and flow into the Maury. Irish Creek flows into the South River, and Mill Creek, which passes through Goshen, is a major tributary of the Calfpasture River.

Map 4.40 | Rockbridge County Locality Introduction



22,542
total population

18,596
acres in the 500 year floodplain

96
flood insurance policies in force

Flood History

Causes and Recurring Problems

Flooding in the unincorporated County is largely confined to land immediately along rivers and streams, where fast-moving water and heavy debris cause most of the damage. Development in these areas is sparse and mostly low-density residential and farm use. The County's greatest flood exposure is near Buena Vista, Glasgow and Goshen, which are built in low areas. After repeated flooding in 1969, 1985, and 1996, many owners of the most vulnerable properties sold, relocated, or chose not to rebuild, and the County completed voluntary acquisitions with FEMA funds.

Major Events

The first recorded flood within the County was in 1771 when the area was still part of Augusta and Botetourt Counties. Another major flood of the Maury River occurred in 1847, then again in 1870. The 1870 flood did serious damage to the industries on Jordan's Point in Lexington, isolating the City for over a week. Other major floods occurred in 1889, 1935, and 1936. A 1950 flood caused severe damage to the Whistle Creek, Kerrs Creek and Buffalo Creek areas.

Hurricane Camille in 1969 killed 23 people in the County, most of them along the South River and Irish Creek in the eastern County, and washouts and mudslides closed 15 state roads. In 1972, intense rainfall from Tropical Storm Agnes caused widespread flooding, but only moderate damage compared with Camille. The November 1985 Election Day Flood, driven by the remnants of Hurricane Juan, was the most destructive event on record. It damaged 584 homes and 32 businesses across the County and caused an estimated $236 million in damage in 2019 dollars. In Buena Vista, more than half of the homes and businesses were damaged; in Glasgow, about 40 percent of the homes and 70 percent of the businesses; and in Goshen, numerous homes and the Stillwater plant. Floods in June 1995 and January and September 1996 followed.

Recent Flooding

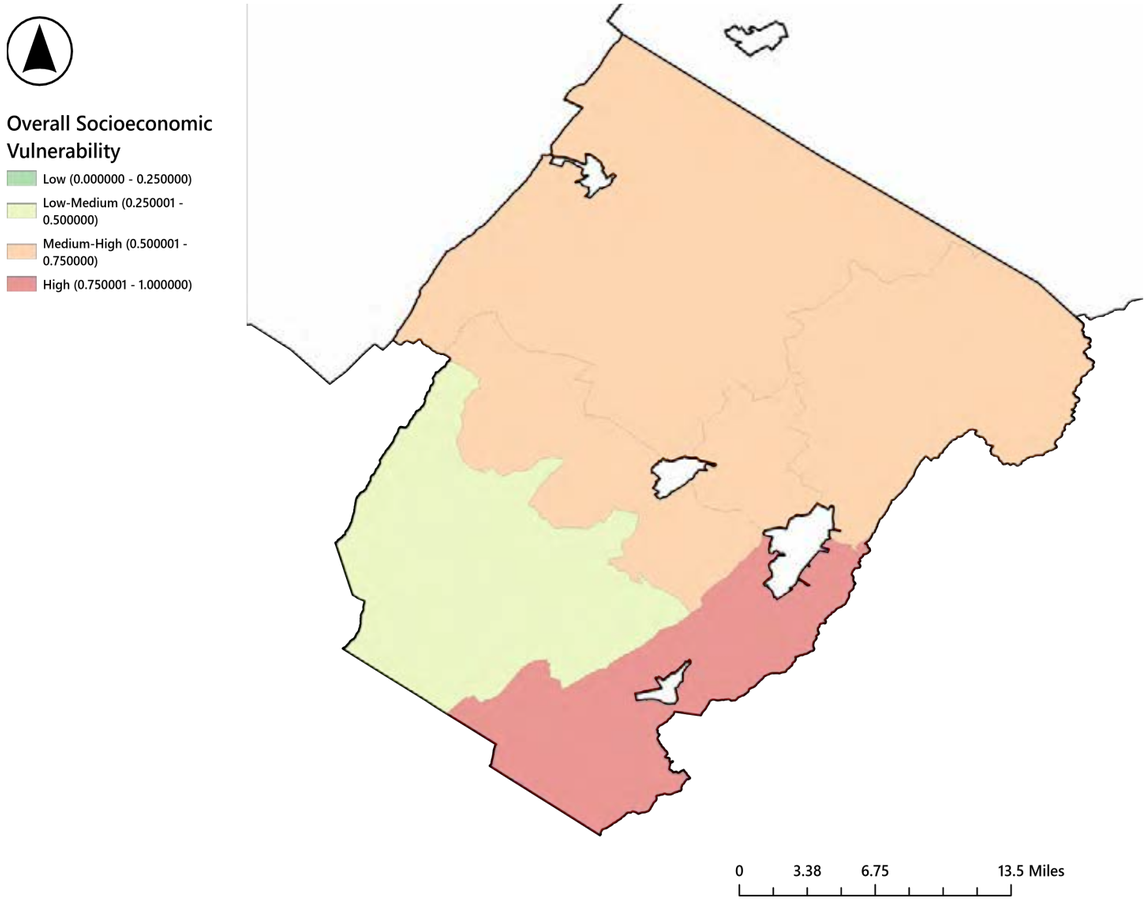
In April 2011, heavy rain closed as many as 33 roads, required a swift-water rescue on Furrs Mill Road, and brought the Maury River near flood stage at Glasgow. Recent flooding in the unincorporated County has generally been localized, including chronic ponding along State Route 130 at the Glades.

Existing Conditions

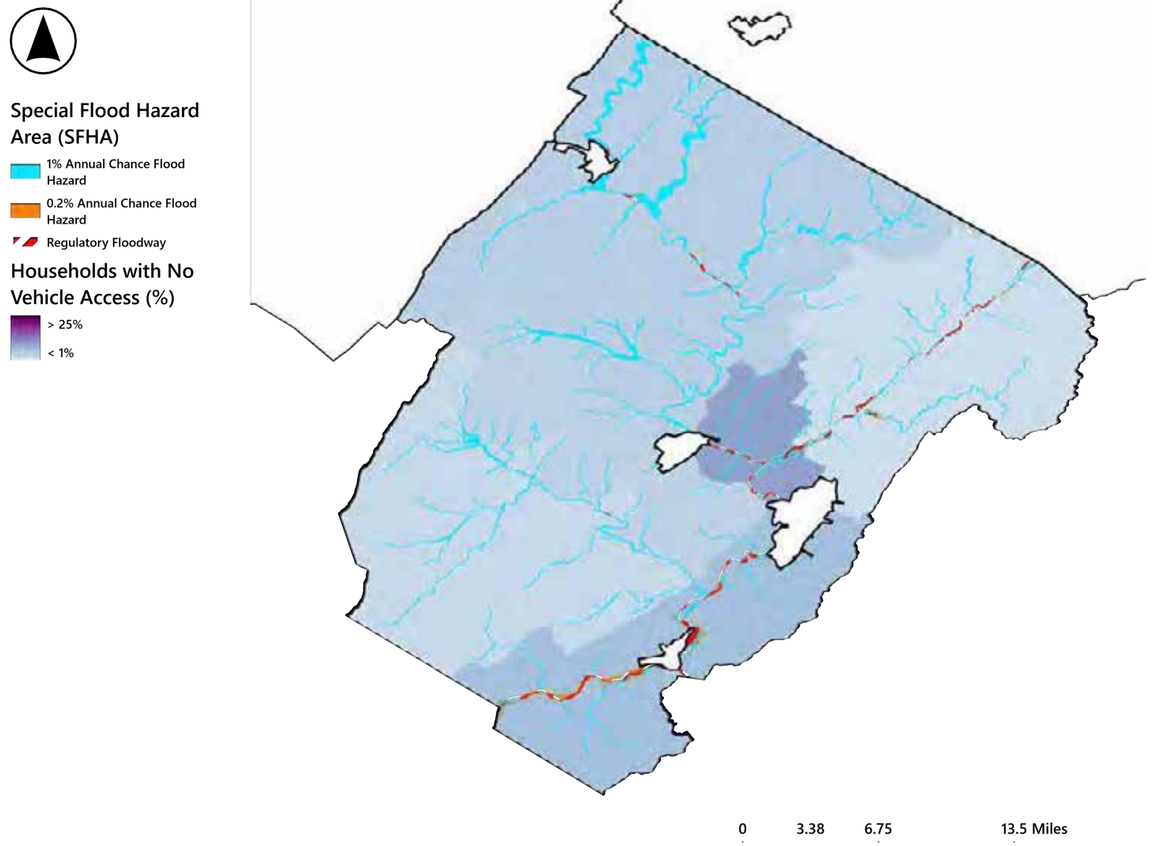
Vulnerable Populations

Higher social vulnerability appears in the southern county and around the Lexington–Buena Vista area, while vehicle limitations are more evident near the cities and in portions of the southern valleys. These concentrations intersect river corridors and a road system with limited cross-valley alternatives.

Map 4.41
Rockbridge County Social Vulnerability Ranking by Census Tract



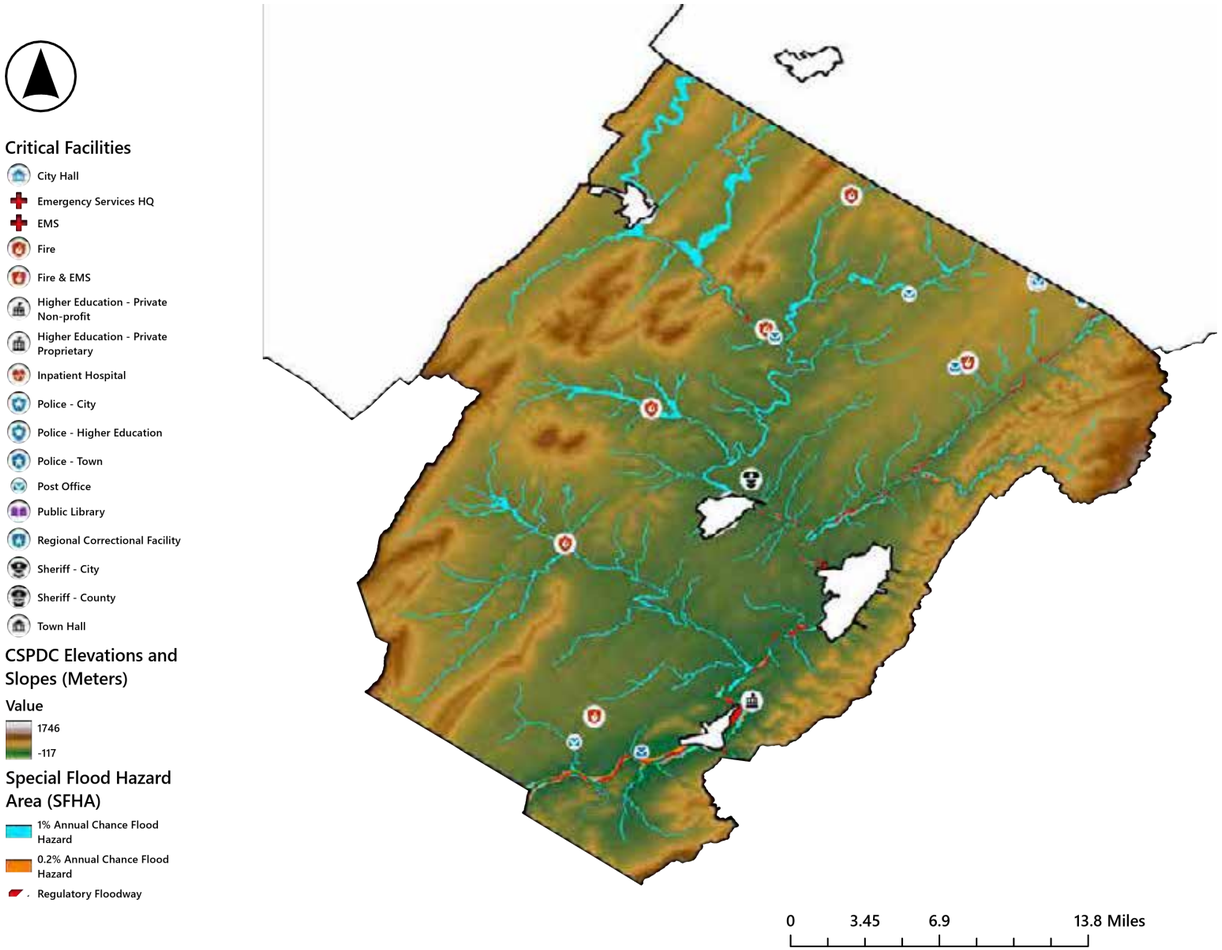
Map 4.42
Rockbridge County Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



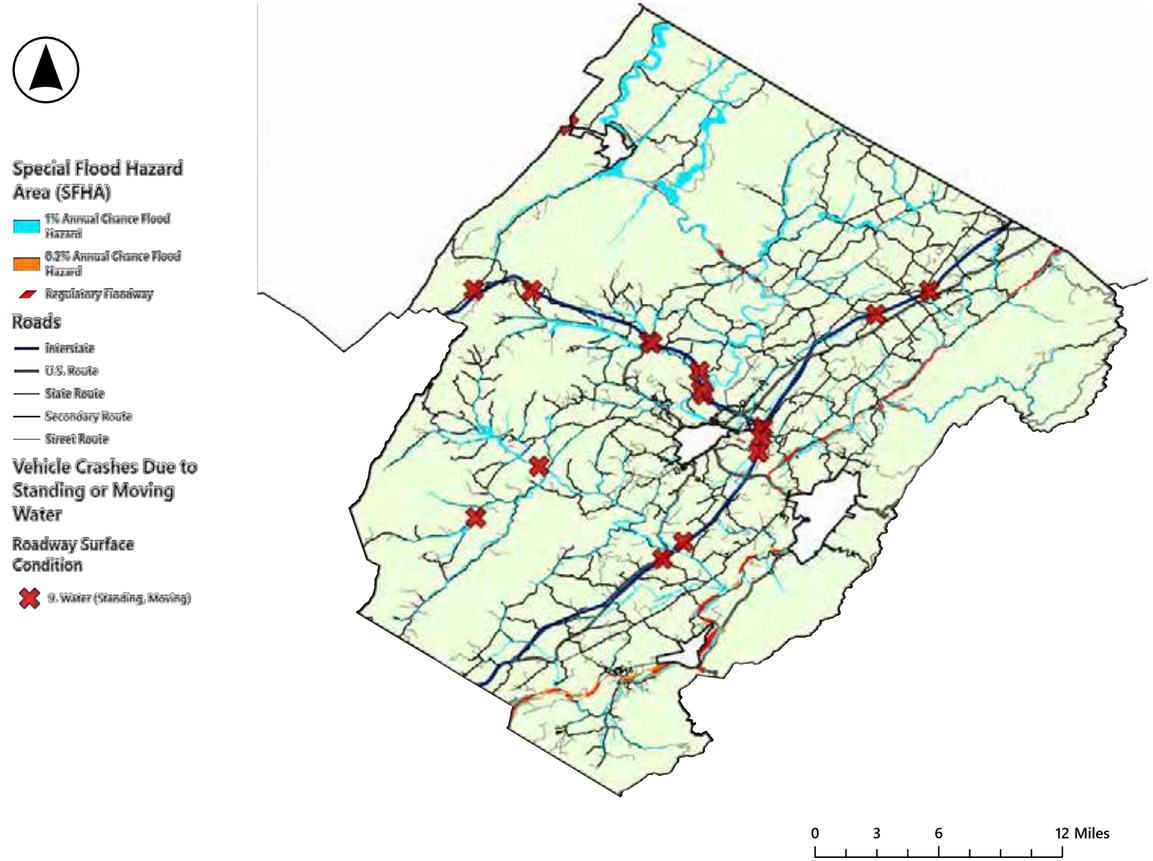
Infrastructure

Critical facilities cluster around Lexington, Buena Vista, and established valley communities, while bridge-condition and crash concerns occur at crossings of the Maury and James Rivers and their tributaries. Dam inundation areas also follow portions of these principal corridors. The combined pattern indicates a regional access problem: flooding or bridge disruption can sever connections between rural areas and the County's service centers. The County has 14 repetitive-loss and 7 severe repetitive-loss properties.

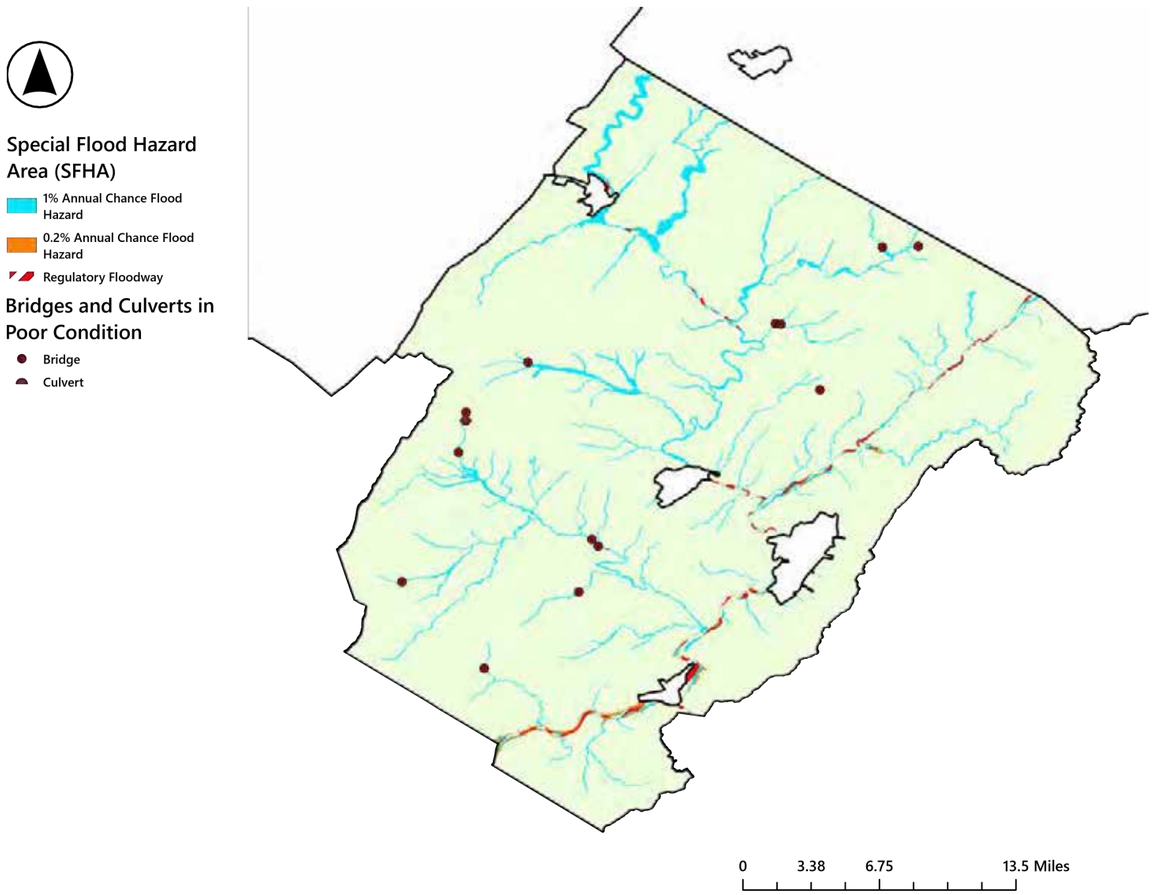
Map 4.43
Rockbridge County Special Flood Hazard Areas, DEM, and Critical Facilities



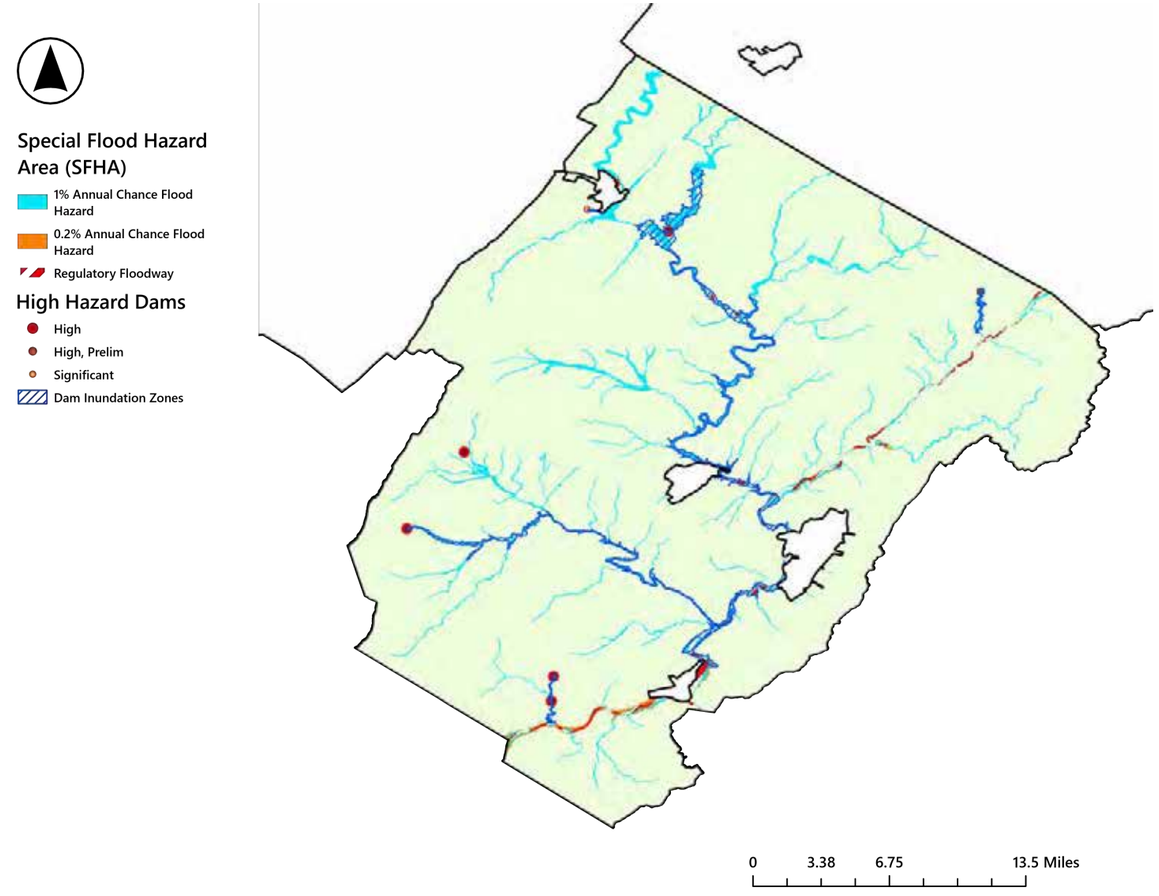
Map 4.44
Rockbridge County Crashes Due to Standing or Moving Water (VDOT), Roads, and Special Flood Hazard Areas



Map 4.45
Rockbridge County Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



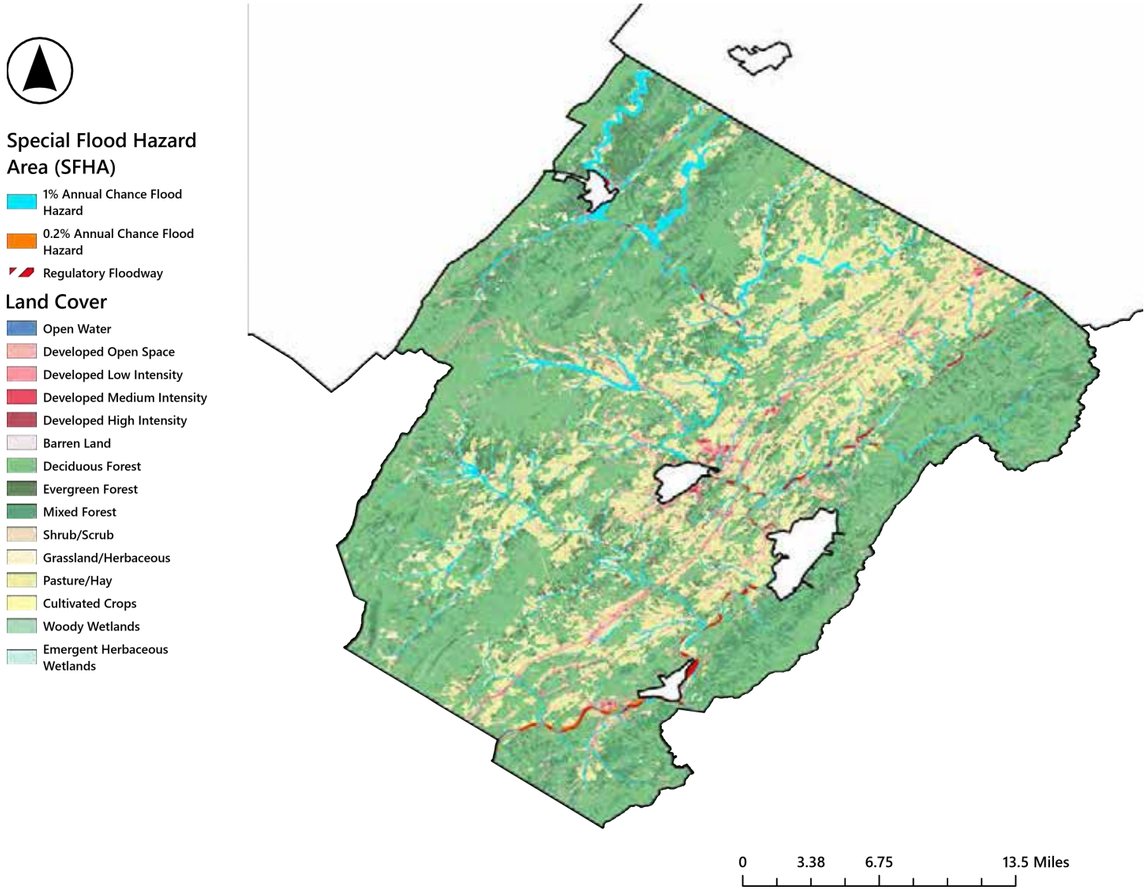
Map 4.46
Rockbridge County Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



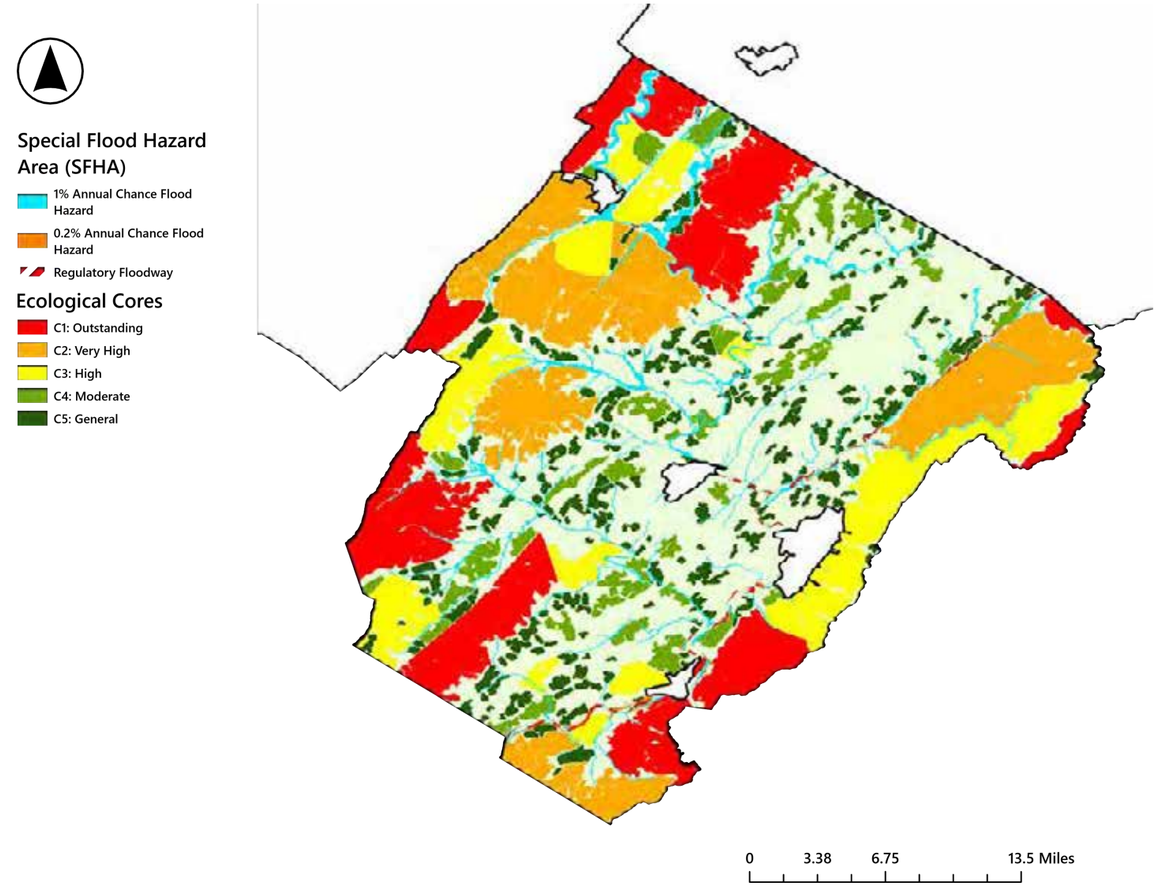
Natural Resources

About 25 percent of the County's land is public, which is the smallest percentage in the CSPDC region among counties. Forested ridges and high-value ecological cores surround the County, while agricultural and developed valleys follow the Maury, James, and tributary floodplains. Many of the valley corridors have less conservation protection than the uplands areas.

Map 4.47
Rockbridge County Land Cover and Special Flood Hazard Areas



Map 4.48
Rockbridge County Ecological Cores and Special Flood Hazard Areas



Future Conditions

MARISA projects that Rockbridge County will average approximately 18 to 37 days per year at or above 95°F by 2070, compared with about two days per year historically. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 2 to 5 weeks. Heavier rainfall could increase riverine flooding along the Maury, James, and South Rivers and intensify localized drainage problems, erosion, sediment movement, and road closures. Karst terrain and dispersed rural development may complicate stormwater management and emergency access.

Needs

Rockbridge County has few structural flood problems in its unincorporated areas. The County's most significant needs include one drainage problem, watershed-scale coordination, and more accurate floodplain mapping.

Drainage and Stormwater Capacity

At the Glades in Natural Bridge Station, water ponds chronically along State Route 130. The ponding results from four conditions: shallow ditches, undersized and inconsistent driveway culverts, limited grade, and fragmented property ownership. An engineering assessment is needed to compare coordinated ditch and culvert upgrades with a subsurface conveyance alternative.

Watershed Conditions

Sediment and debris from the Little Calfpasture River watershed, which originates in Augusta County, are filling Lake Meriwether. Addressing the problem will require coordination with Augusta County, potentially through wetland restoration or riparian improvements upstream.

Critical Facilities

The County has secured $3 million in congressionally directed funding to relocate the Maury Service Authority water intake out of the floodplain, and the project is under way.

Data and Planning

The County's flood maps were last significantly updated in 2000. Detailed studies cover the South River, portions of Irish Creek, and the Maury River in populated areas. However, rural reaches, including the Maury River between Goshen and Lexington, rely on approximate Zone A mapping, and County staff using LIDAR terrain data have found clear inconsistencies between Zone A boundaries and actual ground elevations.

Staffing and Procedures

Rockbridge County has several aspects of its floodplain program that are above minimum state standards. The County requires elevation certificates for all Zone A development and tracks floodplain determinations and map amendments in GIS. The County ordinance includes substantial damage requirements, but the County has no written procedure for tracking cumulative improvements.

The County's building official also serves as floodplain agent for Glasgow and informally for Goshen. The joint emergency operations plan with Lexington and Buena Vista includes a debris management annex.

Resilience Actions

Table 4.10 | Rockbridge County Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A. The 10% design concept addresses ponding along State Route 130 at the Glades.	Mid	VDOT; property owners; CSPDC	Regional 1, 6; HMP RB-8
2	**Coordinate with Augusta County on Lake Meriwether sedimentation,** since the sediment originates in the Augusta County portion of the Little Calfpasture watershed.	Long	Augusta County; Natural Bridge SWCD; Headwaters SWCD	Regional 1, 8; HMP RB-5
3	**Assist with relocation of the Maury Service Authority water intake** out of the floodway.	Near	Maury Service Authority	Regional 7

Additional related HMP actions: RB-3 (joint emergency operations plan), RB-6 (water monitoring), RB-7 (refinement of FIRM data in Zone A areas), RB-9 (dam emergency action plans), and RB-18 (Cedar Creek dam removal).



Rockbridge County

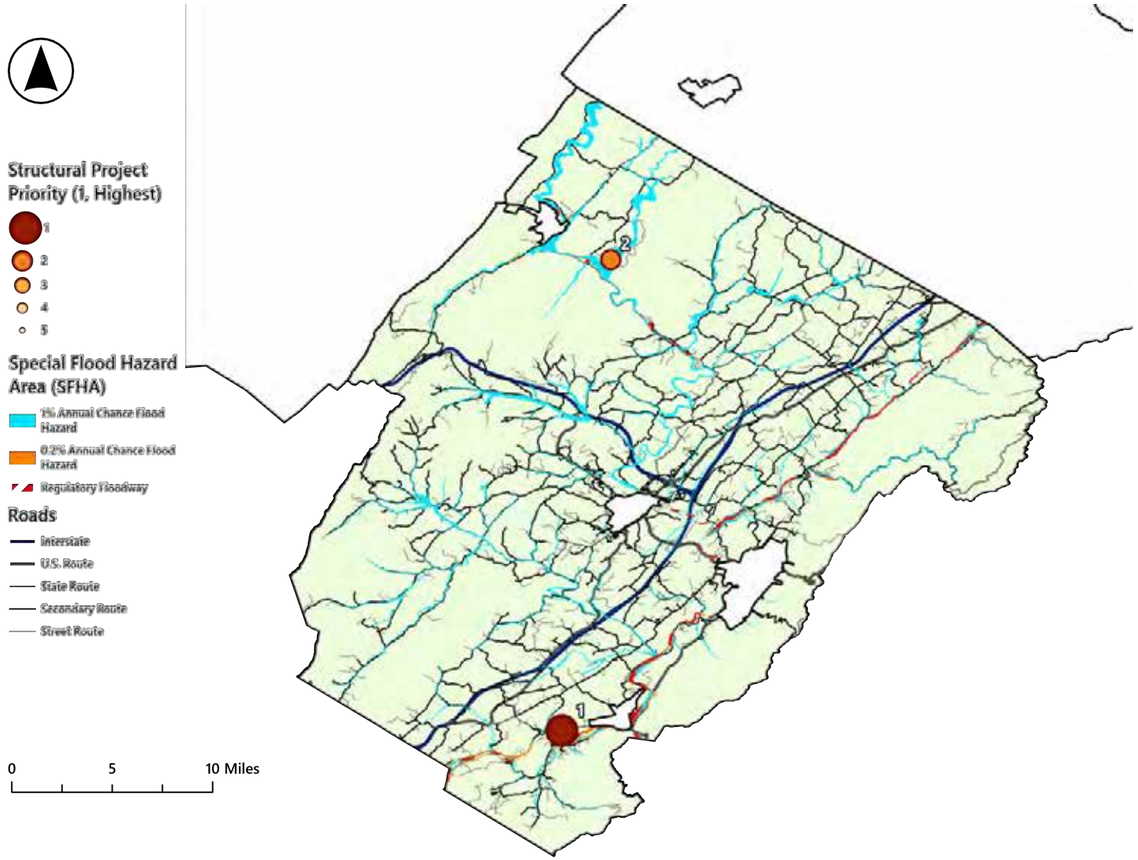
Table 4.11 | Rockbridge County Priority Projects

Priority	Project	Severity
1	The Glades at Natural Bridge Station Drainage Improvements — Route 130*	MODERATE
2	Watershed-Scale Coordination — Lake Meriwether and Little Calfpasture River Sediment and Water Quality	MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*



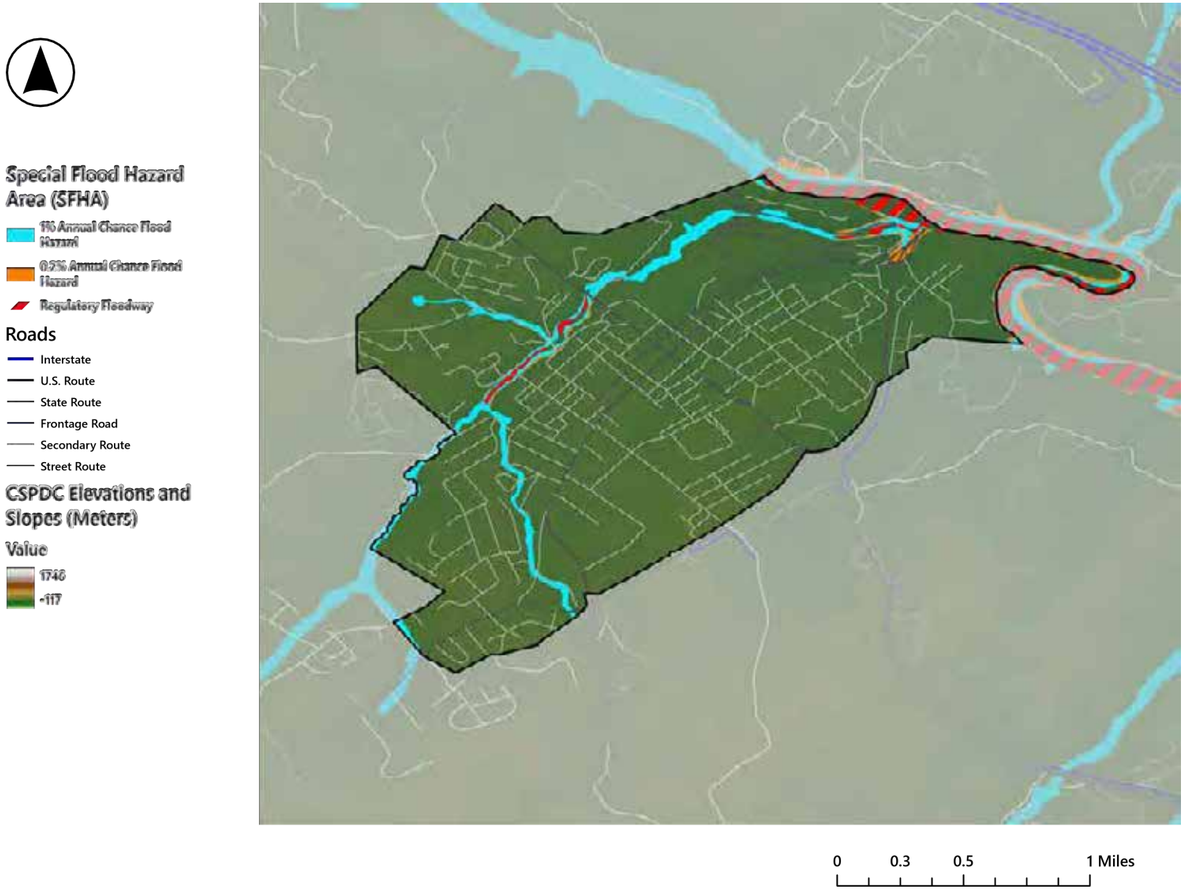
Map 4.49 | Rockbridge County Priority Projects



City of Lexington *At A Glance*

The City of Lexington is an independent city surrounded by Rockbridge County and is home to Washington and Lee University and the Virginia Military Institute. Like the rest of the Rockbridge area, Lexington lies within the James River drainage basin. The Maury River passes along the City's northern edge, and Woods Creek, a small tributary of the Maury, flows through the western part of the City before joining the river. Stormwater from across the City flows downhill toward the Maury River and Woods Creek and converges at several low points.

Map 4.50 | City of Lexington Locality Introduction



7,519
total population

107
acres in the 500 year floodplain

9
flood insurance policies in force

Flood History

Causes and Recurring Problems

Riverine flooding affects low-lying areas along the Maury River and Woods Creek, but most of Lexington's recurring flood problems stem from local drainage. Runoff converges at low points such as Jefferson and North Main Streets, where aging and buried drainage systems lack capacity. Tropical storms produce the largest river floods, typically from June through November, and frontal systems bring flooding in spring and fall.

Major Events

The 1870 flood destroyed industries at Jordan's Point, swept away several houses, and isolated the City for more than a week. In March 1936 during the "Great Spring Flood," the Maury River rose 20 feet above normal and forced evacuations. Hurricane Camille in 1969 and the November 1985 Election Day Flood both inundated the sewage treatment plant at Jordan's Point. In June 1995, back-to-back storms severely damaged two houses along the Maury River, which were later demolished. Flooding in 1995 and 1996 together caused more than $100,000 in damage.

Recent Flooding

Recent flooding in Lexington has been localized, affecting streets and properties at drainage low points rather than producing widespread riverine damage.



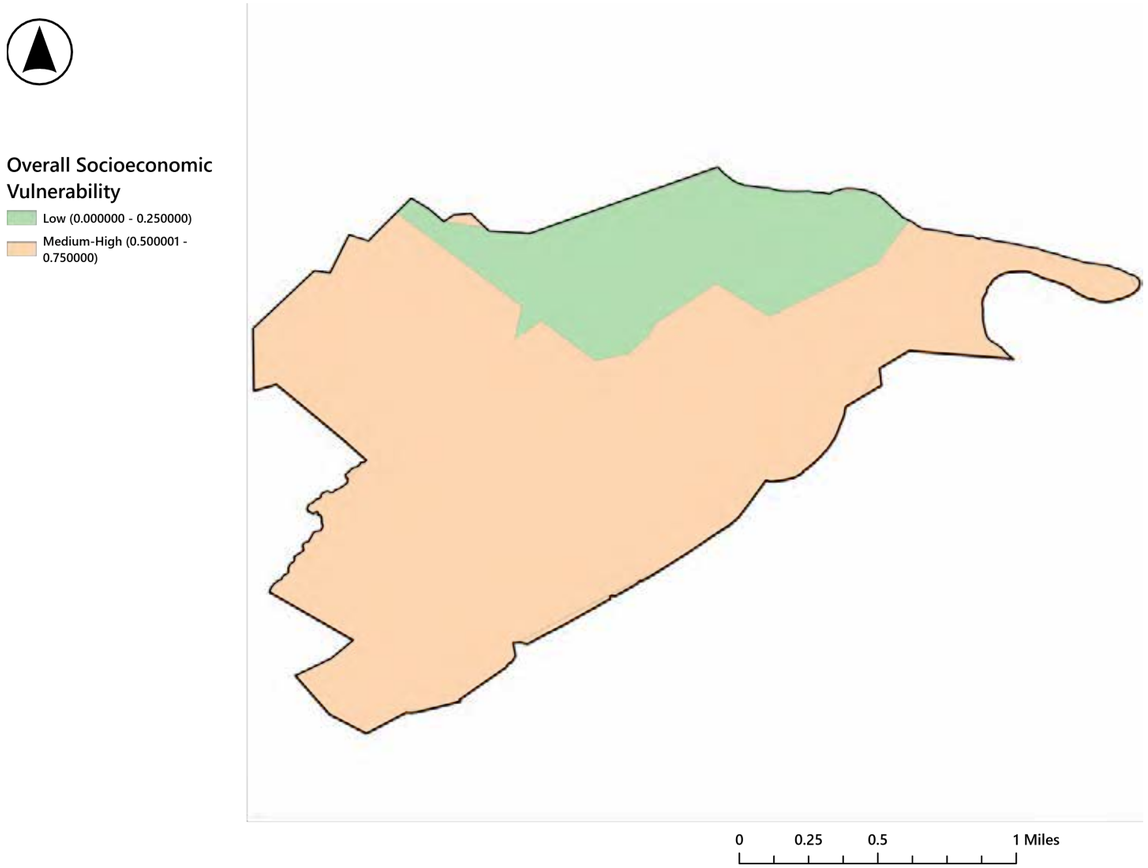
City of Lexington

Existing Conditions

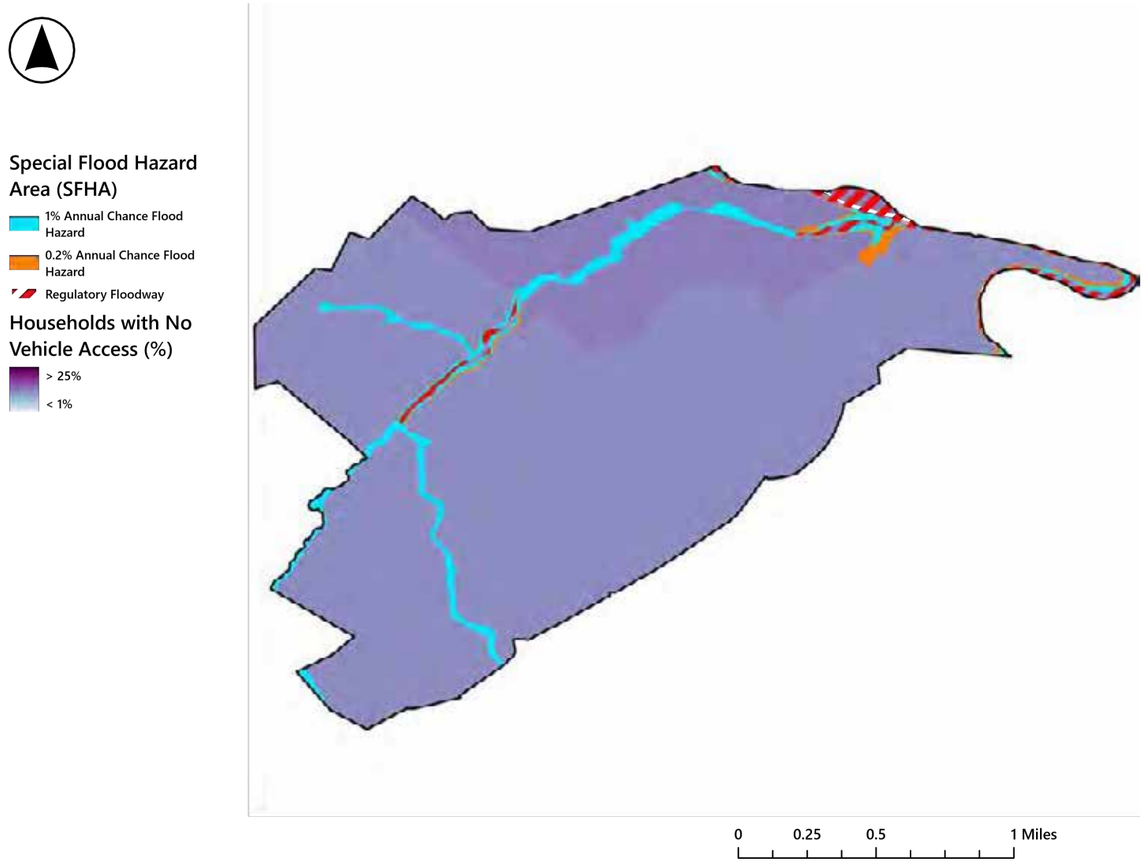
Vulnerable Populations

The maps indicate greater social vulnerability in the southwestern and central portions of Lexington. The Maury River and smaller drainage corridors constrain movement through a compact urban area, so residents without vehicles or with limited resources may have fewer options when a crossing or route is disrupted.

Map 4.51
City of Lexington Social Vulnerability Ranking by Census Tract



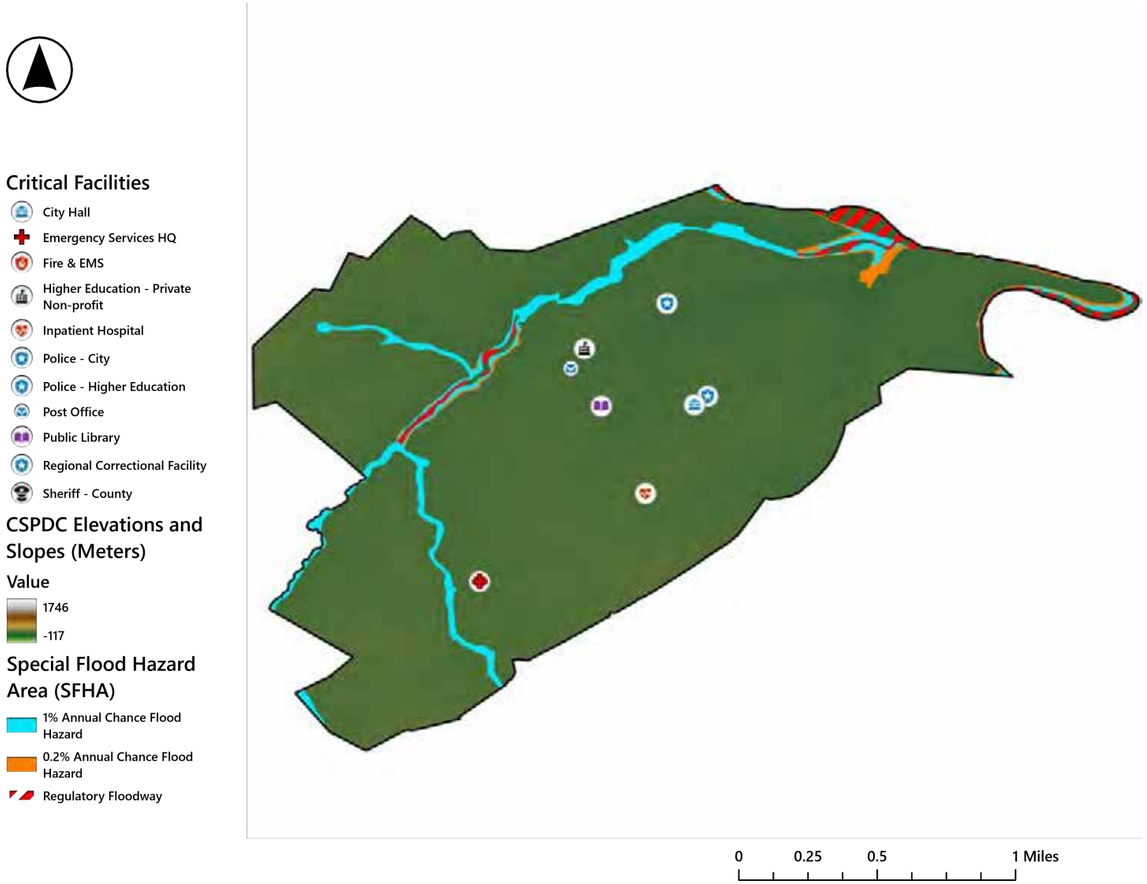
Map 4.52
City of Lexington Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



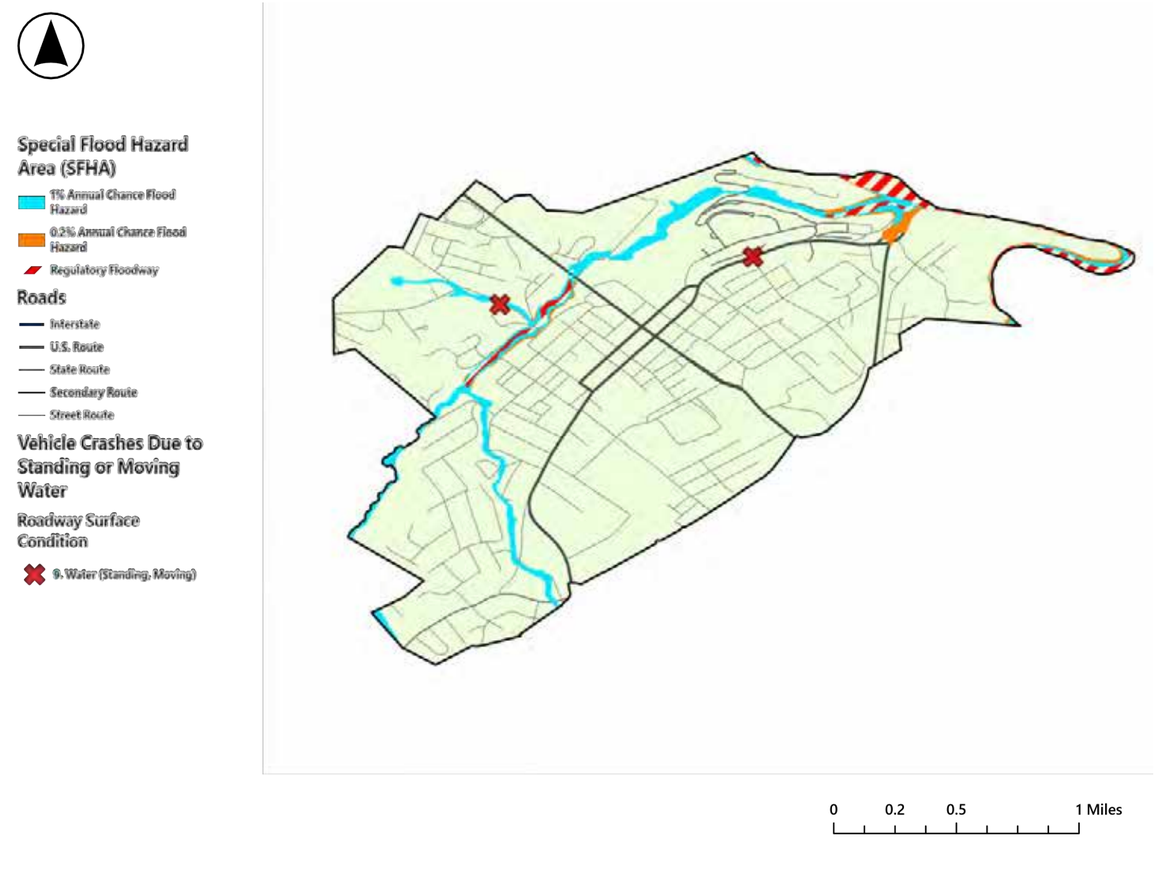
Infrastructure

Most critical facilities occupy the developed upland core, but access to them depends on approaches and crossings near the Maury River and local streams. Bridge and roadway concerns are concentrated along the eastern river corridor and connecting routes. The resilience issue is therefore continuity of access: facilities may remain operational while employees, responders, or residents cannot reach them.

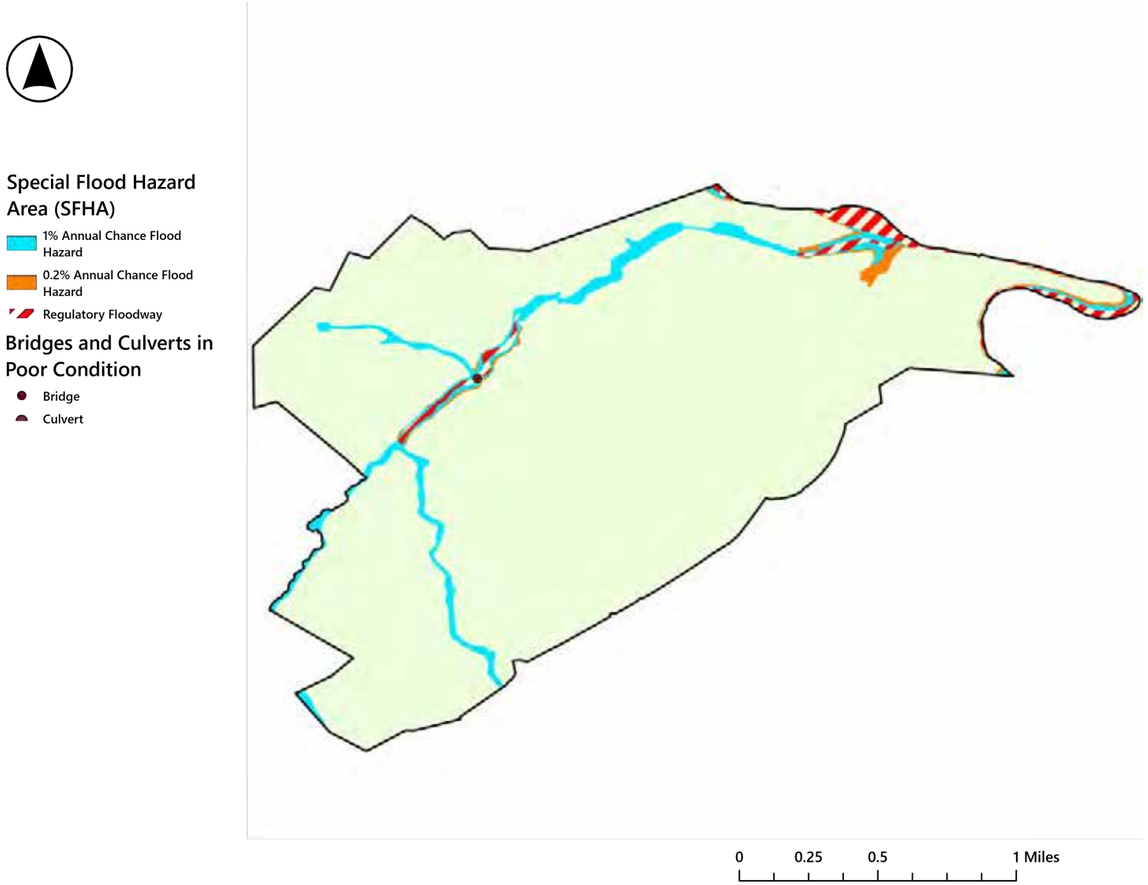
Map 4.53
City of Lexington Special Flood Hazard Areas, DEM, and Critical Facilities



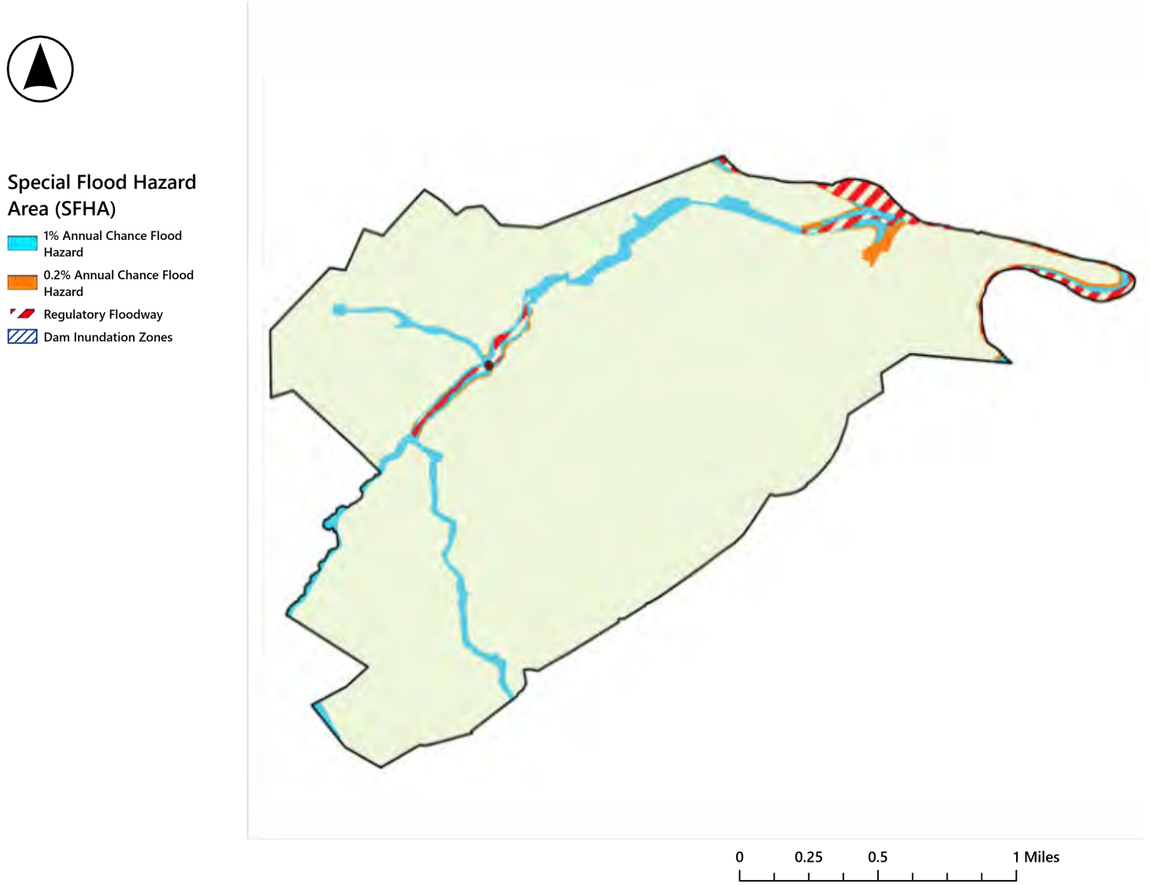
Map 4.54
City of Lexington Crashes Due to Standing or Moving Water (VDOT), Roads, and Special Flood Hazard Areas



Map 4.55
City of Lexington Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



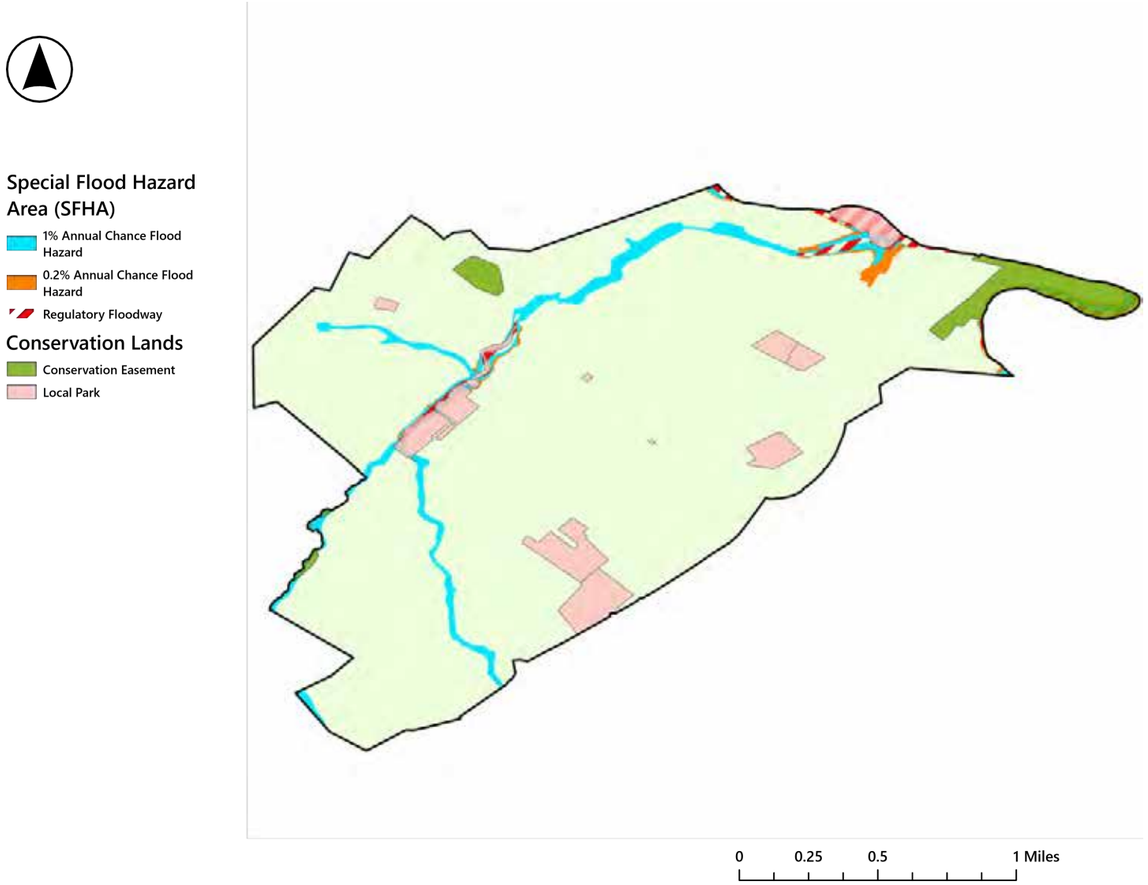
Map 4.56
City of Lexington Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



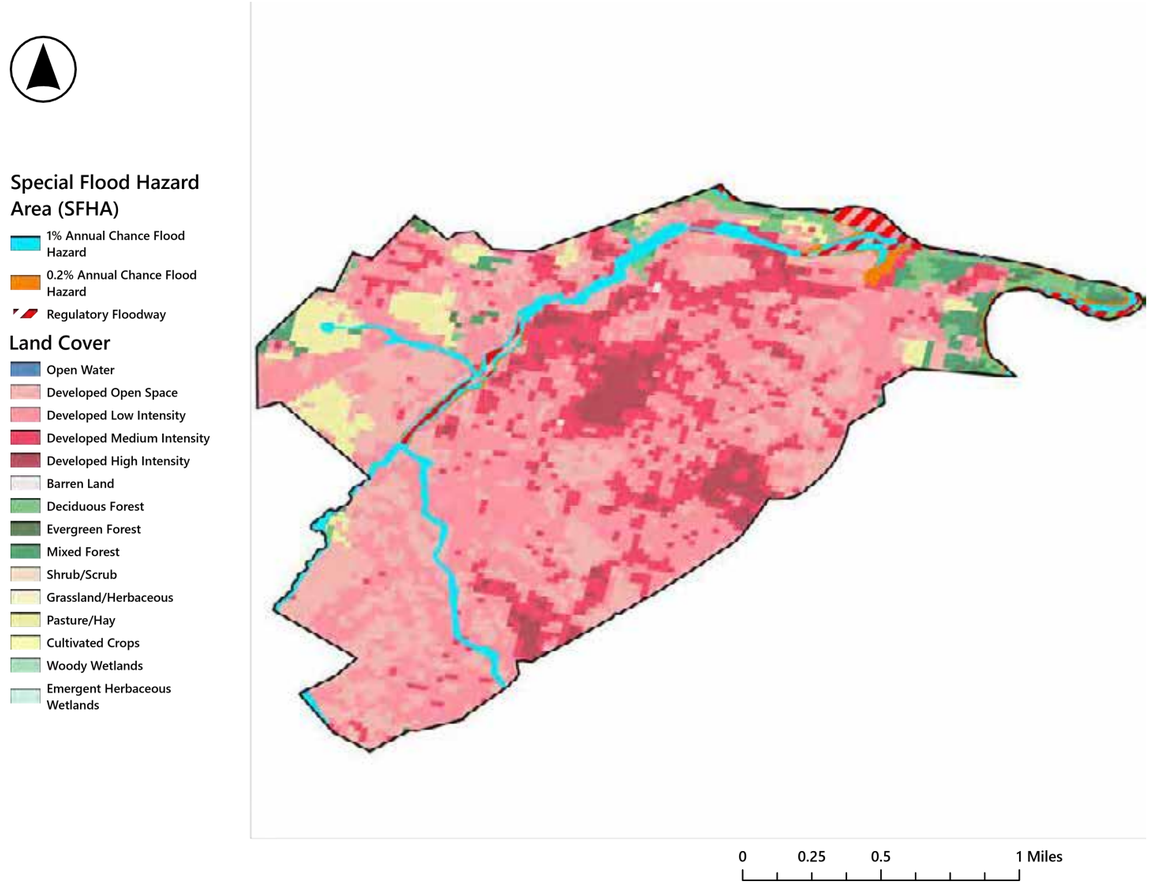
Natural Resources

Lexington's compact development leaves relatively little floodplain open space. The Maury River corridor and scattered institutional or undeveloped parcels form the principal remaining network for flood storage, infiltration, and stream buffering.

Map 4.57
City of Lexington Conservation Easements and Special Flood Hazard Areas



Map 4.58
City of Lexington Land Cover and Special Flood Hazard Areas



Future Conditions

MARISA does not provide a separate outlook for Lexington, so the Rockbridge County outlook provides the closest available climate context. Rockbridge County currently averages about two days per year at or above 95°F, and the projected 2070 average is 18 to 37 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 2 to 5 weeks. Within Lexington, heavier rainfall could increase flows through buried and open drainage systems, including the Jefferson Street corridor, and increase flood pressure near Woods Creek and the Maury River.

Needs

Lexington's needs center on aging and buried drainage systems in its downtown and older neighborhoods. Compared with other localities of its size, the City has greater financial capacity to address these needs because it collects a stormwater utility fee.

Drainage and Stormwater Capacity

The most significant need is the deteriorating stormwater channel buried beneath the Jefferson Street corridor between Hopkins Green and Massie Street. Its condition and alignment must be verified through camera inspection and survey before a repair or replacement alternative can be selected and priced. Other drainage problems include:

- an undersized culvert at Randolph and Henry Streets;
- the outfall between Wallace Street and South Main Street;
- drainage between Myers and McLaughlin Streets;
- spring discharge and winter icing near McLaughlin and Myers Streets, which also create pedestrian safety hazards near an elementary school.

The City's capital improvement plan includes planning-level costs for several of these projects, but the buried systems need further investigation before final costs can be set.

Additional phases of subsidized housing may be built in the Windermere and Wallace Street area, where development has historically complicated stormwater improvement planning. Recent development activity near Country Club Road has also added to drainage concerns along that corridor.

Shared and Regional Issues

Country Club Road, which runs along the City-County boundary, floods recurrently, and the City has submitted several projects for the corridor. The City is also working with state and federal partners to decommission Moores Creek Dam, its historic back-up water supply dam. A geotechnical investigation found that the dam rests on unstable fill from a prehistoric slope failure, so it cannot be rehabilitated. Because two universities are located within the City, coordination with Washington and Lee University and the Virginia Military Institute is often a consideration when developing new projects.

Funding and Capacity

Lexington adopted a stormwater utility fee in 2024. At its full rate, the fee is expected to generate about $400,000 to $450,000 per year. The City also funds projects through utility revenue, the general fund, and bonds, and it has an adopted Stormwater Improvement Plan with scoped projects, planning-level costs, and phasing. It uses an on-call engineering contract but has limited grant administration staff. The joint emergency operations plan with Rockbridge County and Buena Vista includes a debris management annex.

Resilience Actions

Table 4.12 | City of Lexington Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the projects identified in the City's Stormwater Improvement Plan,** shown on the locality map and described in Appendix A.	Mid	On-call engineer	Regional 1; HMP LX-3
2	**Coordinate drainage improvements with planned street, utility, and accessibility work,** including the Jackson Avenue project and water and sewer replacement.	Near	City departments	Regional 1; HMP LX-14
3	**Address Country Club Road drainage jointly with Rockbridge County,** defining responsibilities on each side of the boundary.	Mid	Rockbridge County	Regional 1

Additional related HMP actions: LX-4 (Woods Creek restoration), LX-5 and LX-6 (Moores Creek Dam emergency action plan and decommissioning), and LX-13 (emergency operations plan).

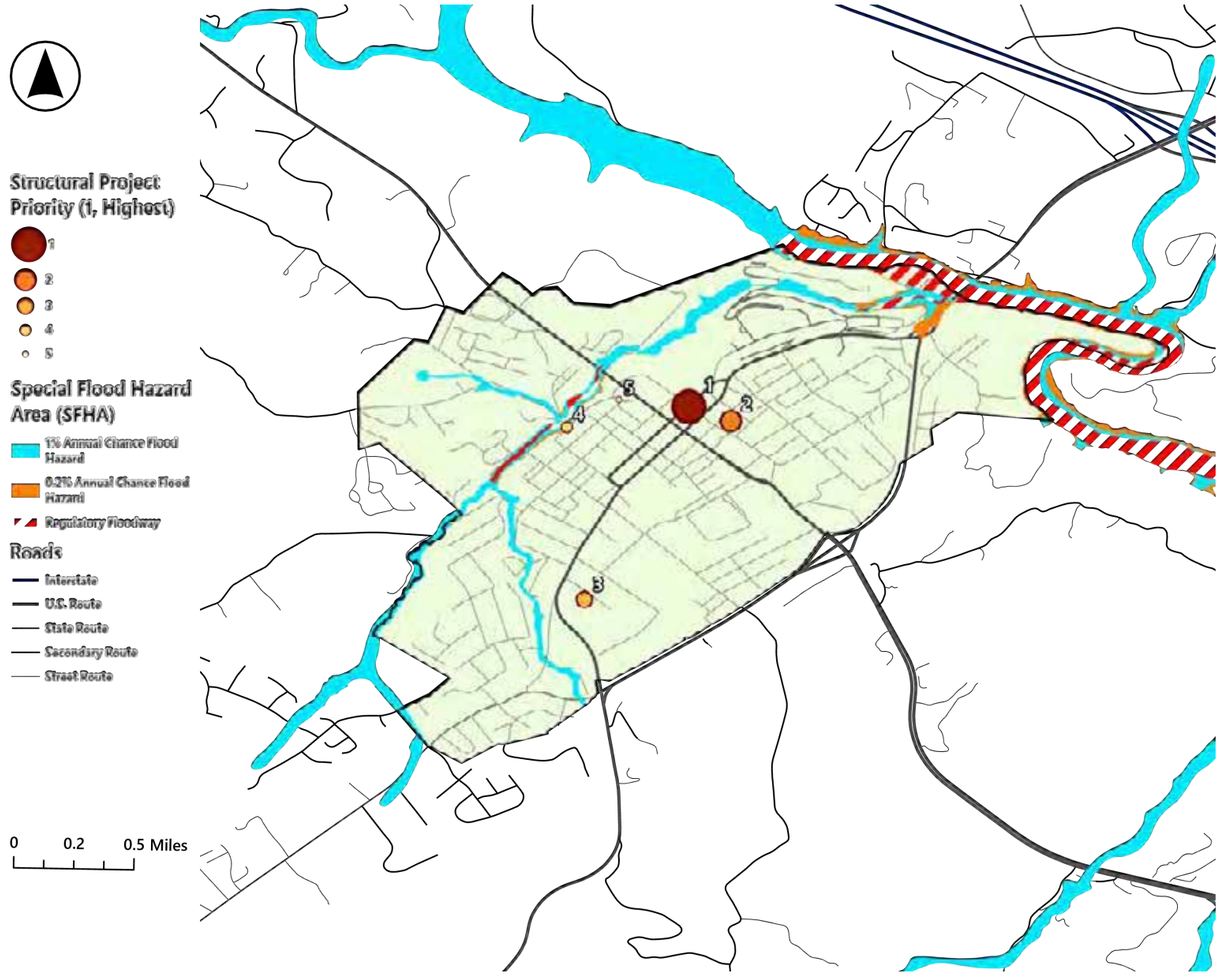
Table 4.13 | City of Lexington Priority Projects

Priority	Project	Severity
1	Jefferson Street Subterranean Channel Improvements — Hopkins Green to Massie Street*	HIGH
2	Randolph Street and Henry Street Culvert Replacement — Town Branch	HIGH
3	Storm Drain Improvements — Wallace Street to South Main Street	MODERATE TO HIGH
4	Storm Drain Improvements — Myers Street to McLaughlin Street (Jackson Avenue Phase II)	MODERATE
5	Lime Kiln Road and McLaughlin Street Ephemeral Spring Drainage and Pedestrian Safety Improvements (ADA)	MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*



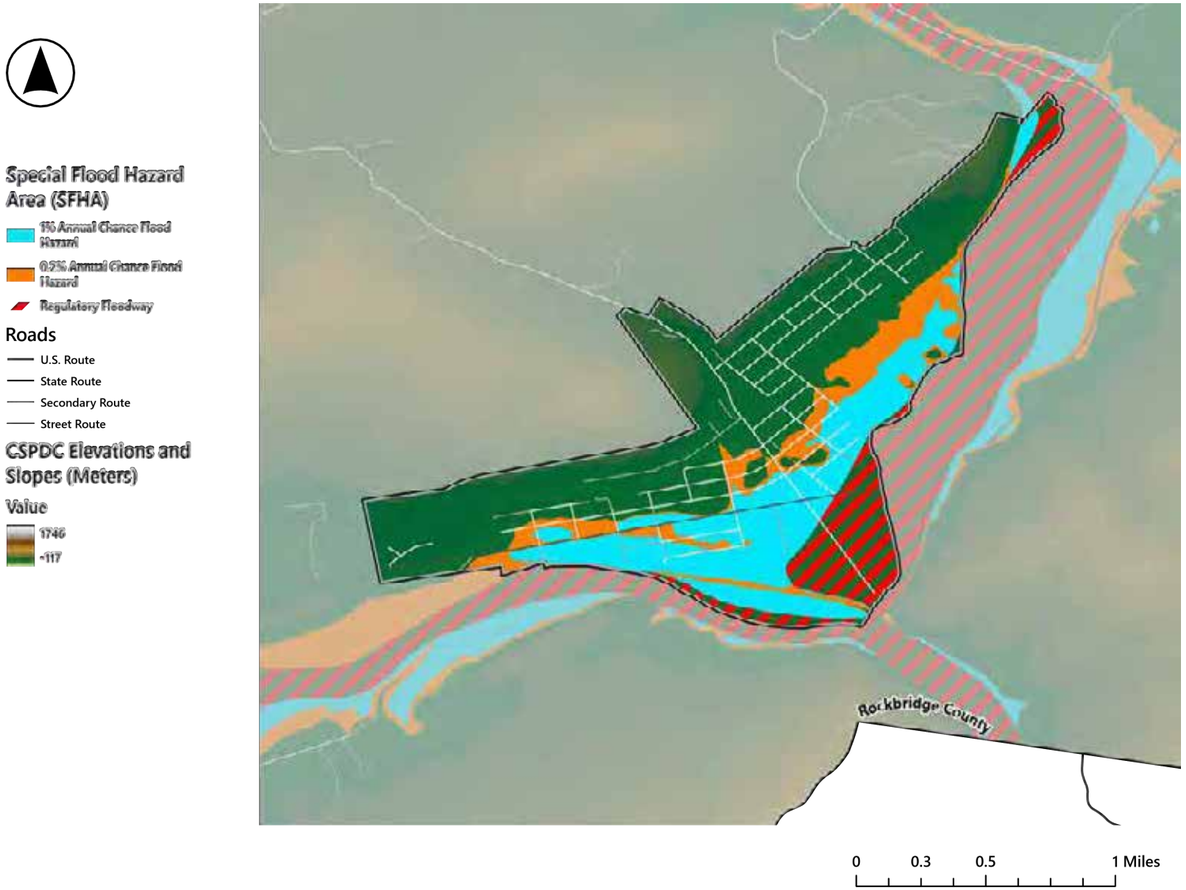
Map 4.59 | City of Lexington Priority Projects



Town of Glasgow *At A Glance*

The Town of Glasgow is located in southeastern Rockbridge County at the confluence of the James and Maury Rivers, at the base of the Blue Ridge Mountains. Glasgow is bounded on the south by the James River, on the east by the Maury River, and on the north and west by Sallings and Miller Mountains. The bowl-shaped, mostly flat topography concentrates runoff from the surrounding mountains before it discharges to the rivers. The Norfolk Southern railroad passes through Town, and Mohawk Industries, the Town's only major industrial employer, operates a flooring plant along the river.

Map 4.60 | Town of Glasgow Locality Introduction



1,330
total population

454
acres in the 500 year floodplain

18
flood insurance policies in force

Flood History

Causes and Recurring Problems

Flooding has been a recurring and defining hazard in Glasgow, and it comes from two sources: the Maury and James Rivers, and the steep, unnamed streams that carry runoff from Sallings and Miller Mountains through Town. The Town has no engineered stormwater system, drainage depends entirely on a few open natural channels, and the railroad embankment blocks runoff except where culverts pass beneath it. Debris and sediment from the mountain streams clog culverts and channels, causing backwater flooding in developed areas. Flooding has affected residential, commercial, industrial, and transportation assets, often repeatedly, and its effects fall heavily on the lower-income Pocahontas Street area north of the railroad.

Major Events

Severe floods occurred in 1870, 1877, 1913, 1936, 1969, 1972, 1985, 1992, 1995, and 1996, affecting homes, commercial and industrial facilities, railroads, streets, bridges, and a sewage treatment plant. Hurricane Camille in 1969 is Glasgow's flood of record: 14 feet of water flooded the business district, a quarter of the Town's homes were damaged, and three residents died. In 1972, Tropical Storm Agnes caused the worst flooding in Rockbridge County at Glasgow, forcing 50 families to evacuate. The November 1985 Election Day Flood damaged almost half the Town's homes and two-thirds of its businesses. In June 1995, flooding from the mountain streams proved worse than river flooding: 42 homes flooded on the first floor and 64 more had flooded basements. During a past major flood, Mohawk Industries sustained more than $10 million in damage and shut down for several days.

Recent Flooding

In 2002, flooding derailed a Norfolk Southern train into the river. Hurricane Isabel (2003) was a notable event that reinforced that tropical systems remain a continuing threat to the community. In April 2011, the Maury River rose to near flood stage at 18 feet. Residents north of the railroad report flooding fears even in routine heavy rain.

Existing Conditions

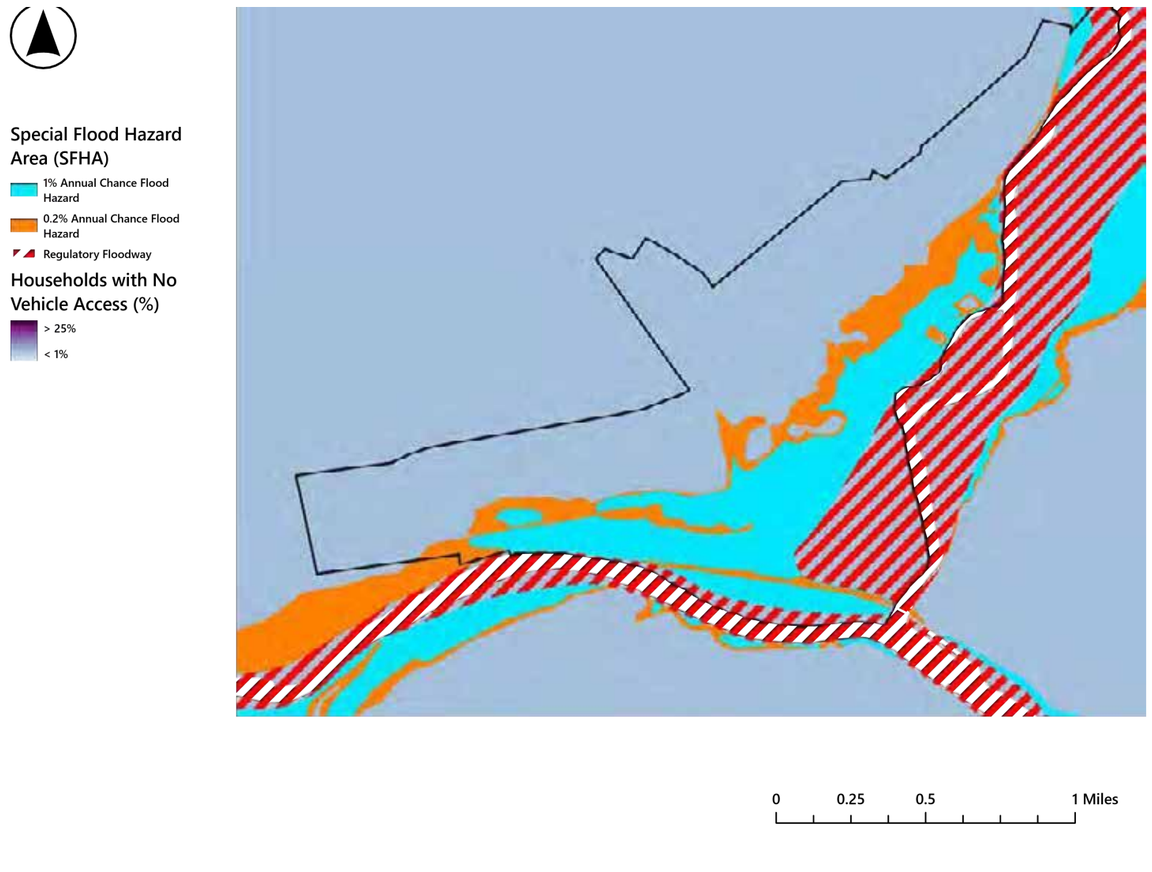
Vulnerable Populations

Glasgow lies within a tract mapped with relatively high social vulnerability, although tract-level data extend beyond the Town and should not be read as a household-level finding. The Town's residential flood risk is concentrated in the Pocahontas Street and Second Street area north of the railroad. Census data indicate many households there have lower incomes and lack vehicles, and many residents cannot evacuate on their own.

Map 4.61
Town of Glasgow Social Vulnerability Ranking by Census Tract



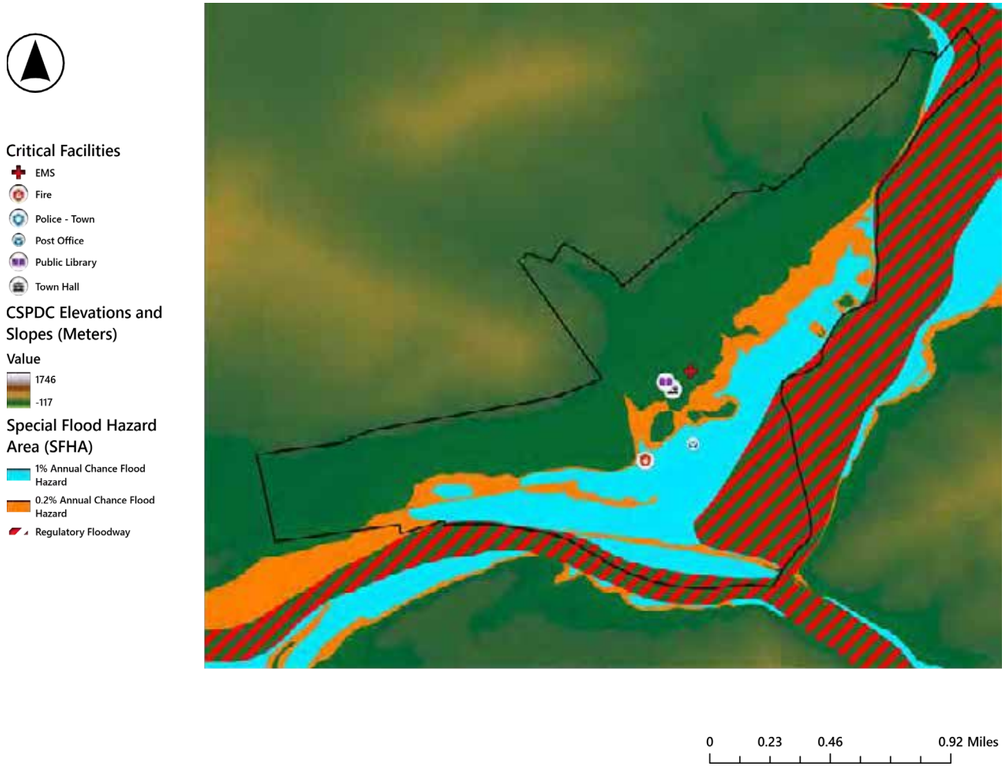
Map 4.62
Town of Glasgow Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



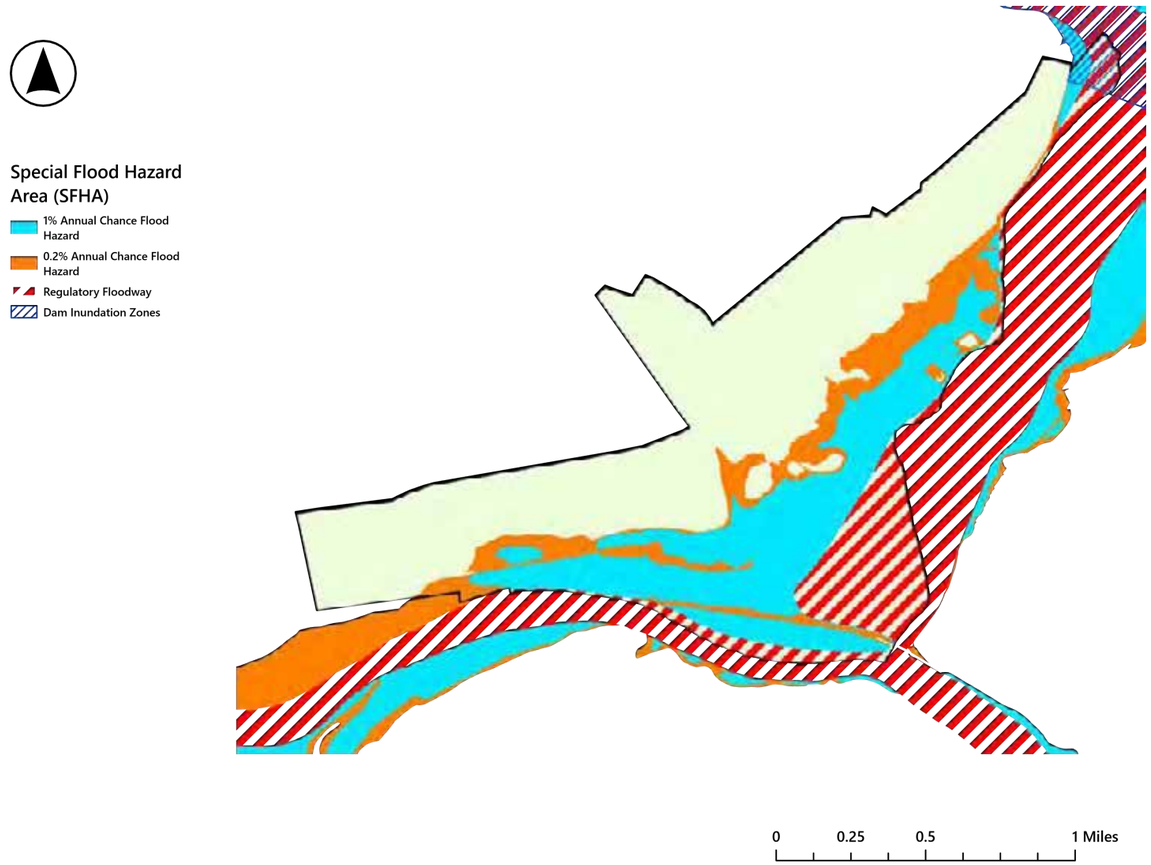
Infrastructure

A broad floodplain and floodway occupy the southern and eastern portions of Glasgow at the James–Maury confluence, and dam inundation mapping follows the same river system. The wastewater treatment plant, the fire department, and the Mohawk plant all lie in or immediately adjacent to the floodplain, and with few alternate approaches, flooding can affect both these facilities and the routes needed to reach them. The Town has 12 repetitive-loss properties.

Map 4.63
Town of Glasgow Special Flood Hazard Areas, DEM, and Critical Facilities



Map 4.64
Town of Glasgow Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



Natural Resources

Conserved parcels and high-value ecological cores border the river confluence, but developed land also occupies portions of the floodplain. The remaining riverfront open space provides both habitat continuity and storage for floodwater arriving from two major watersheds.

Figure 4.65
Town of Glasgow Conservation Easements and Special Flood Hazard Areas

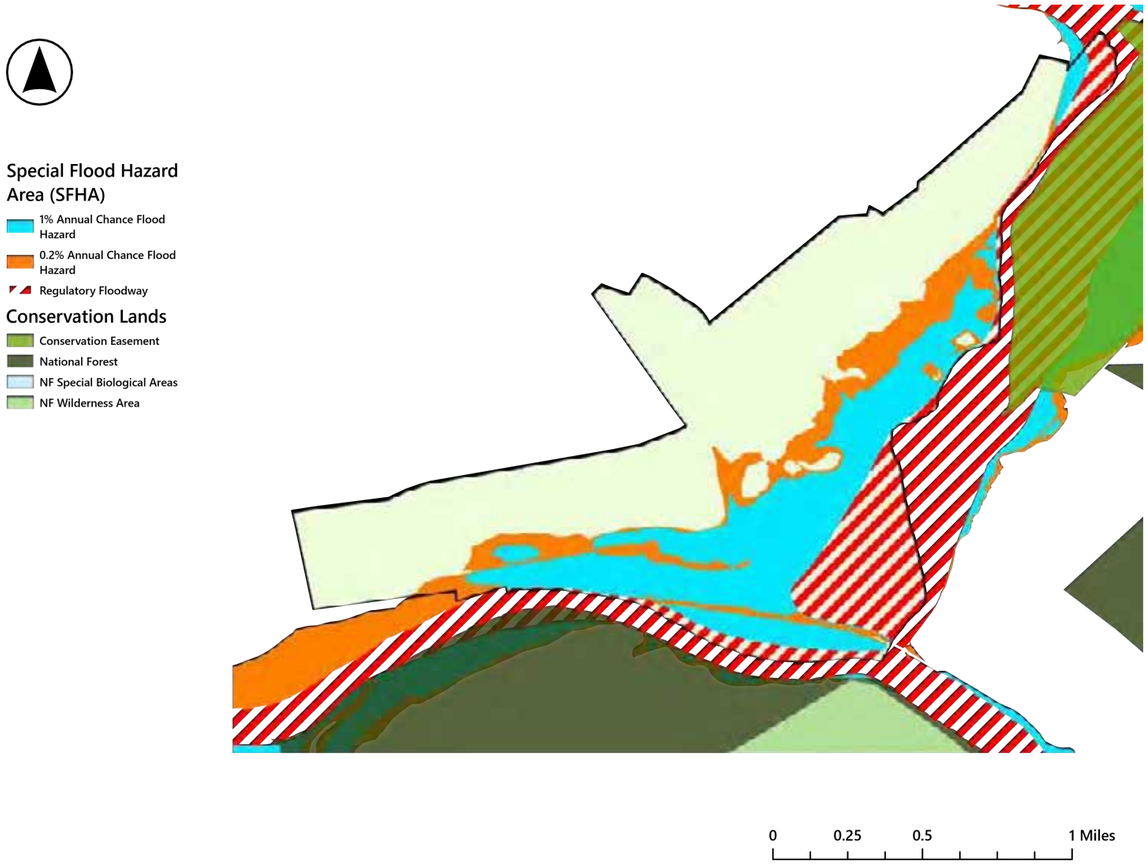
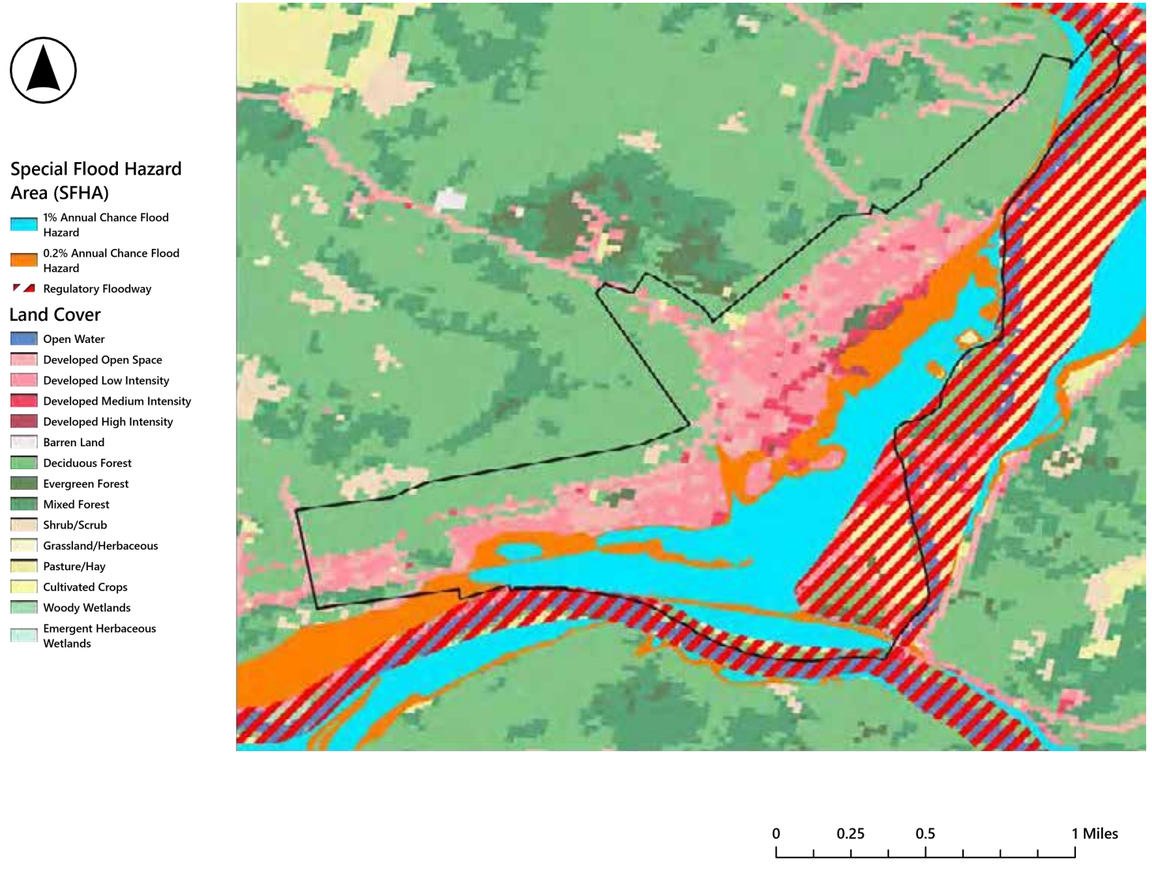
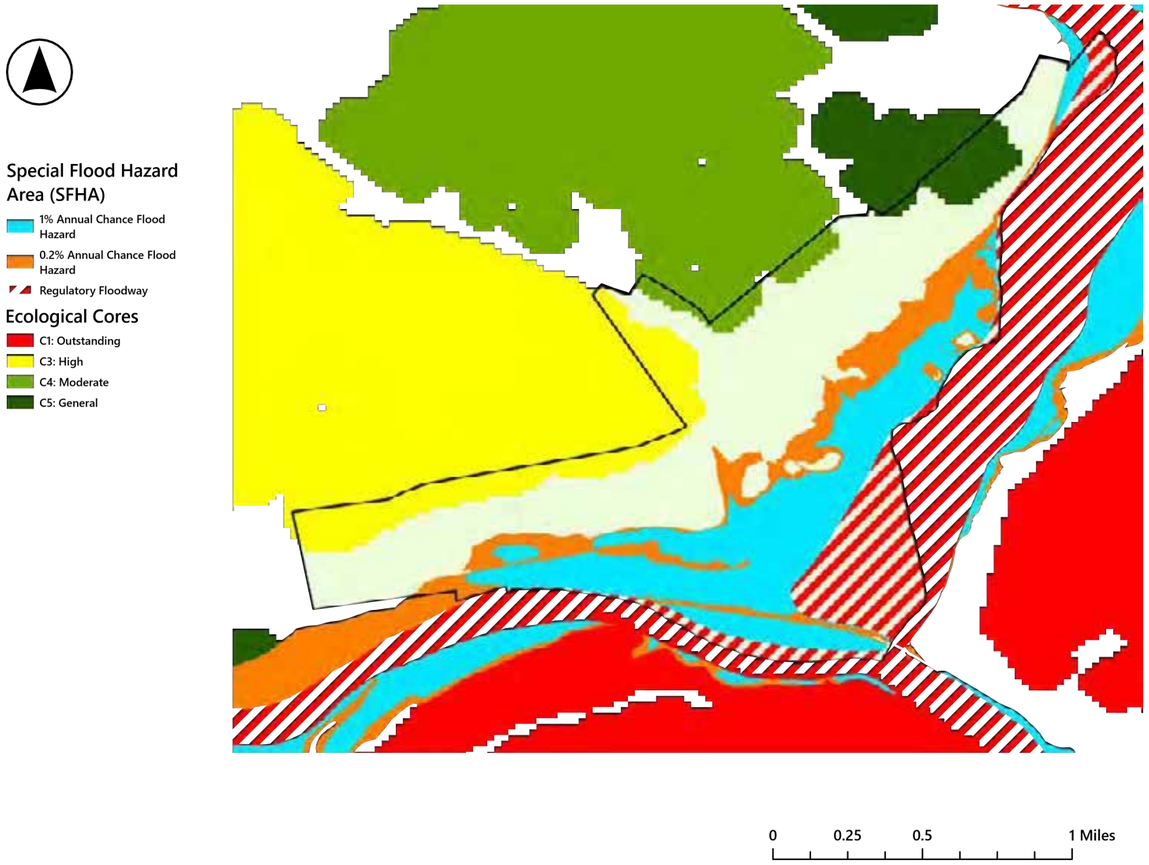


Figure 4.66
Town of Glasgow Land Cover and Special Flood Hazard Areas



Map 4.67
Town of Glasgow Ecological Cores and Special Flood Hazard Areas



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Future Conditions

MARISA does not provide a separate outlook for Glasgow, so the Rockbridge County outlook provides the closest available climate context. Rockbridge County currently averages about two days per year at or above 95°F, and the projected 2070 average is 18 to 37 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 2 to 5 weeks. For Glasgow, heavier rainfall could increase flooding near the Maury and James Rivers and place additional pressure on open drainage channels, road crossings, and the wastewater treatment plant.

Needs

Glasgow's needs center on managing mountain runoff through a town with no engineered drainage system. The Town also needs to protect a vulnerable neighborhood and critical facilities, and its staff and finances are severely limited.

Drainage and Stormwater Capacity

The Town identified the Pocahontas Street, Second Street, and Shenandoah Road corridor as a priority. There, mountain runoff collects against the railroad embankment. Potential measures include a community-scale bioretention basin or wet pond on assembled vacant parcels and a defined channel within the unopened Shenandoah Road right-of-way. The open channels near Fourth, Sixth, and Seventh Streets serve as the Town's primary drainage system and need assessment of capacity, bank erosion, maintenance access, and railroad crossings. Channels near Blue Ridge Road also need stabilization.

Maintenance and Green Infrastructure

The Town's two-person public works crew maintains all drainage channels, and some channel reaches cross private property with limited access. The railroad culverts are undersized and require frequent cleaning. Public works staff cut back the designed vegetation in the Town Hall bioretention facility without knowing its function, so the facility needs restoration and the crew needs maintenance training.

Critical Facilities and Evacuation

The wastewater treatment plant lies in the floodplain, and the Town is drawing down its reserves to address the plant's condition. The fire department also lies in the floodplain. The Town is converting a recently acquired building outside the floodplain into an emergency shelter, in part to serve residents of the Pocahontas Street area who cannot evacuate on their own.

Staffing and Coordination

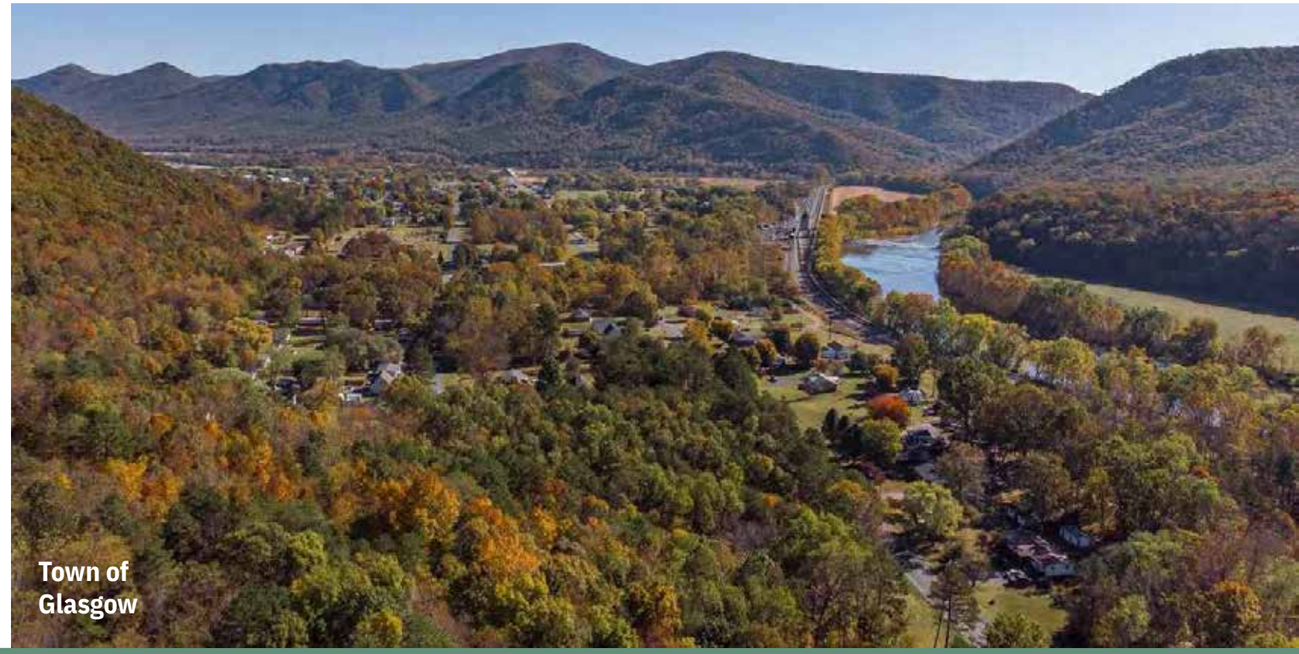
Glasgow has limited staff and financial capacity. The Town will need external support to apply for and manage any project. The Rockbridge County building official serves as the Town's floodplain agent.

Resilience Actions

Table 4.14 | Town of Glasgow Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC	Regional 1; HMP GL-6, GL-8, GL-10
2	**Establish SOP for debris management and clearance from Town drainage ways.** Secure access and maintenance easements.	Near	Community Organizations, County PW	Regional 7

Additional related HMP actions: GL-1 and GL-2 (emergency shelter operations and upgrade of 908 Anderson Street as a shelter), GL-7 (residential flood mitigation), GL-9 (hydrologic and stormwater study), GL-11 (streambank stabilization), and GL-18 (water system protection).

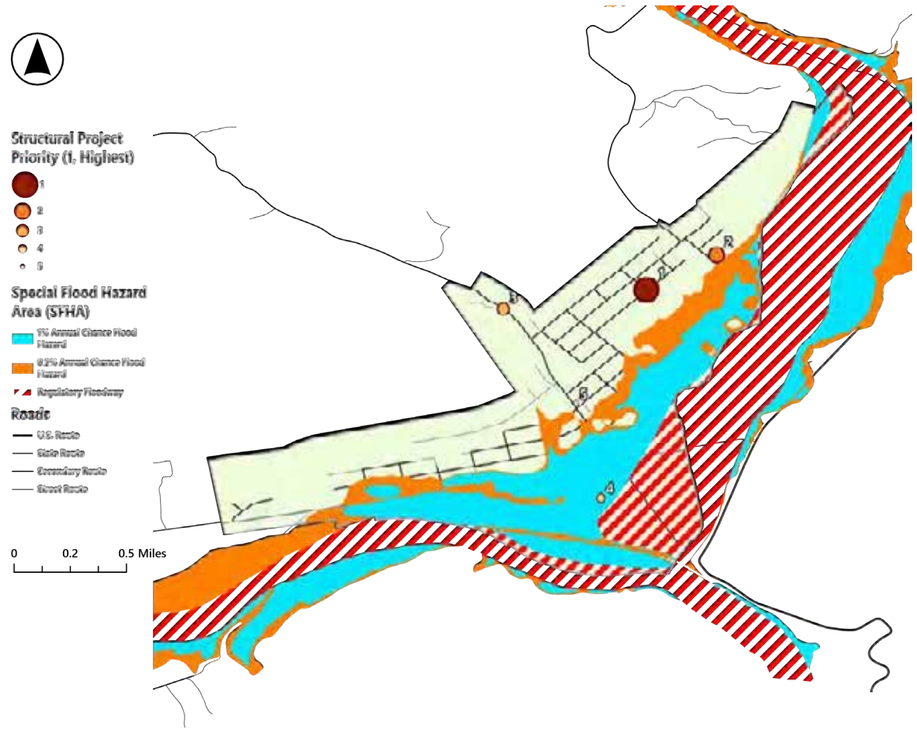


Town of Glasgow

Table 4.15 | Town of Glasgow Priority Projects

Priority	Project	Severity
1	Primary Town Drainage Channel Improvements — 4th, 6th, and 7th Streets	MODERATE (routine events) / HIGH (major storms)
2	Pocahontas Street / 2nd Street / Shenandoah Road Drainage Corridor Improvements	HIGH
3	Blue Ridge Road Mountain Slope Drainage Channel Improvements	MODERATE
4	Wastewater Treatment Plant Flood Vulnerability Improvements	HIGH (potential consequences)
5	Town Hall Bioretention Pond Restoration and Maintenance	LOW

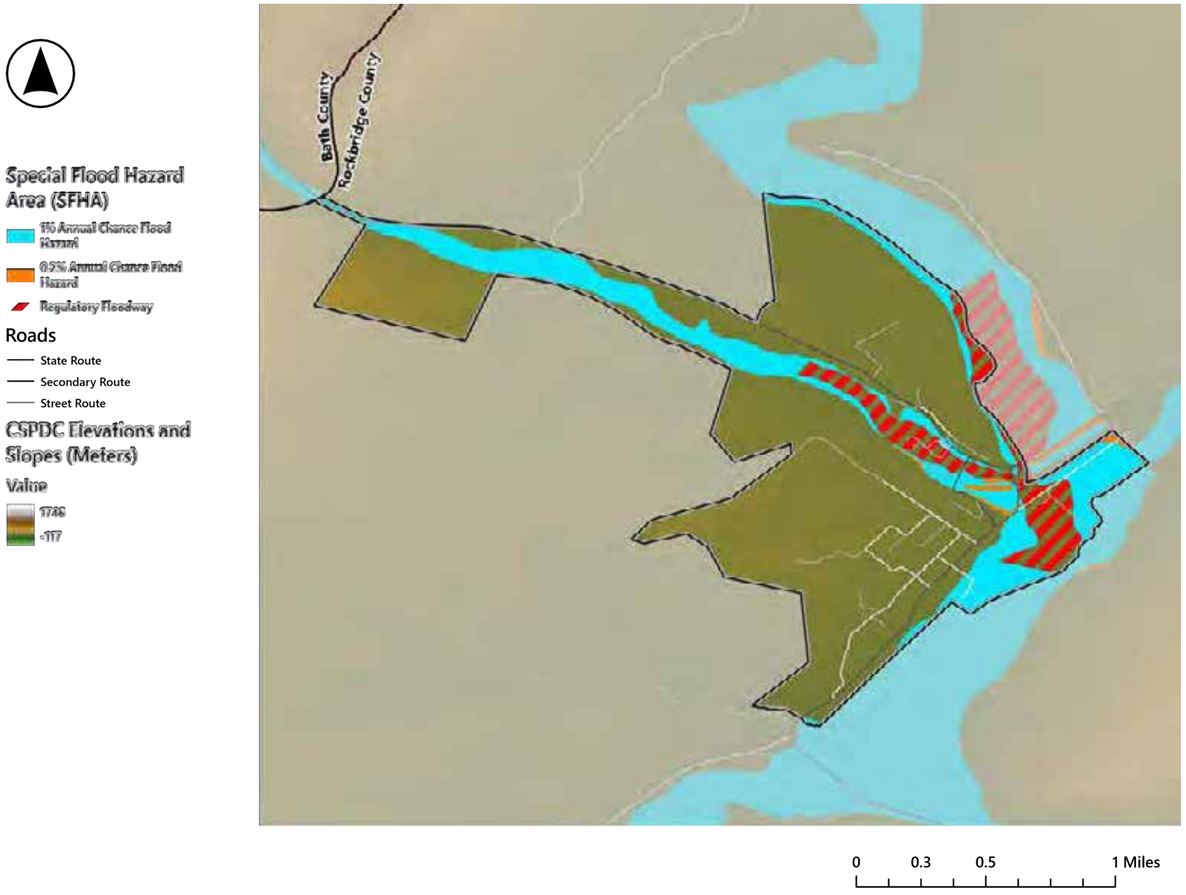
Map 4.68 | Town of Glasgow Priority Projects



Town of Goshen *At A Glance*

The Town of Goshen lies in northern Rockbridge County, in the Allegheny Mountains northwest of Lexington. Mill Mountain and North Mountain surround the Town, and the George Washington National Forest lies nearby. Goshen is the smallest participating locality by population. The Town sits in the James River basin, at the confluence of Mill Creek and the Calfpasture River. Just downstream, the Calfpasture joins the Little Calfpasture River to form the Maury River, which cuts through the mountains at Goshen Pass. The streams meeting at Goshen drain about 186 square miles, and a narrow gorge about one mile downstream restricts their flow. As a result, nearly the entire Town lies within the 100-year floodplain, and floodwater backs up into Town during high flows.

Map 4.69 | Town of Goshen Locality Introduction



271
total population

286
acres in the 500 year floodplain

3
flood insurance policies in force

Flood History

Causes and Recurring Problems

Mill Creek and the Calfpasture River meet in the center of Town, with a combined drainage area of about 190 square miles. Nearly the entire Town lies within the 100-year floodplain. Four factors drive flooding:

- a narrow gorge one mile downstream that backs water up into Town;
- three bridges near the confluence that restrict flow, particularly the Mill Creek bridge;
- the Town's low elevation relative to both streams;
- the streams' shape and flow paths.

Since the Town is located near the headwaters of the Maury River, there is little or no warning of an impending flood. Additionally, flooding has closed State Routes 39 and 42 on several occasions, cutting off access to Goshen.

Major Events

During Hurricane Camille in 1969, floodwater inundated the Stillwater plant. The November 1985 Election Day Flood, estimated at greater than a 150-year event, was the most severe in Goshen's history. It produced the heaviest damage in Rockbridge County because of the speed of the floodwaters, and it severely damaged State Route 39 through Goshen Pass. Goshen also flooded in April 1992, June 1995, and January and September 1996.

Recent Flooding

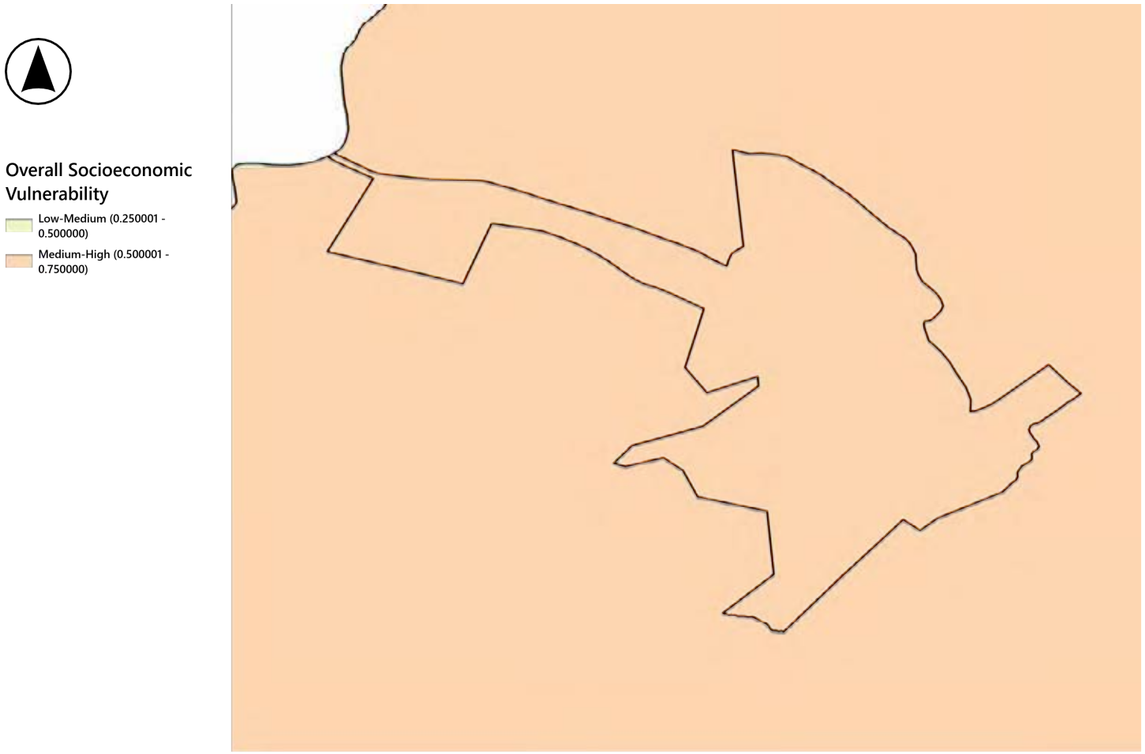
The low-water bridge on State Route 42 floods during nearly every significant rain, and debris and log jams at the confluence continue to restrict flow. When both streams rise together, flooding reaches all of Main Street, much of Virginia Avenue, and most of the Town's historic residential and civic buildings.

Existing Conditions

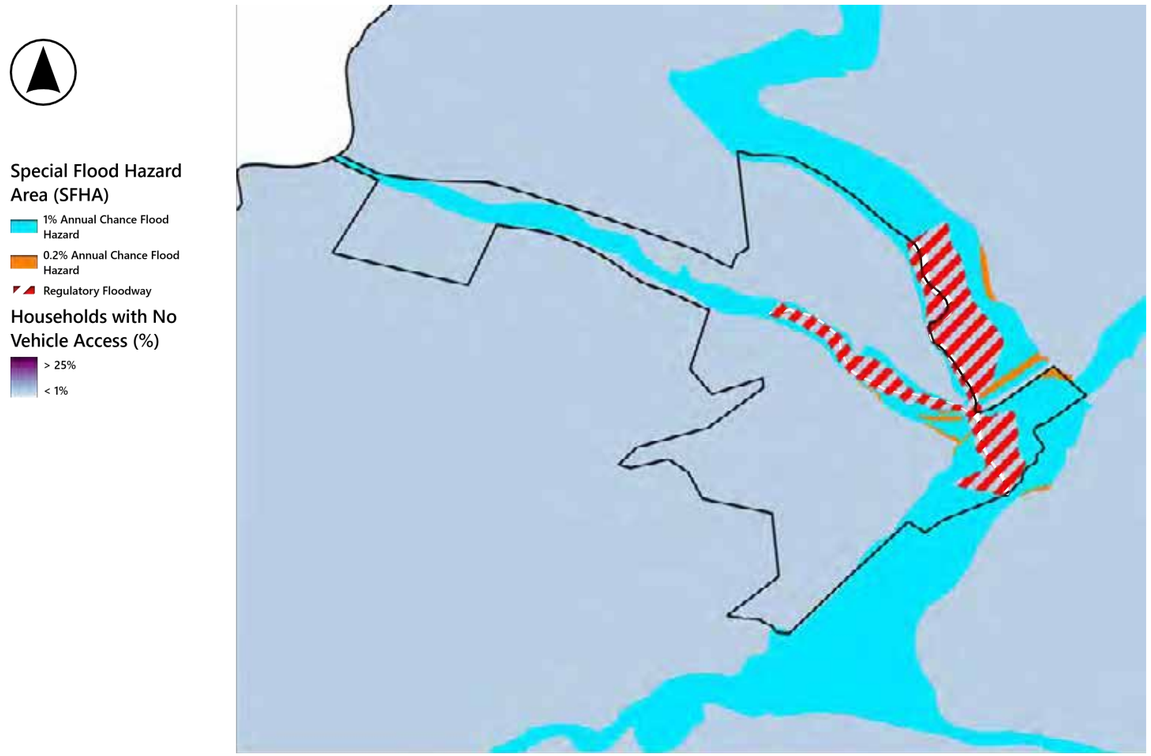
Vulnerable Populations

Goshen shows moderate social vulnerability and no extreme concentration of households without vehicles, but those indicators understate the community's exposure to isolation. The Town is remote and has limited routes to outside services.

Map 4.70
Town of Goshen Social Vulnerability Ranking by Census Tract



Map 4.71
Town of Goshen Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

The floodplain broadens around the confluence, placing much of the Town and its access network in a shared flood corridor. The water system pump house and inflow vault lie in the Mill Creek floodplain, and the public library occupies the old schoolhouse within the area partially protected by an Army Corps of Engineers berm. The rescue squad sits at the edge of the floodplain, and dam inundation mapping follows the same valley. The Town has two repetitive-loss properties and one severe repetitive-loss property.

Figure 4.72
Town of Goshen Special Flood Hazard Areas, DEM, and Critical Facilities

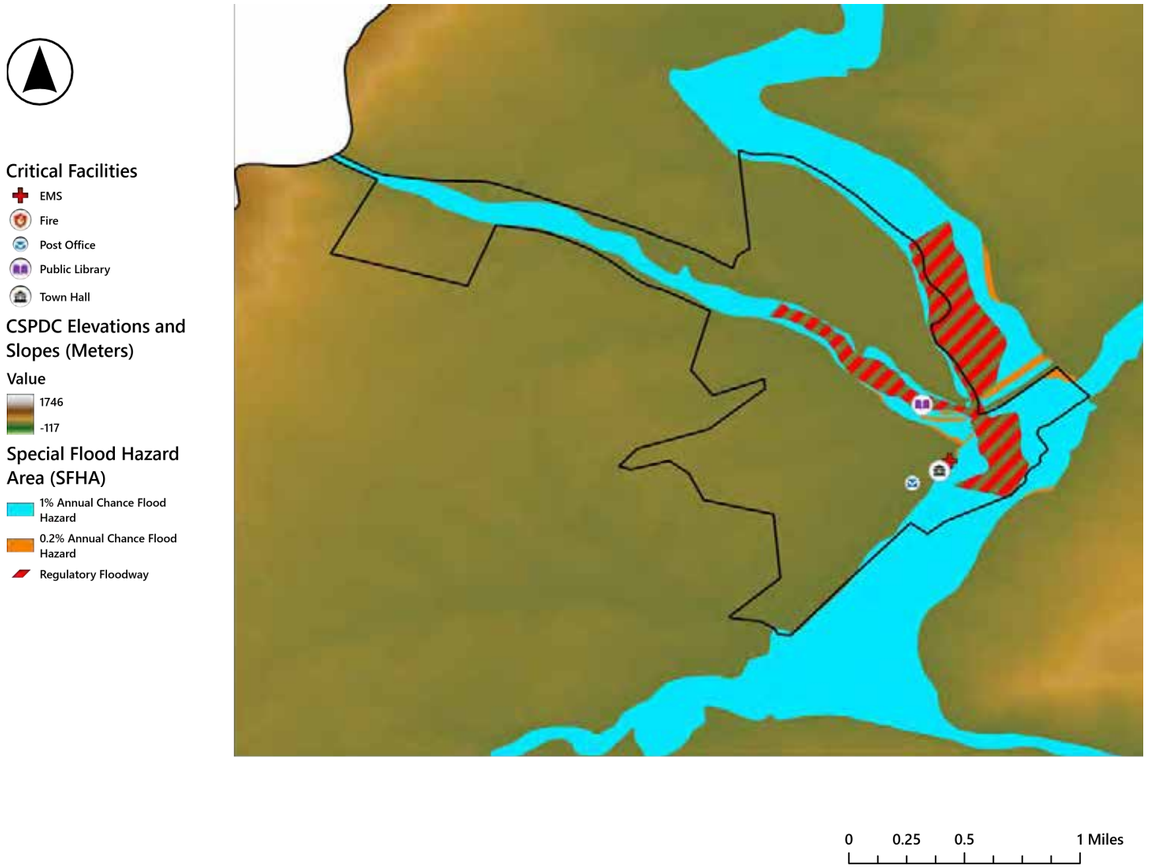
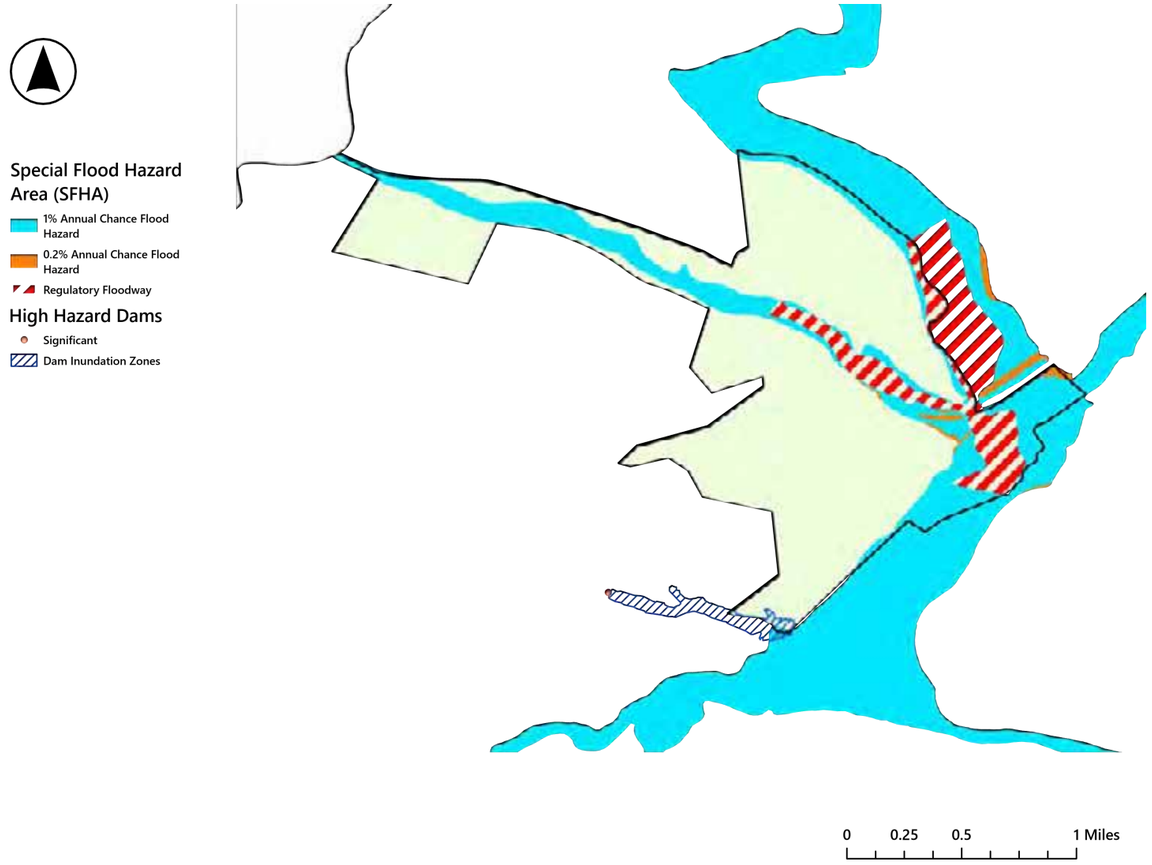


Figure 4.73
Town of Goshen Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



Natural Resources

Goshen is surrounded by forest, conserved land, and high-value ecological cores that provide strong upstream storage and slope protection. Settlement occupies the narrower valley floor at the edge of the floodplain.

Figure 4.74
Town of Goshen Conservation Easements and Special Flood Hazard Areas

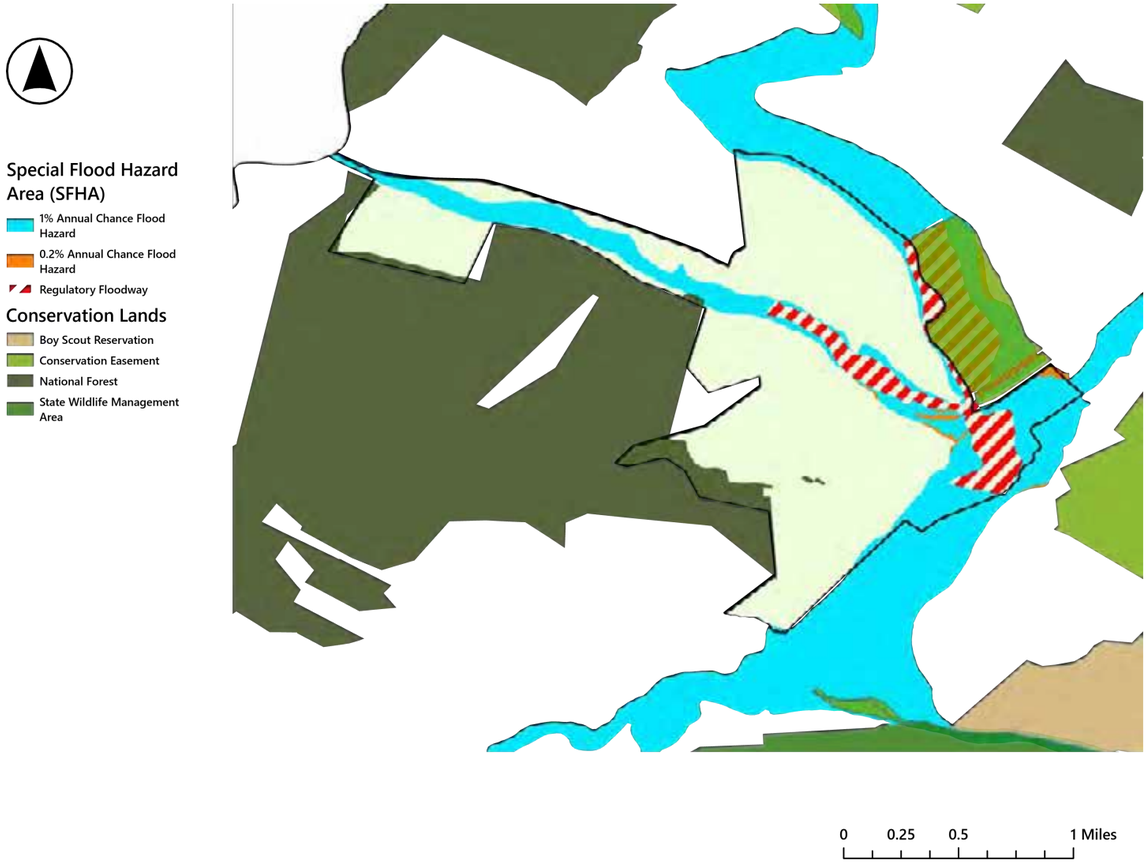


Figure 4.75
Town of Goshen Land Cover and Special Flood Hazard Areas

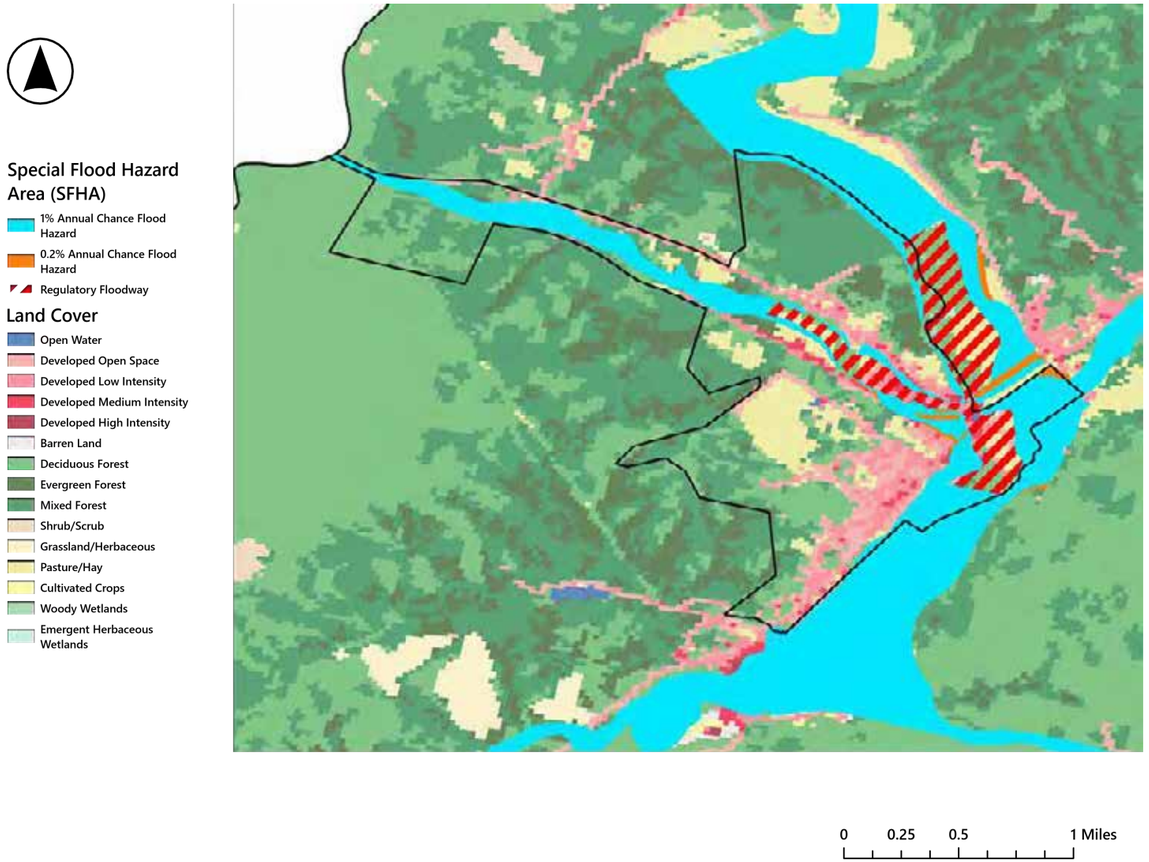
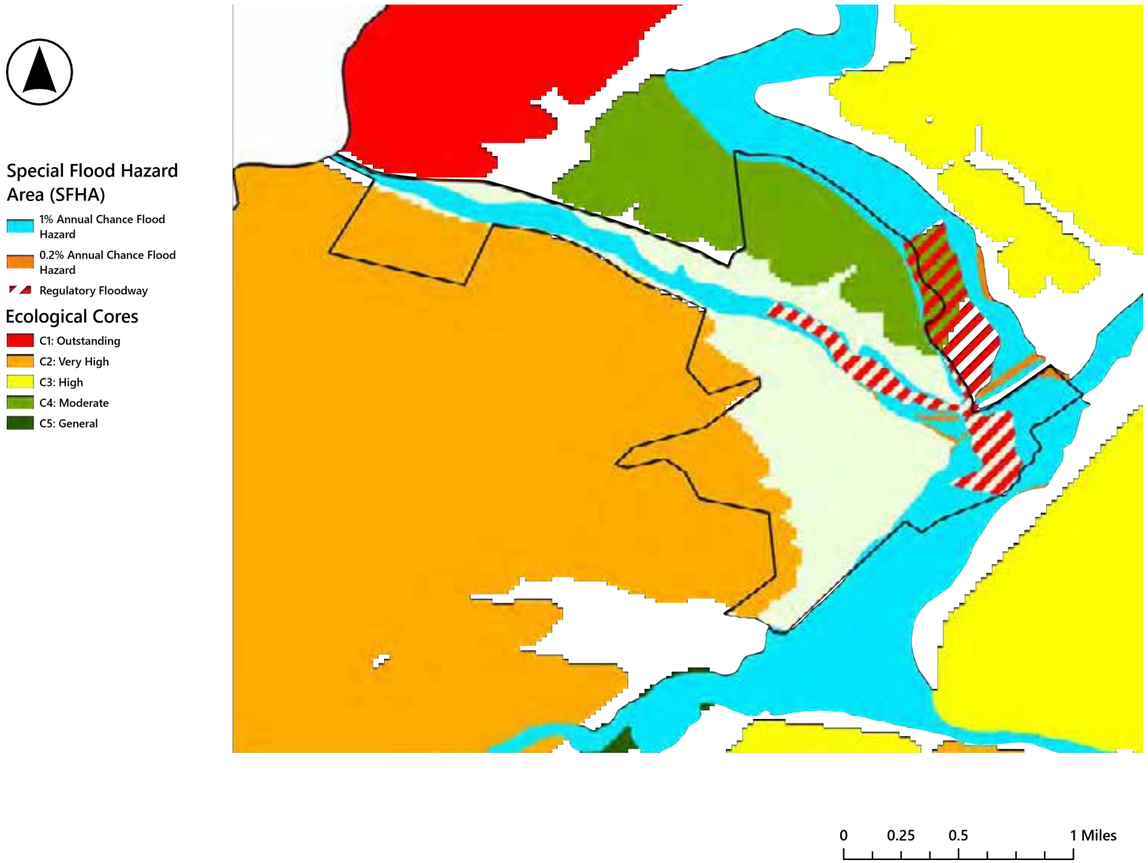


Figure 4.76
Town of Goshen Ecological Cores and Special Flood Hazard Areas



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Future Conditions

MARISA does not provide a separate outlook for Goshen, so the Rockbridge County outlook provides the closest available climate context. Rockbridge County currently averages about two days per year at or above 95°F, and the projected 2070 average is 18 to 37 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 2 to 5 weeks. At Goshen, heavier rainfall could produce higher and faster flows where Mill Creek meets the Calfpasture River, increasing pressure on the existing berm, drainage outlets, roads, and nearby properties.

Needs

Goshen is one of the most flood-vulnerable communities in the region. The Town's needs center on the river confluence flooding, access during floods, and water supply protection.

Stream and Channel Conditions

Debris, overgrowth, and log jams at the confluence of Mill Creek and the Calfpasture River restrict flow. Federal regulators have limited authorized work at the confluence to clearing only, so any widening or deepening of the narrowed Calfpasture channel will require a longer engineering and permitting effort. A partially completed Army Corps of Engineers berm along Mill Creek also needs completion with a controlled outlet so floodwater does not remain trapped behind it after river levels fall.

Critical Facilities and Access

The water system pump house and inflow vault need a flood vulnerability assessment and protection of the generator, electrical equipment, and water-supply components. During major floods, the Town can be cut off in several directions:

- the State Route 42 low-water bridge floods;
- the steel bridge on Cameron Hall Road becomes impassable;
- State Route 39 through Goshen Pass and the bridges east of Town are vulnerable;
- trains stopped on the Main Street crossing can block access, leaving a low-water bridge as the only backup route for emergency vehicles.

A former road connection across the railroad that once offered a bypass has been eliminated. Residents on the Cameron Hall Lane side of the steel bridge cannot evacuate or receive fire or medical service during floods.

Staffing and Coordination

The Town has no designated floodplain manager. The fire chief handles floodplain matters informally, with guidance from Rockbridge County. Goshen is nominally covered by the Rockbridge County emergency operations plan but does not use it in practice, and the volunteer fire department and community volunteers handle debris removal.

Resilience Actions

Table 4.16 | Town of Goshen Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC; USACE	Regional 1; HMP GO-6, GO-8, GO-14
2	**Establish recurring debris and log jam removal at the confluence,** with the required authorizations, to maintain flow capacity between larger channel improvements.	Near	DEQ; USACE	Regional 3
3	**Prepare a flood access plan for isolated areas.**	Near	Rockbridge County Emergency Management; VDOT	Regional 7
4	**Designate a floodplain administrator and formalize County support** through a written agreement with Rockbridge County.	Near	Rockbridge County	HMP GO-5

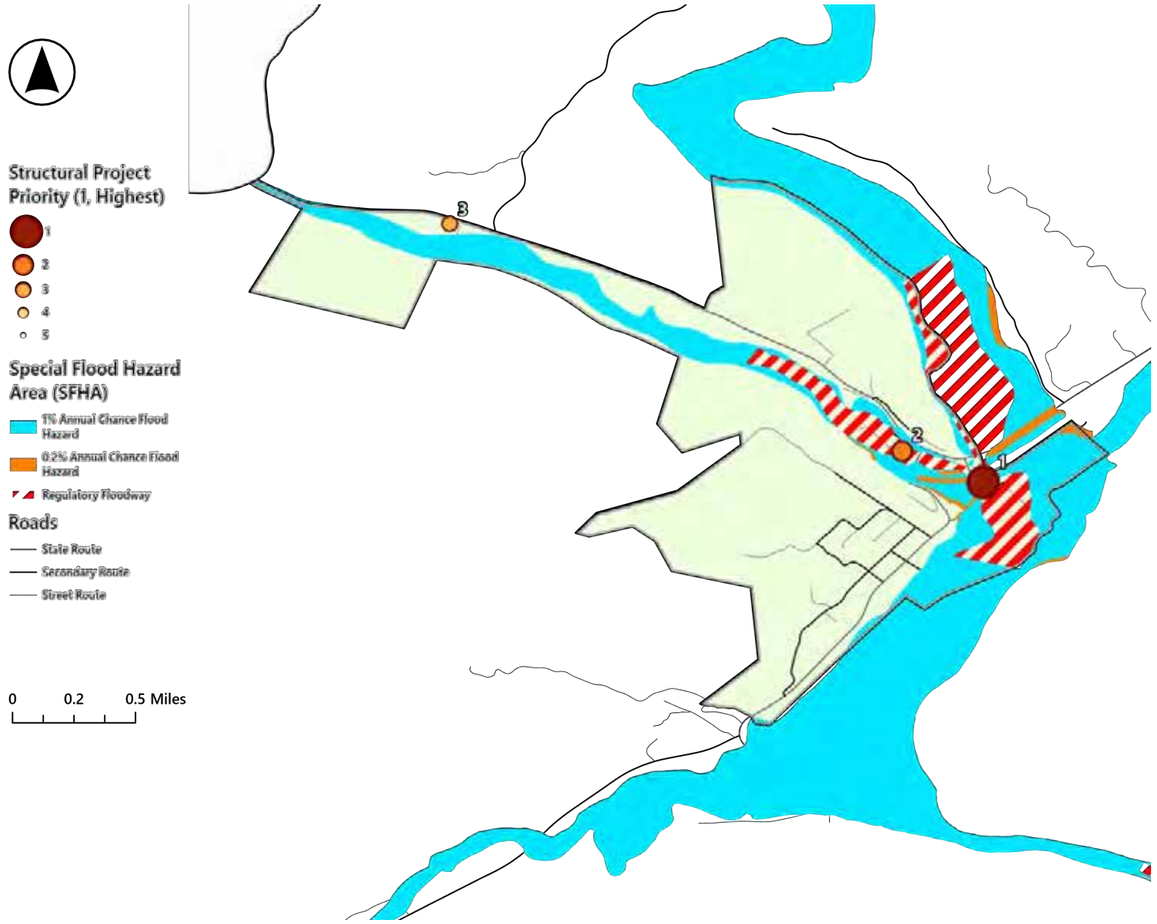
Additional related HMP actions: GO-1 and GO-13 (fire department shelter signage and backup generator), GO-2 (audible emergency warning system), and GO-4 (natural systems flood mitigation).

Table 4.17 | Town of Goshen Priority Projects

Priority	Project	Severity
1	Mill Creek and Calfpasture River Confluence Clearing and Channel Improvement*	HIGH
2	Mill Creek Berm Completion — Partial Army Corps of Engineers Structure	HIGH
3	Water System Pump House Flood Vulnerability Mitigation	MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

Map 4.77 | Town of Goshen Priority Projects

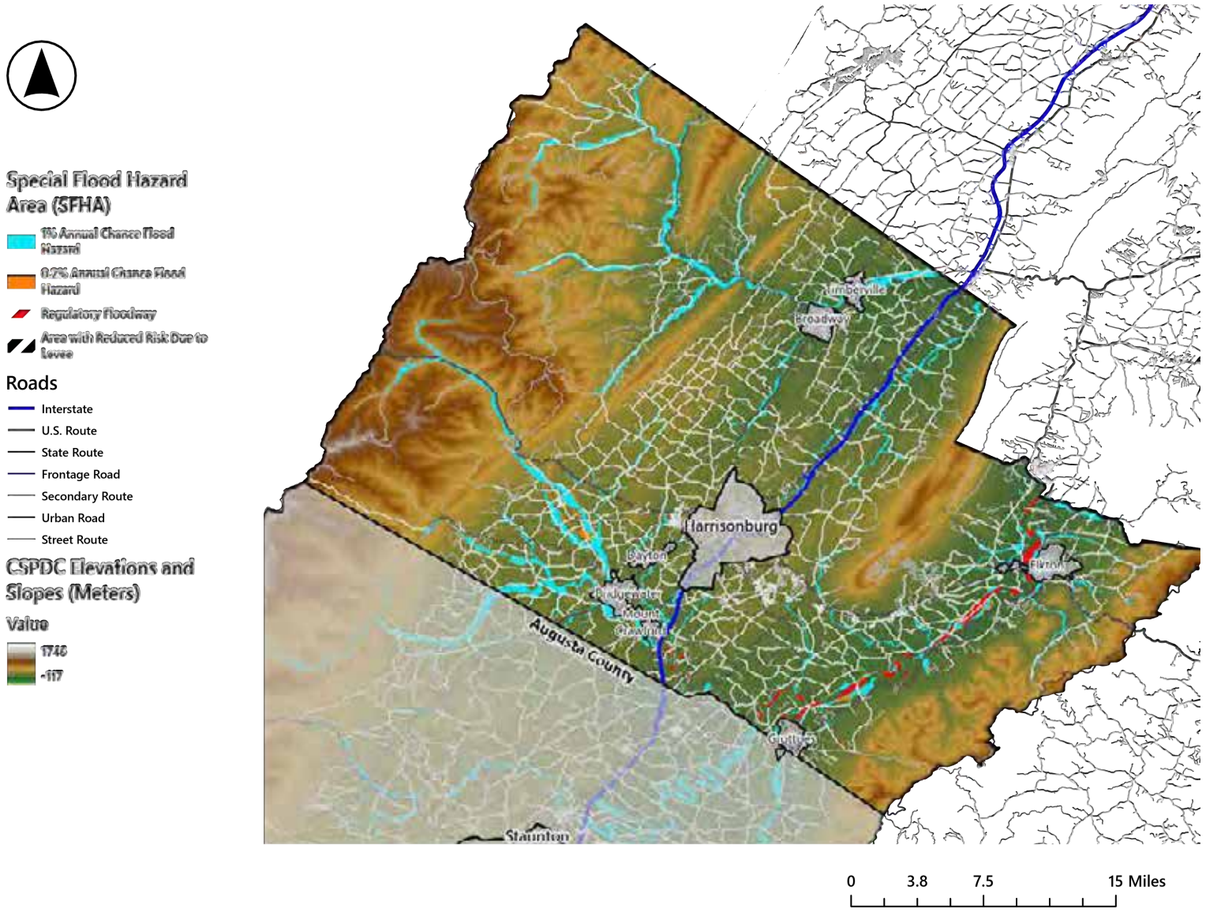


Rockingham County *At A Glance*

Rockingham County is located in the north-central part of the region and borders Augusta, Albemarle, Greene, Page, and Shenandoah Counties and Pendleton and Hardy Counties in West Virginia. The County surrounds the independent City of Harrisonburg and includes seven towns: Bridgewater, Broadway, Dayton, Elkton, Grottoes, Mount Crawford, and Timberville. Each town administers its own floodplain program. Rockingham is the region's most populous county and, with about 850 square miles of land, its second-largest county by area.

The entire County lies within the Shenandoah River basin. The North and South Forks of the Shenandoah River flow through the northern and eastern portions of the County, the North River crosses the south-central portion, and the South River crosses the southeast.

Figure 4.78 Rockingham County Locality Introduction



MS4
community

89,391
total population

28,567
acres in the 500 year floodplain

242
flood insurance policies in force

Flood History

Causes and Recurring Problems

Flooding occurs across the County rather than in a single area. Most floods result from heavy rain and rapid snowmelt in late fall and early spring or from intense summer thunderstorms, and runoff concentrates quickly on the County's steep slopes. Inadequate drainage, undersized culverts and bridges, structures close to streams, and debris in channels add to the damage. Areas of recurring concern include Naked Creek in the northeast and the Bergton, Criders, and German River Road corridor in the west.

Major Events

In October 1942, the North Fork of the Shenandoah River reached 25.3 feet at Cootes Store, then the highest stage on record. The June 1949 flood was the most damaging on the North River; it killed four people in Bridgewater and caused about $650,000 in direct damage at the time. Tropical Storm Agnes in June 1972 led to a federal disaster declaration for the County. The November 1985 Election Day Flood struck the western County hardest, killed three County residents, and washed out an 1896 railroad bridge in Elkton.

Rain-on-snow flooding in January 1996 led to another federal declaration. Eight months later, Hurricane Fran broke nearly every flood record on the Shenandoah River and its tributaries. The North Fork crested near 28 feet at Cootes Store, a new record, and the South Fork crested at 30.9 feet at Lynnwood. More than 125 roads closed, 16 homes and 18 mobile homes were destroyed, 334 more structures were damaged, and agricultural losses reached about $10 million. On Naked Creek, the flood carved a new channel and destroyed or heavily damaged about two dozen homes. In September 2003, Hurricane Isabel damaged roads and farmland, and two people died crossing a flooded stream by horse and buggy.

Recent Flooding

In May 2018, flash flooding damaged homes, farm buildings, and roads in Fulks Run. Late May and early June storms that year produced rainfall rates of 6 inches per hour and required swift-water rescues, and in June the Bergton area was hit hardest by a stalled front. A summer thunderstorm estimated at a 10- to 25-year event overwhelmed the State Route 42 culverts in Cobbler's Valley. Winter storms and flooding in February 2025 led to a federal major disaster declaration for the County.

Existing Conditions

Vulnerable Populations

Higher social vulnerability is concentrated in parts of the south-central and southeastern county and near Harrisonburg, with additional pockets of vehicle limitation in the southwest and southeast.

Figure 4.79
Rockingham County Social Vulnerability Ranking by Census Tract

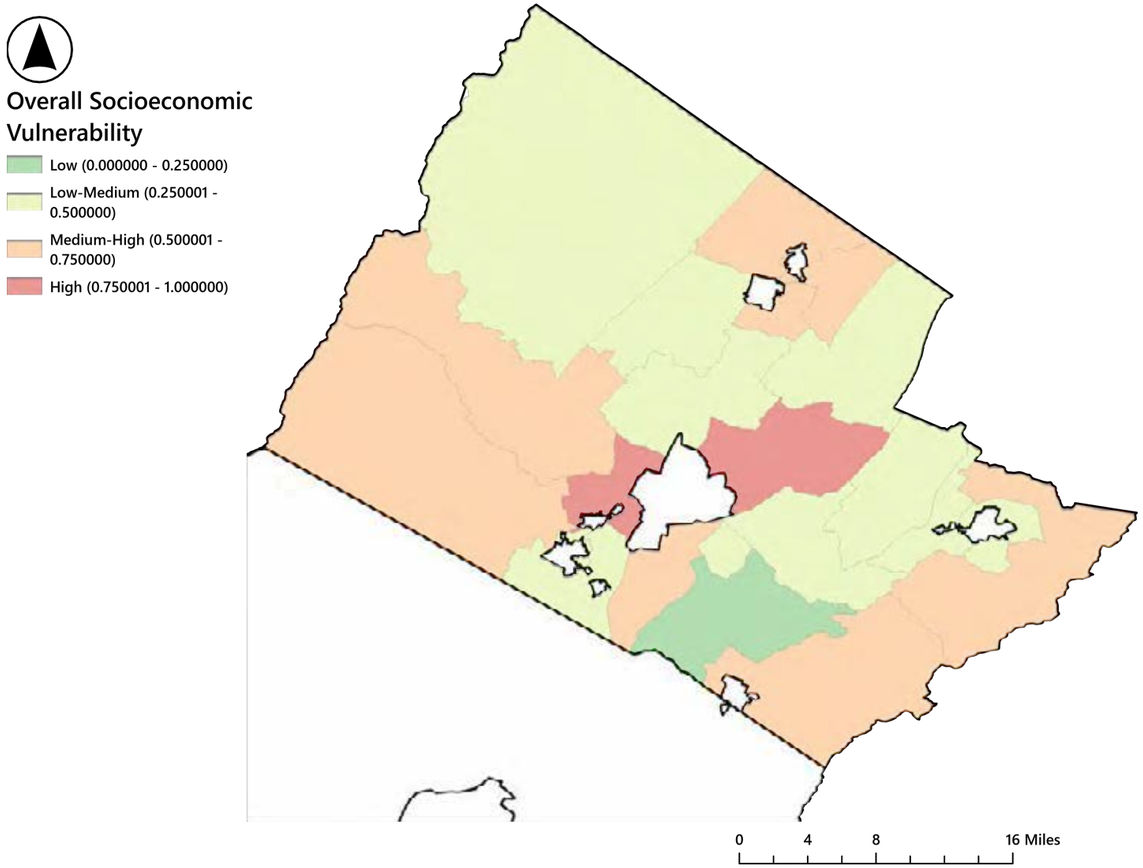
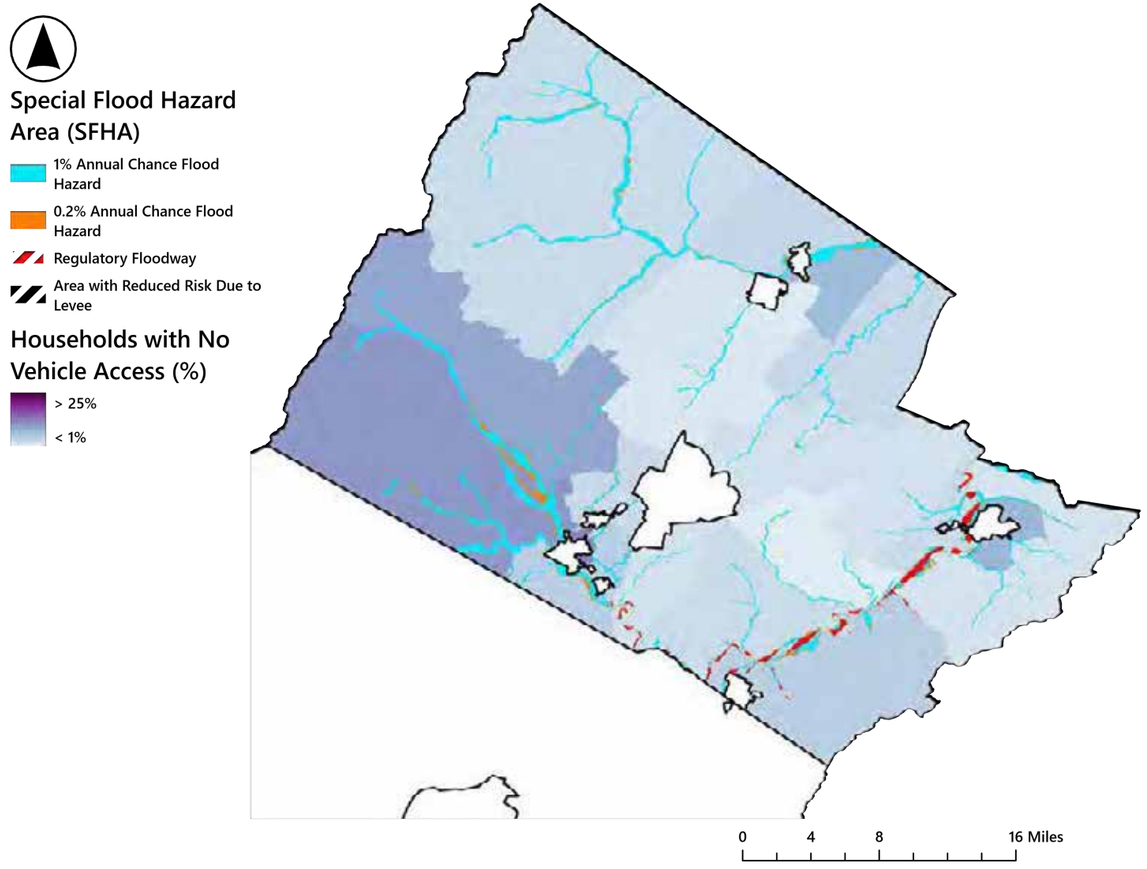


Figure 4.80
Rockingham County Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

Rockingham County's distributed facilities depend on a dense network of roads and stream crossings maintained by VDOT. Bridge-condition and crash concerns are most evident in portions of the south and east and around urbanizing areas, and dam inundation corridors follow the river forks and tributaries. The County's refuse transfer site in Elkton lies almost entirely within the floodplain, and about half of the County government building in Harrisonburg sits in the floodway over Blacks Run, which passes beneath it in a culvert. The County has 12 repetitive-loss properties and 1 severe repetitive-loss property.

Figure 4.81
Rockingham County Special Flood Hazard Areas, DEM, and Critical Facilities

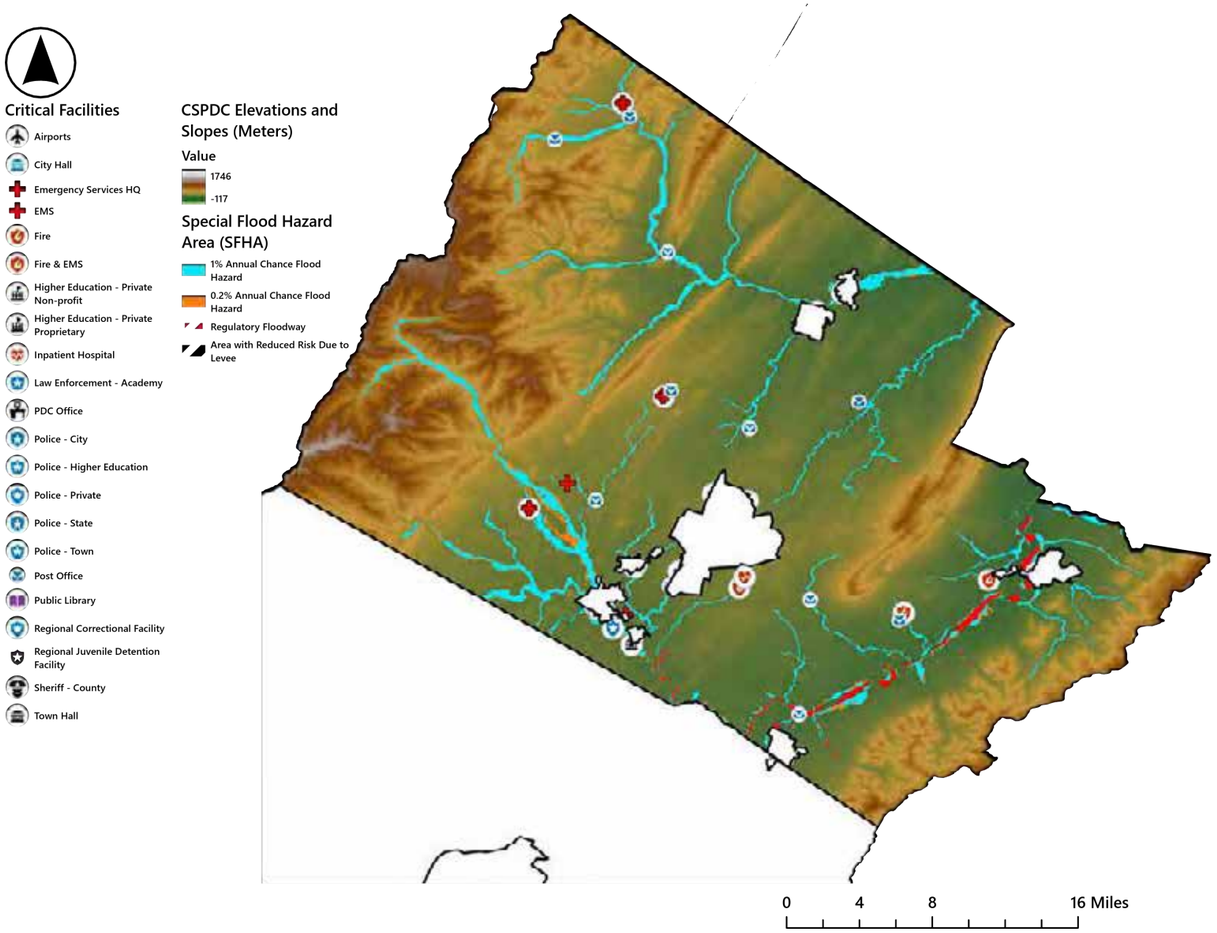


Figure 4.82
Rockingham County Crashes Due to Standing or Moving Water (VDOT), Roads, and Special Flood Hazard Areas

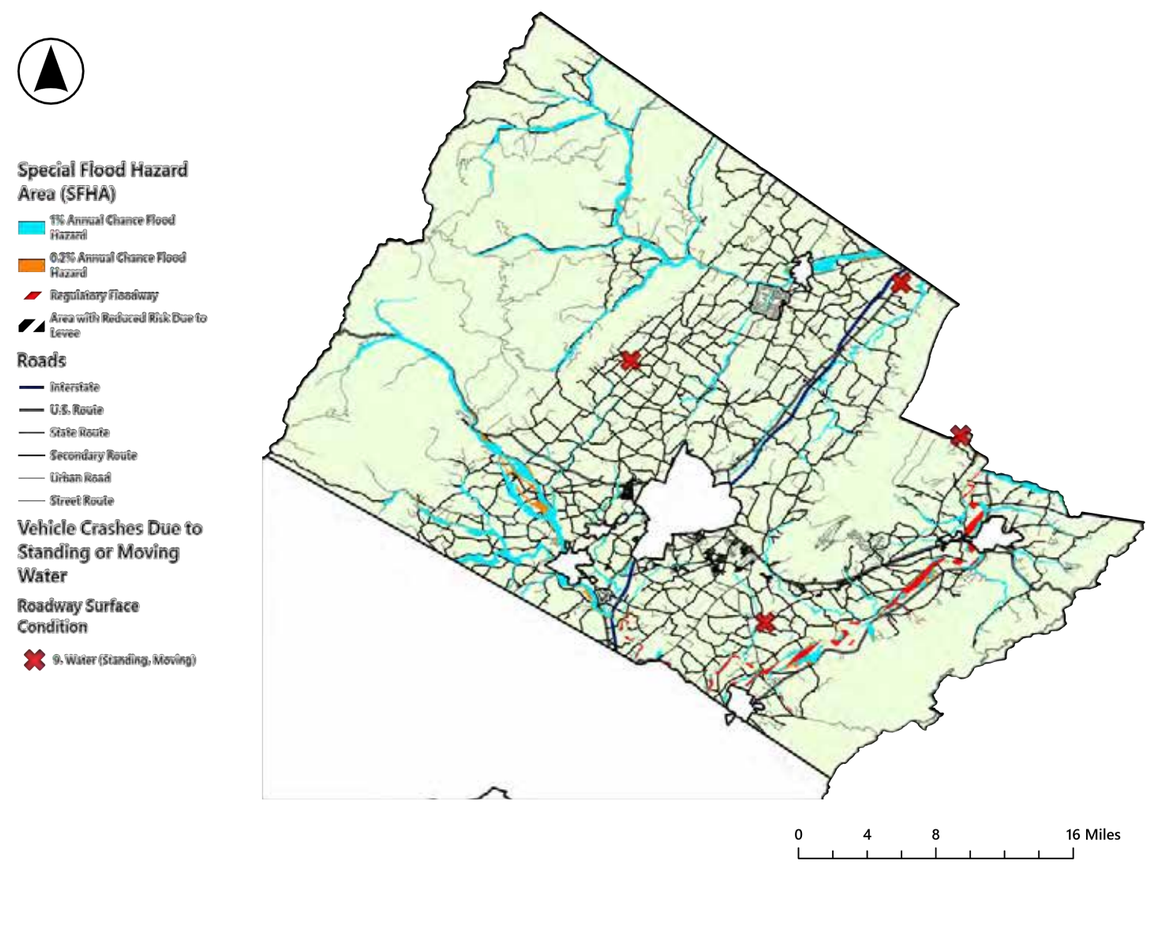


Figure 4.83
Rockingham County Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas

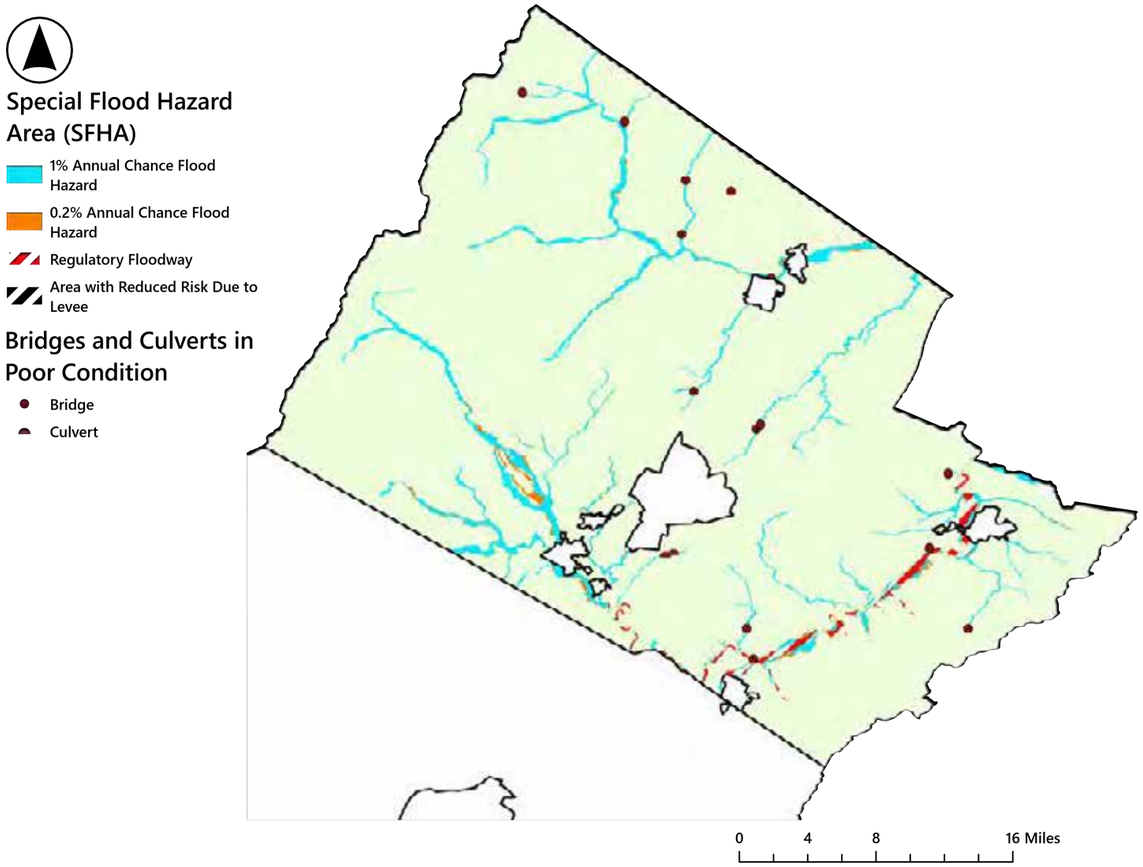


Figure 4.84
Rockingham County Water Treatment and Special Flood Hazard Areas

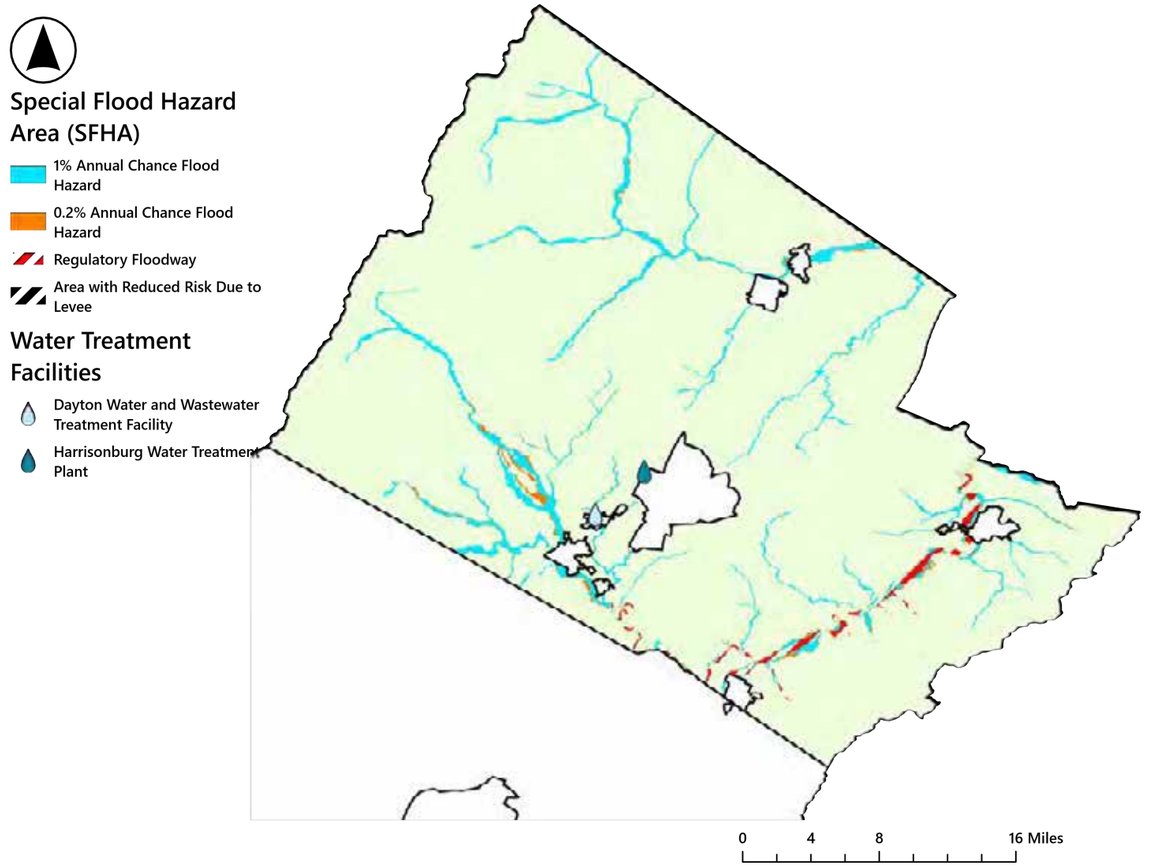
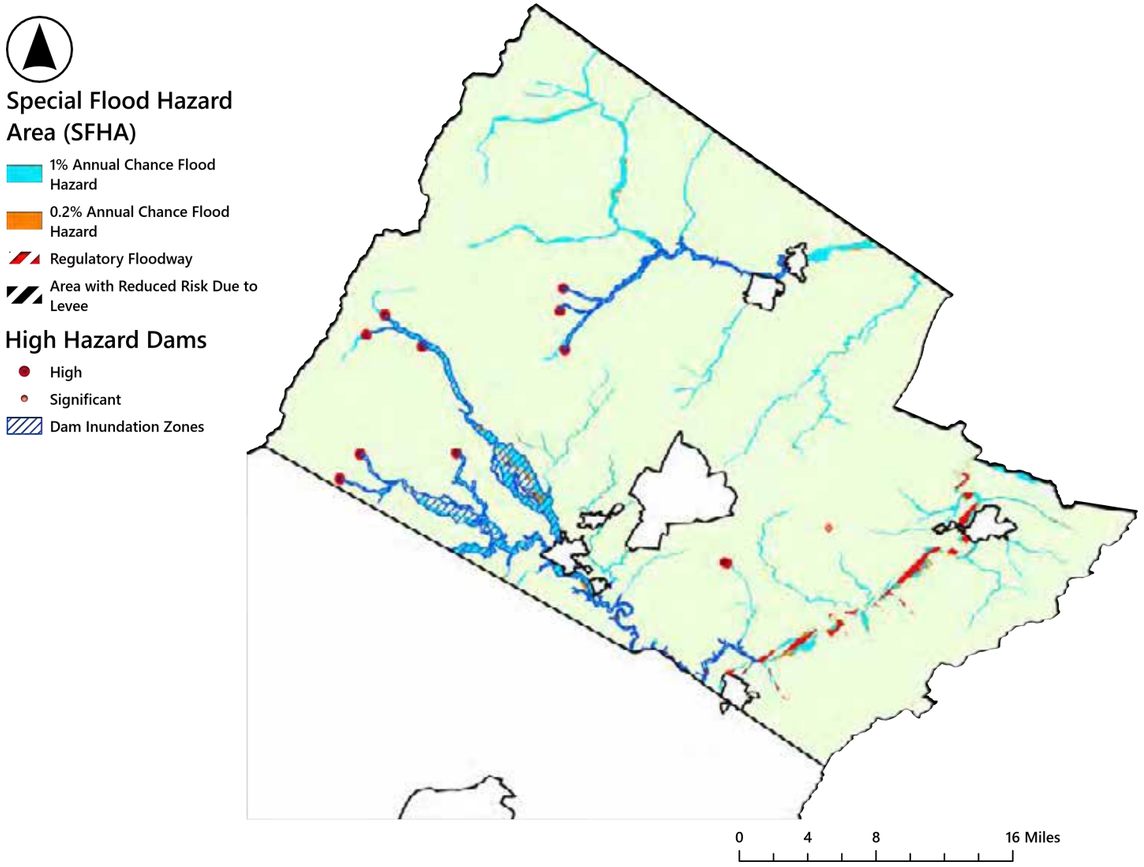


Figure 4.85
Rockingham County Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



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Natural Resources

About 33 percent of the County is public land. Large conserved lands and ecological cores occupy the mountain blocks east and west of the Shenandoah Valley, while the central valley is predominantly agricultural and developed. Many river corridors crossing this working landscape lack the level of protection found in the uplands.

Figure 4.86
Rockingham County Conservation Easements and Special Flood Hazard Areas

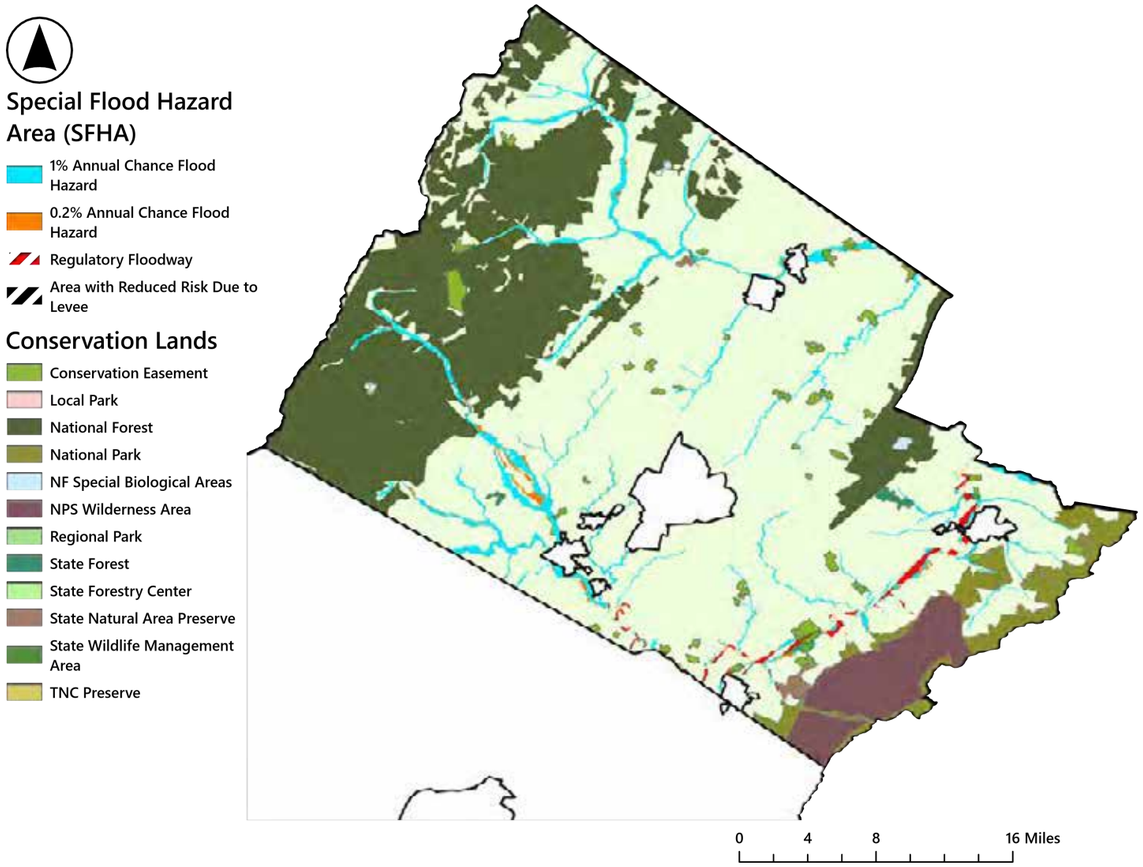


Figure 4.87
Rockingham County Land Cover and Special Flood Hazard Areas

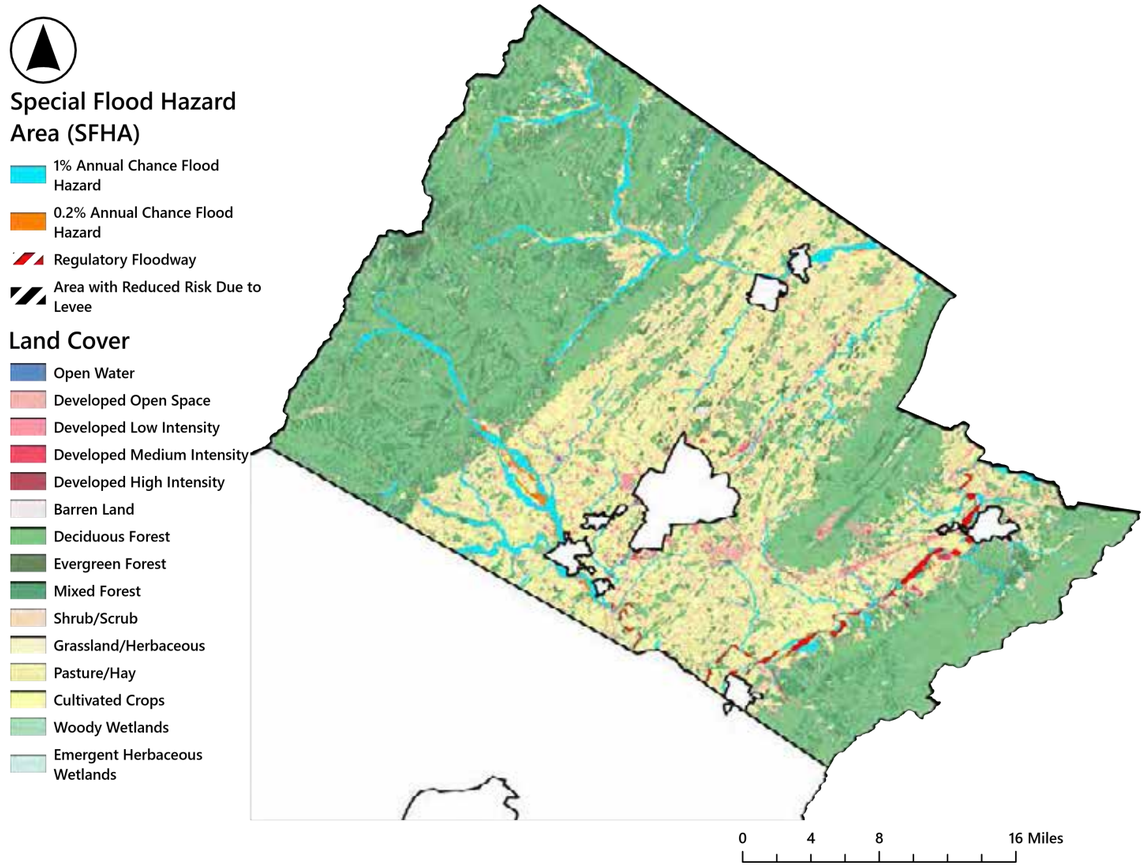
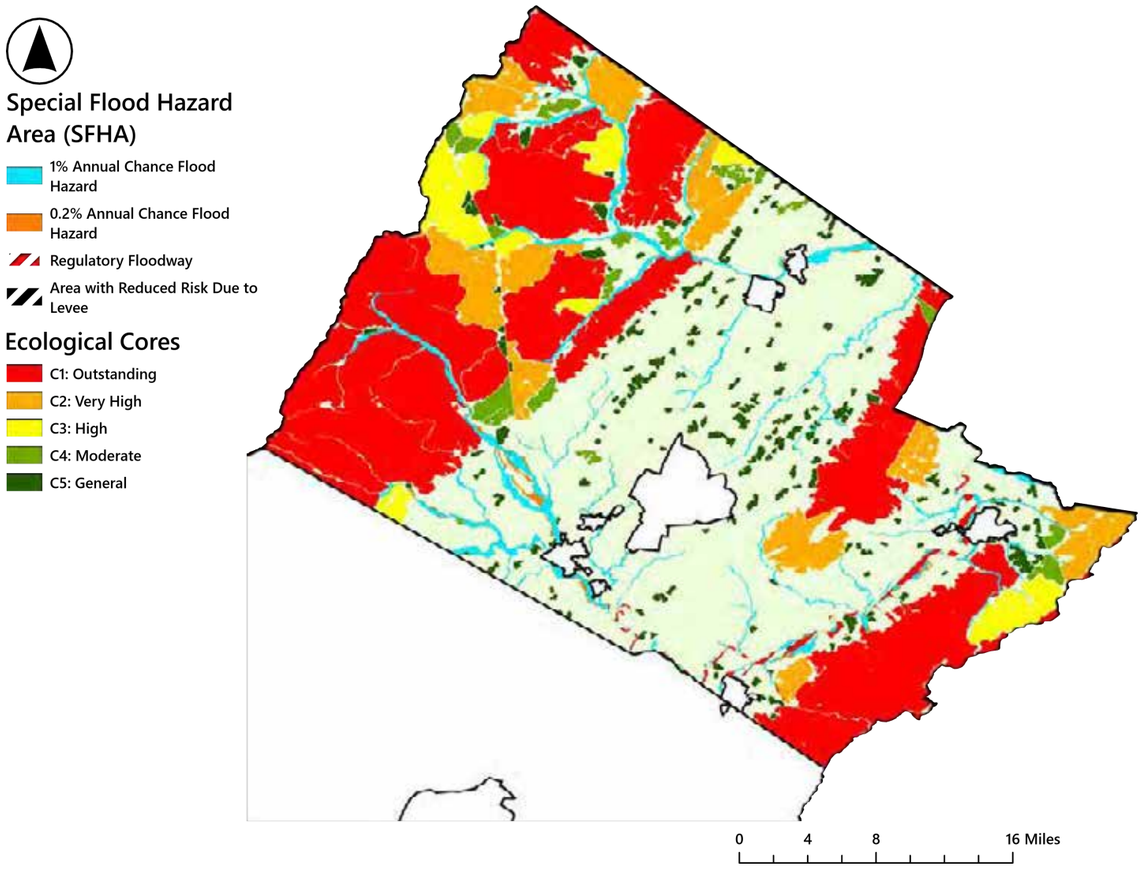


Figure 4.88
Rockingham County Ecological Cores and Special Flood Hazard Areas



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Future Conditions

MARISA projects that Rockingham County will average approximately 16 to 34 days per year at or above 95°F by 2070, compared with about one day per year historically. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could increase rapid mountain runoff, overtop undersized road crossings, and add stormwater volume in growing areas such as the Stone Spring Road corridor.

Needs

Rockingham County's needs center on flooding issues in the northwest part of the County, stormwater capacity in the Stone Spring area, and the build-out of a new MS4 stormwater program.

Areas of Concern

Rockingham County did not identify priority projects for this plan. Instead, County staff identified one area with a community-scale, recurring flood problem and several locations of more limited concern.

The Bergton, Criders, and German River Road area in the County's northwest corner is the only area of the County where flooding has been an acute, reoccurring issue. Little Dry River runs through a narrow valley where runoff from two ridges concentrates quickly on the flat valley floor. Storms as small as a 3-year event flood the road, and a 25-year storm can produce conditions resembling a 100-year flood. Undersized VDOT culverts and two single-lane bridges that function as box culverts compound the problem. Most homes are farmhouses built on grade between the 1800s and mid-1900s. Residents were not supportive of a flood study out of concern that updated maps would impose insurance and construction requirements, but County staff are open to re-engaging the community because the Board and community sentiment have changed.

In the Stone Spring Road growth area, the Taylor Spring Lane basin is at capacity, and Congress Creek and Pleasant Run will receive increased runoff as the area builds out. In Cobbler's Valley, runoff from the partially built Zephyr Hill subdivision overwhelmed the State Route 42 culverts during a recent storm. The subdivision has since been stabilized, but the event underscores that new development can have unanticipated stormwater impacts.

The 2002 regional flood plan identified several additional areas that County staff did not raise in 2026:

- Port Republic, where about half of the village's roughly 65 structures have flooded from the North and South Rivers;
- Rawley Springs, where about 38 percent of dwellings lie in the floodplain and Spring Run reclaimed its original channel through Rivenrock Park in 1992 and 1996;
- the Dry River communities, including Countryside Estates, where seven of 18 properties have flooded and the community well lies in the floodplain;
- Naked Creek, where Hurricane Fran destroyed or heavily damaged about two dozen homes.

Stormwater Program Development

The County recently entered the MS4 program and has not yet adopted stand-alone stormwater management ordinances. Its current authority is limited to the illicit discharge provisions the MS4 permit requires and to erosion and sediment control, which is being updated to meet the Virginia Stormwater Management Act. Post-construction stormwater standards are an important near-term need. The County owns no stormwater infrastructure other than the Taylor Spring Lane basin. It addresses subdivision and rural drainage complaints as they arise, in coordination with VDOT and property owners.

Critical Facilities

The County's refuse transfer site in Elkton lies almost entirely within the floodplain. The County is working with the Town of Elkton to move components out of the floodplain, although full relocation is not feasible. About half of the County government building in Harrisonburg sits in the floodway over Blacks Run, which passes beneath it in a culvert; however, County staff do not consider this an active risk given the building's design.

Coordination and Floodplain Administration

A large share of resident flooding complaints involve VDOT roads, including single-lane gravel roads that wash out during heavy rain.

The County's flood maps date to February 2008. The FEMA update now under way will likely add some properties to the floodplain because of improved modeling. The towns rely on the County's emergency operations plan, whose debris management provisions could be developed further.

The County's TMDL-impaired streams, Blacks Run, Cooks Creek, and Linville Creek, offer opportunities to pair flood and water quality projects, although the County owns no parcels along Blacks Run or Cooks Creek. As an MS4, the County could also partner on projects downstream, such as stream restoration along Cooks Creek in Dayton, that generate pollutant reductions toward its Cooks Creek TMDL obligations. Residents also frequently ask the County about Lake Shenandoah, a state-owned facility whose deteriorated dam led to a drawdown of the lake. The County has no authority over that facility.

Resilience Actions

Table 4.18 | Rockingham County Resilience Actions

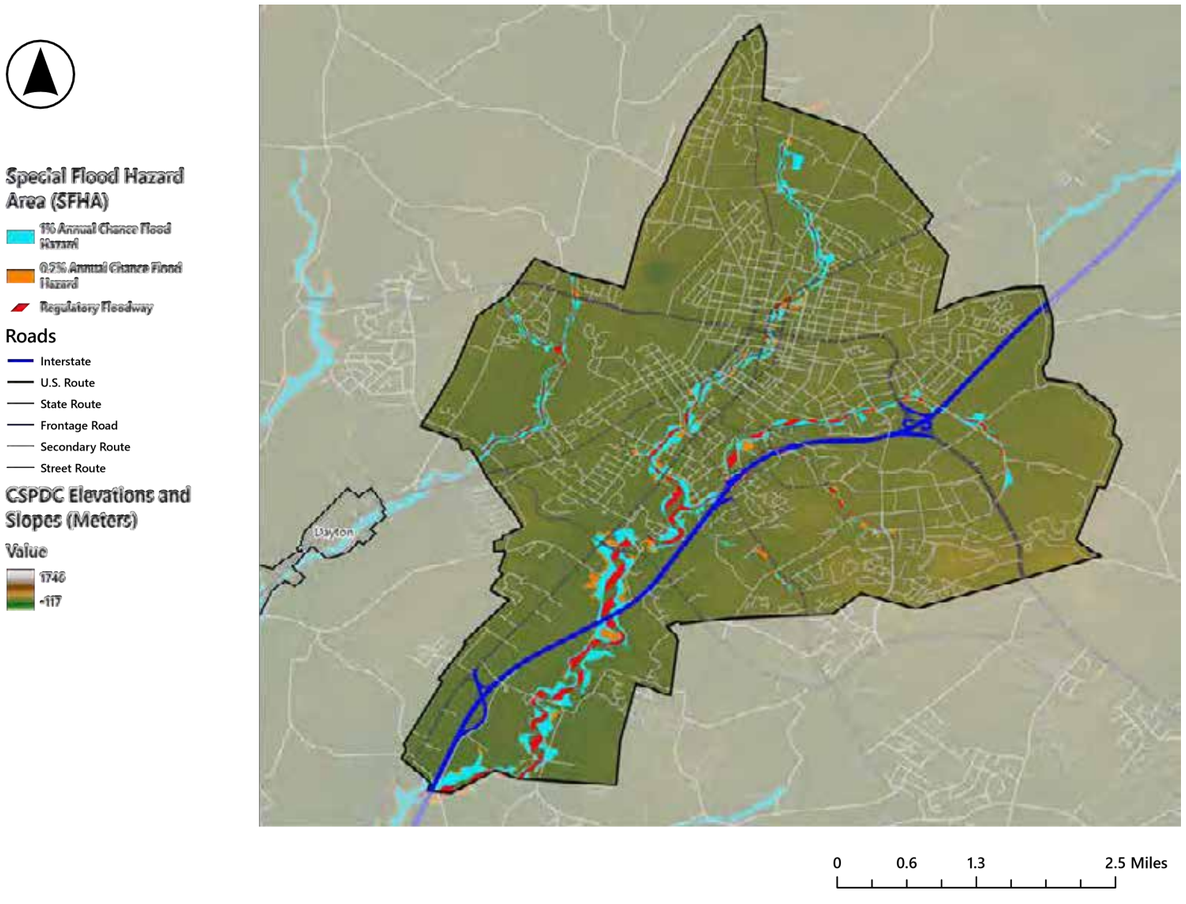
#	Action	Timeline	Potential Partners	Related Actions
1	**Continue to evaluate the feasibility of a flood study for the Bergton, Criders, and German River Road corridor,** re-engaging residents prior to study advancing.	Mid	VDOT; residents; CSPDC	Regional 1
2	**Adopt post-construction stormwater ordinances** suited to the County's new MS4 program.	Near	DEQ; CSPDC	Regional 4
3	**Update floodplain information.** Notify owners affected by the FIRM update and confirm which areas of concern from the 2002 plan remain active.	Near	DCR; FEMA	HMP RH-4

Additional related HMP actions: RH-5 (natural systems flood mitigation), RH-12 (karst awareness), and RH-14 (shelter backup power).

City of Harrisonburg *At A Glance*

The City of Harrisonburg is an independent city surrounded by Rockingham County, is the largest city by population in the region, and is home to JMU, which operates its own MS4 stormwater program. The City lies within the Shenandoah River system of the Potomac basin. Blacks Run, the City's main stream, drains about 81 percent of the City; it flows from the north through downtown, much of it in buried culverts, and joins Cooks Creek south of the City. With the Sunset Heights Branch, which drains about 12 percent, about 94 percent of Harrisonburg drains to Cooks Creek and on to the North River. Small areas at the City's edges drain to Smith Creek and Linville Creek in the North Fork watershed. About 41 percent of the City is covered by impervious surfaces, which send runoff quickly into these channels.

Figure 4.89
City of Harrisonburg Locality Introduction



MS4
community

53,715
total population

809
acres in the 500 year floodplain

87
flood insurance policies in force

Flood History

Causes and Recurring Problems

Flooding in Harrisonburg is localized and stems mainly from aging and undersized stormwater infrastructure rather than overbank river flooding. Blacks Run is a small creek that runs through buried culverts for much of its downtown course, and many mapped floodplains in the City are nominally dry channels that residents do not associate with flood risk. Most flood events occur from May through July.

Major Events

In 1896, Blacks Run flooded houses along its banks. In September 1950, Blacks Run overflowed onto Main Street. Hurricane Diane in August 1955 backed up the City's flood and sewer systems into homes and businesses and damaged the City's hydroelectric dam. The City was included in federal disaster declarations for Tropical Storm Agnes in 1972, the 1985 Election Day Flood, and both 1996 floods; during Hurricane Fran, Blacks Run flooded but damage was minimal compared with the rest of Rockingham County. After Hurricane Isabel in September 2003, a JMU student drowned when his canoe overturned on Blacks Run.

Recent Flooding

Storms in late May and early June 2018 produced rainfall rates of 6 inches per hour, flooded downtown businesses and City parks, closed US Route 11, and required swift-water rescues. On May 6, 2024, an approximately 200-year rainfall event flooded basements, yards, and roads in neighborhoods that had not flooded before. In late September 2024, the remnants of Tropical Storm Helene delivered several inches of rain in about an hour, causing flash flooding and road closures. Public Works tracks recurring flooding complaints in a complaint log and records all flood responses in its Cityworks asset management system.

Existing Conditions

Vulnerable Populations

Harrisonburg's highest social vulnerability is concentrated in northern and eastern neighborhoods and in portions of the south; households without vehicles are especially concentrated in northern and central tracts. Several drainage corridors pass through or near these densely developed areas.

Figure 4.90
City of Harrisonburg Social Vulnerability Ranking by Census Tract

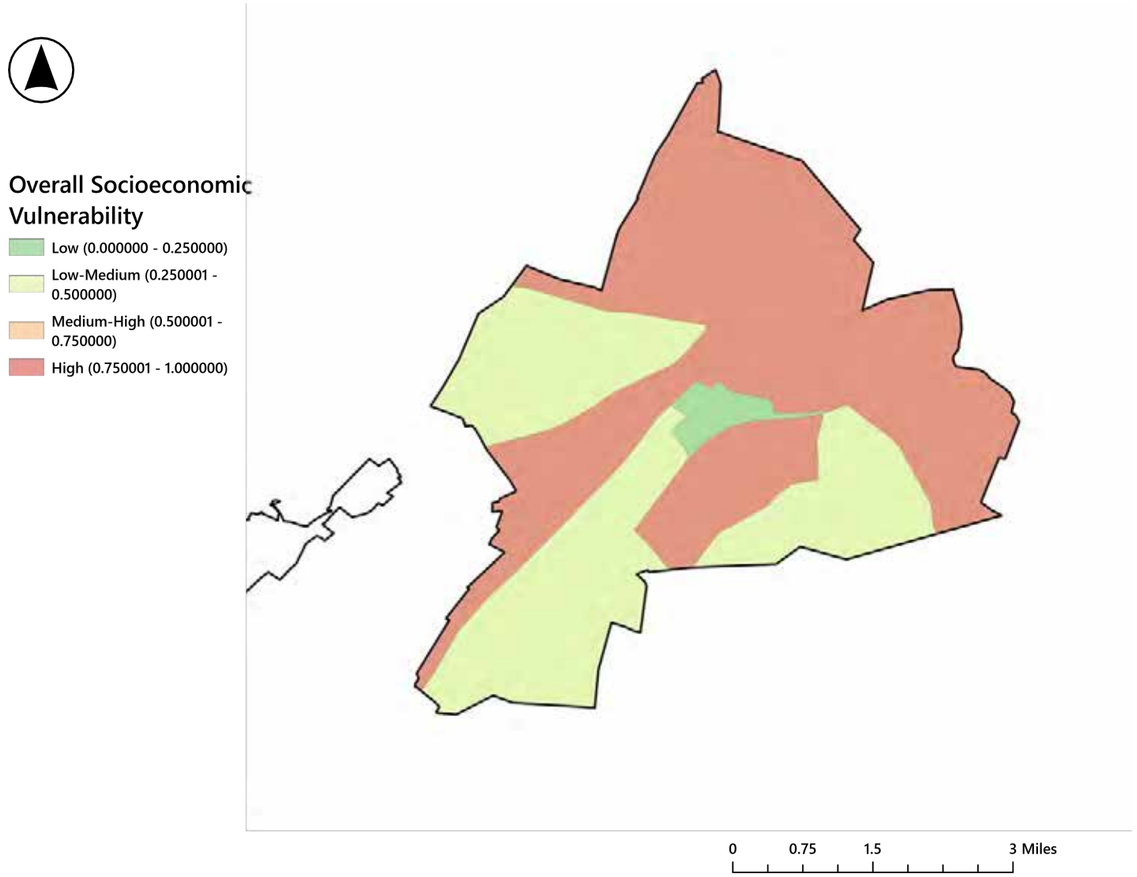
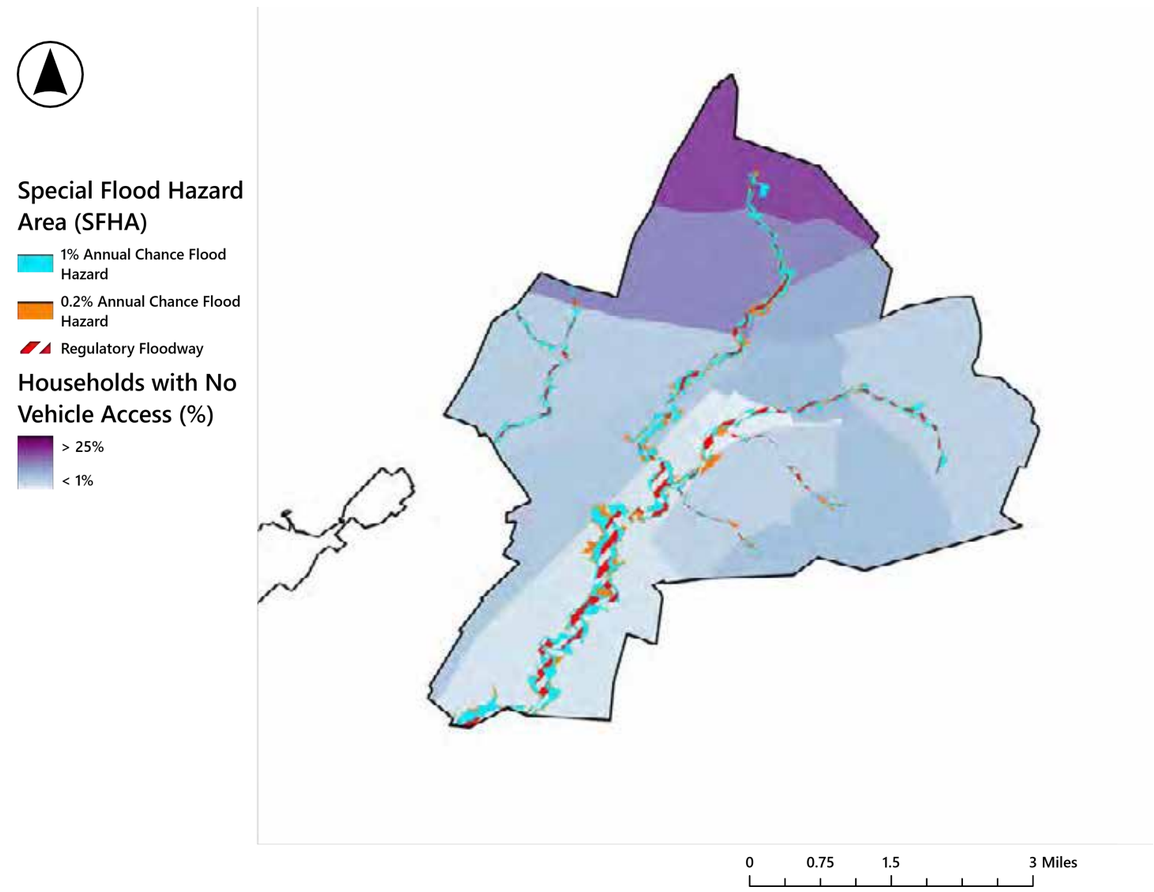


Figure 4.91
City of Harrisonburg Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

Mapped floodplains are relatively narrow, but the City's central stream network passes through dense development near critical facilities and road crossings. A fire station and a major electrical substation on Maryland Avenue sit in the floodplain, with Blacks Run exposed behind them, and most of the Public Works complex lies in the floodplain or floodway. Downtown, the floodplain is mapped above ground even where Blacks Run runs in culverts, so many civic and commercial buildings appear within it. The City has four repetitive-loss properties.

The City owns 48 stormwater management facilities, which it inspects annually, and it inspected 18 privately owned facilities during the 2024–25 reporting year. Most existing facilities are dry detention ponds built to control runoff volume; they provide little water quality benefit and are strong candidates for retrofit.

Figure 4.92
City of Harrisonburg Special Flood Hazard Areas, DEM, and Critical Facilities

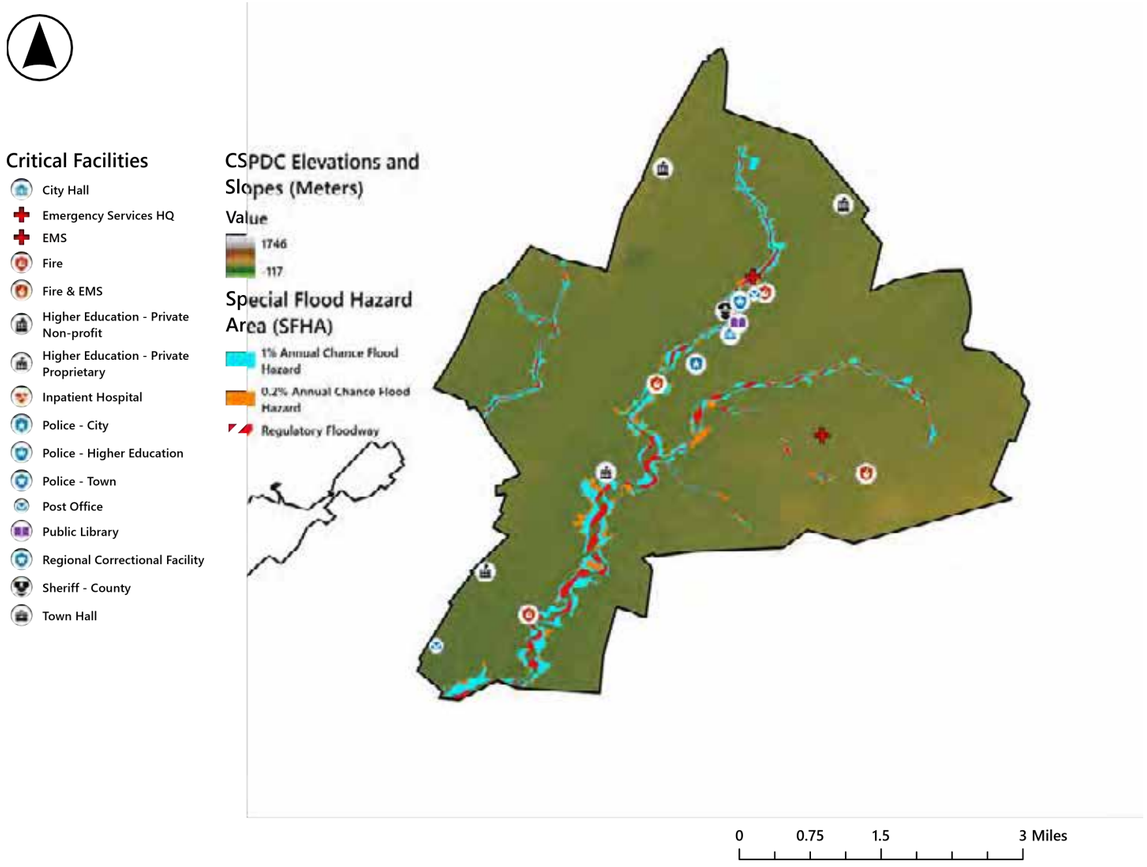


Figure 4.93
City of Harrisonburg Crashes Due to Standing or Moving Water (VDOT), Roads, and Special Flood Hazard Areas

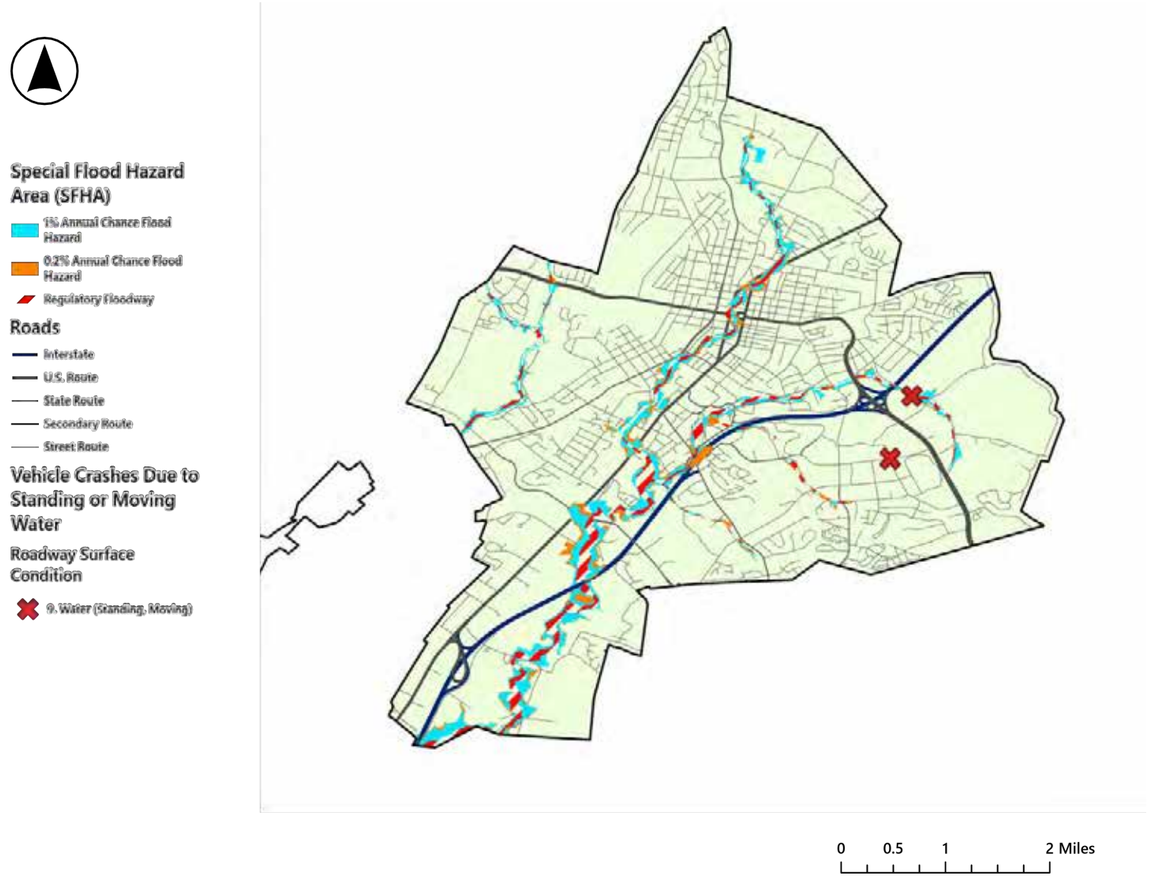


Figure 4.94
City of Harrisonburg Bridges and Culverts Classified as “Poor” Rating, VDOT, 2024
Overlaid on Special Flood Hazard Areas

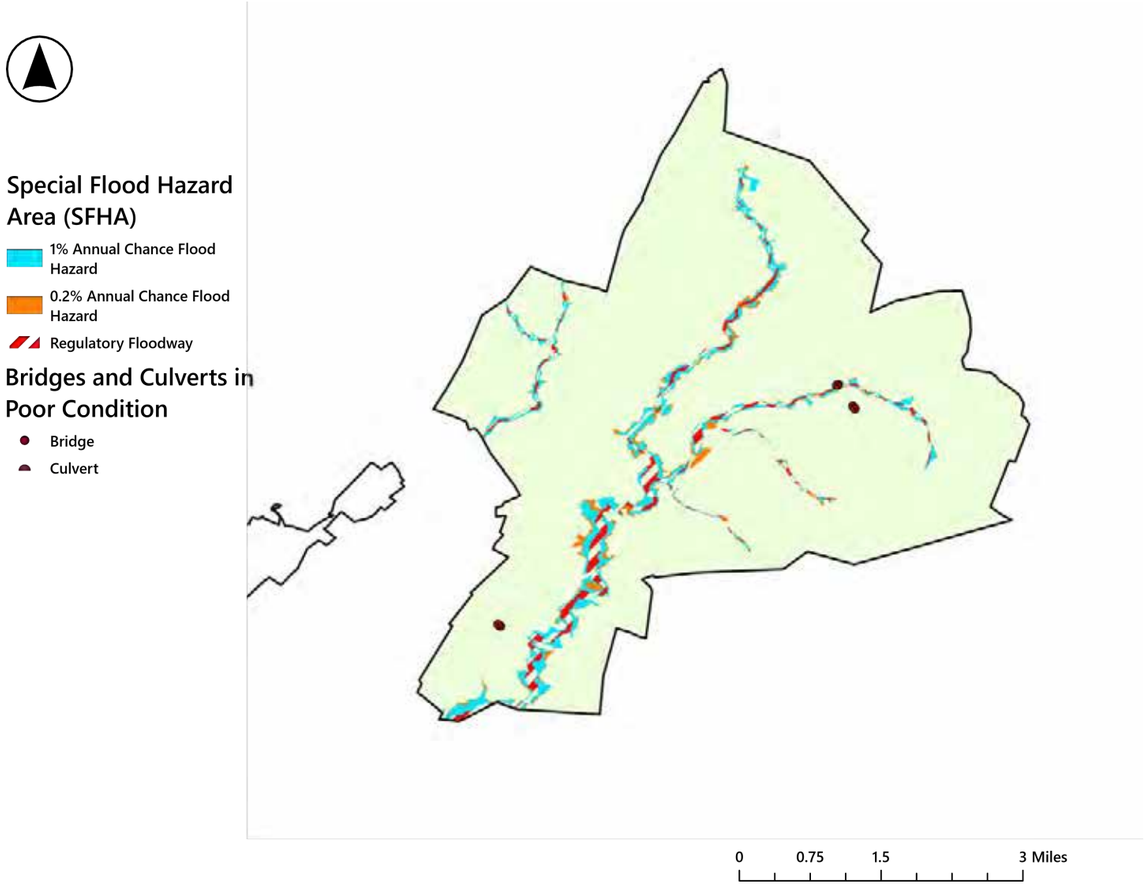
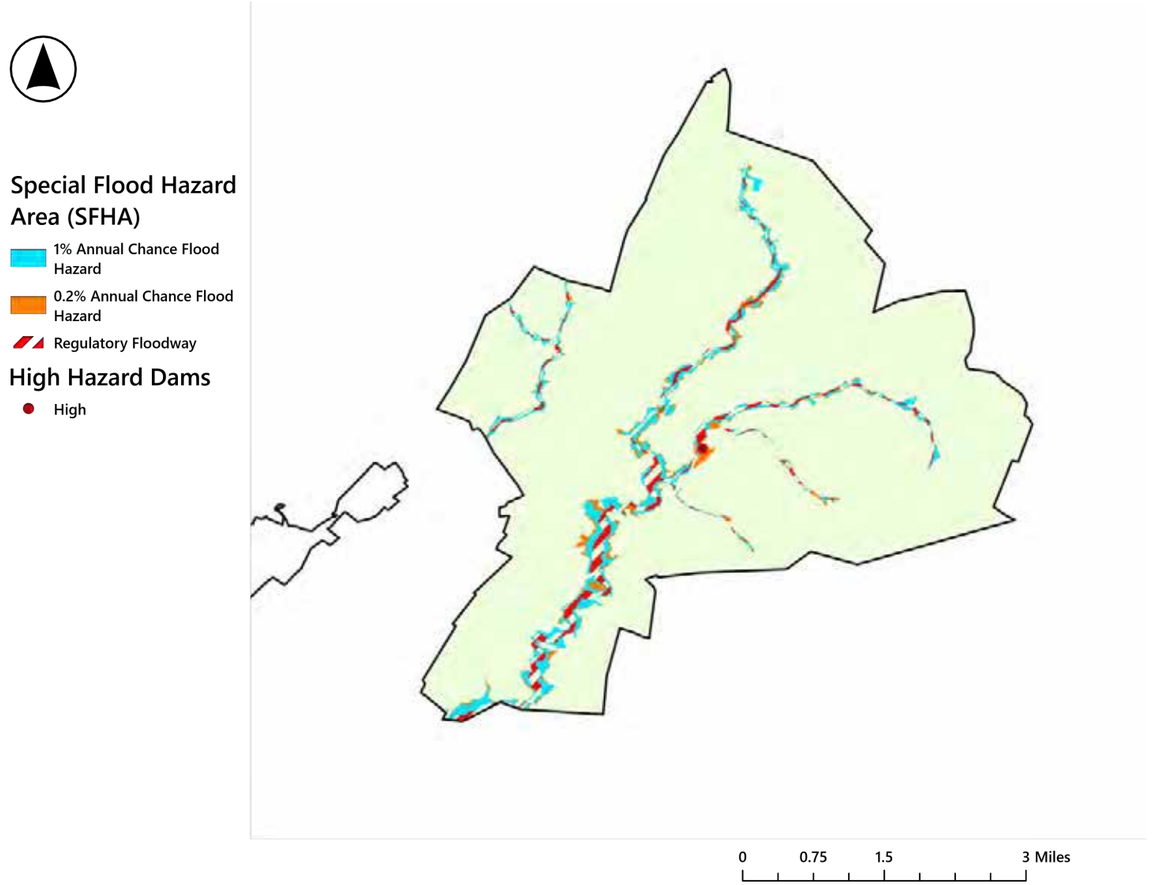


Figure 4.95
City of Harrisonburg
Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



Natural Resources

Harrisonburg has limited conserved land and only scattered ecological-core remnants within a highly developed landscape. As a result, stream buffers, parks, and other permeable parcels carry a disproportionate share of flood-storage and infiltration functions. The City has completed four stream restoration projects, including the Blacks Run restoration in the southern part of the City, which restored just over a mile of stream, and the North End Greenway and Mountain View Drive restorations. In 2019, the City completed a woodchip bioreactor at Purcell Park on Sibert Creek, funded by the National Fish and Wildlife Foundation, and its Saufley Farm project will plant 80 to 100 acres of trees and preserve 19 acres of existing forest.

Figure 4.96
City of Harrisonburg Conservation Easements and Special Flood Hazard Areas

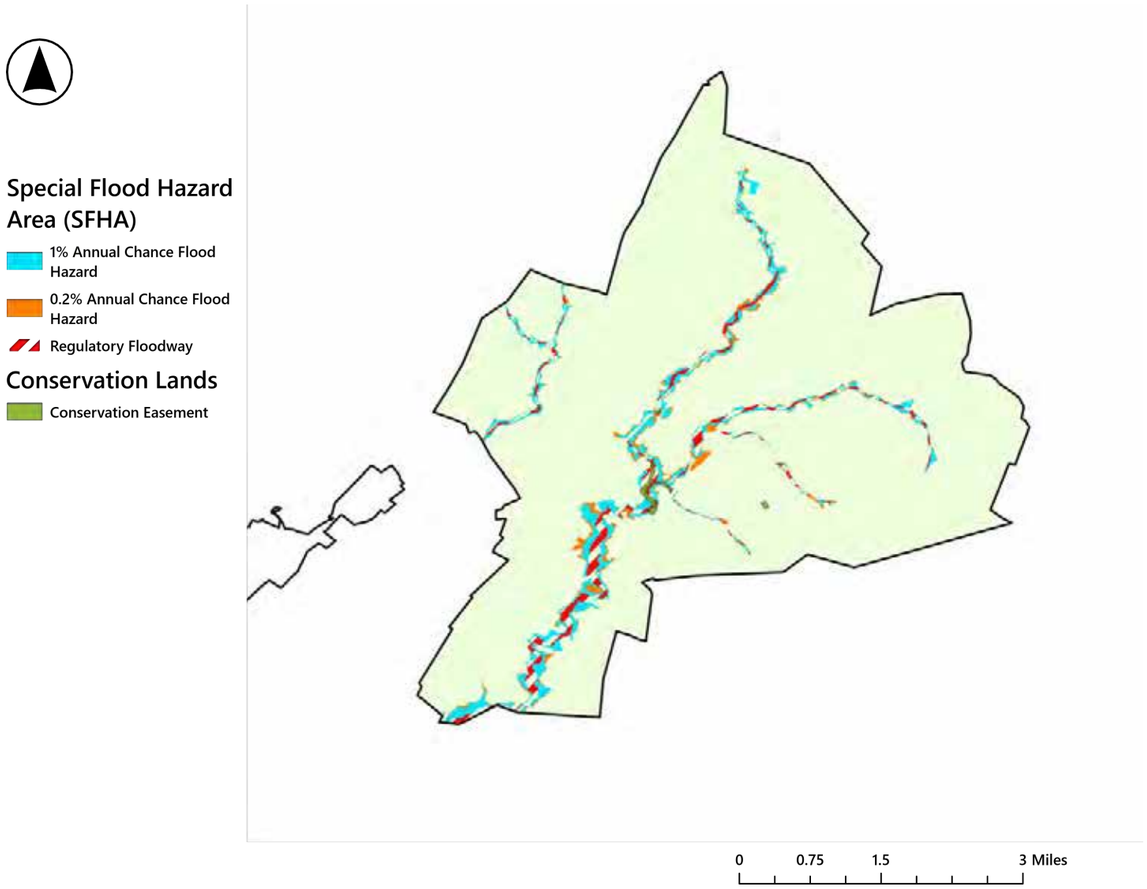


Figure 4.97
City of Harrisonburg Land Cover and Special Flood Hazard Areas

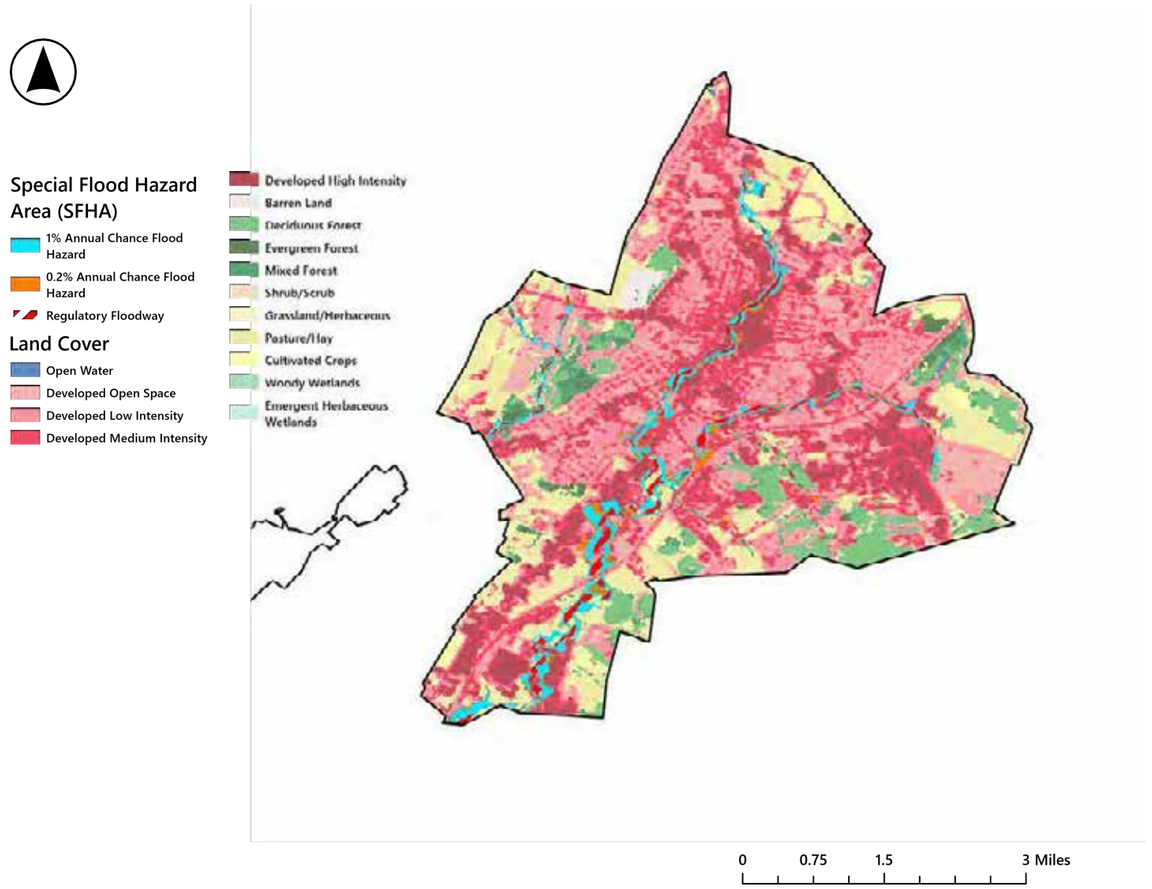
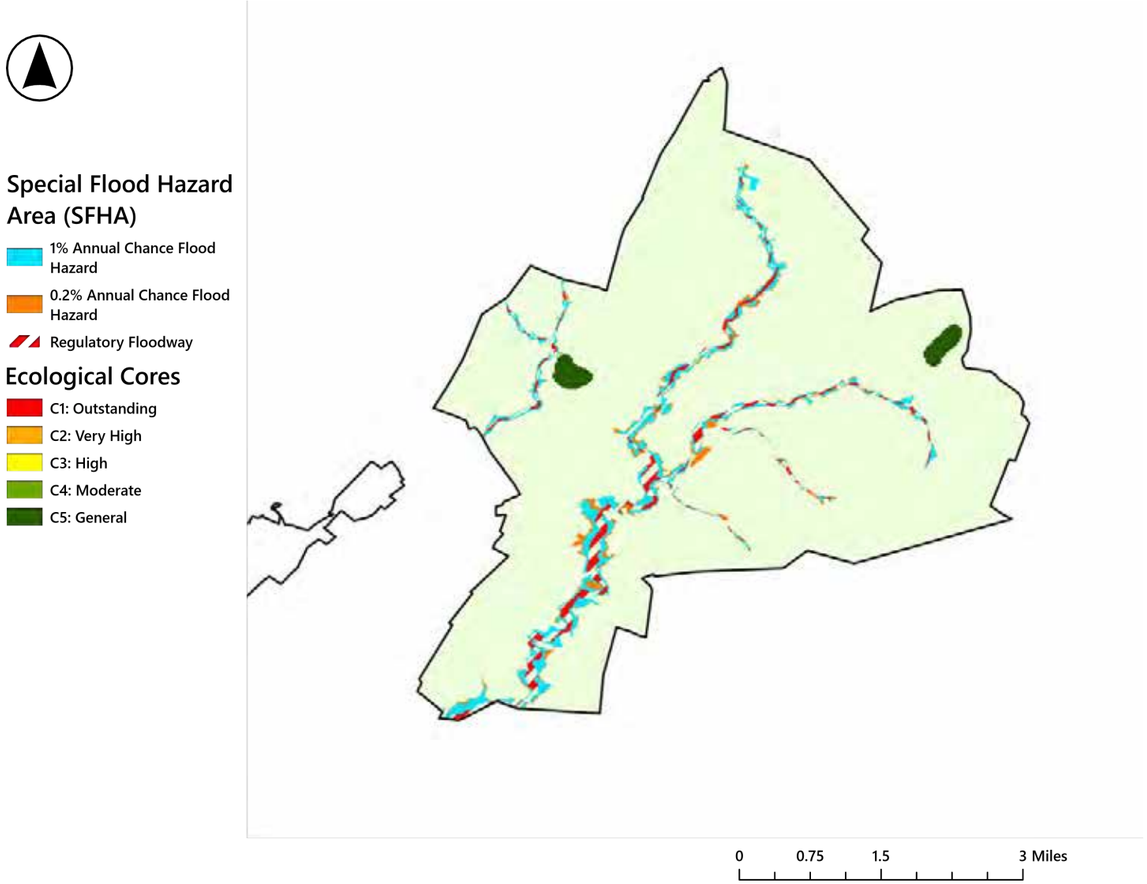


Figure 4.98
City of Harrisonburg Ecological Cores and Special Flood Hazard Areas



Future Conditions

MARISA projects that Harrisonburg will average approximately 22 to 43 days per year at or above 95°F by 2070, compared with about two days per year historically, and the City's urban heat-island effect may further increase heat exposure. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. More frequent heavy rainfall would increase runoff from impervious surfaces and add pressure on aging systems in the Waterman Drive, Suter Street, Northeast, and Chicago Avenue areas.

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Needs

Harrisonburg's needs center on neighborhood-scale stormwater improvements and on strengthening a floodplain program that is well staffed and continuing to build capacity.

Drainage and Stormwater Capacity

The City's flooding is localized rather than community-wide, and it stems mainly from aging and undersized stormwater infrastructure rather than overbank river flooding. The 2024 Stormwater Improvement Plan identifies problem areas across the City, and staff have set the following priorities:

- **Waterman Drive** is the top priority, and the City is beginning design and planning this budget year.
- **Suter Street** is second, and a preliminary design has been developed.
- **The Northeast neighborhood** is third. It will be phased, beginning with the Hill Street to North Mason Street section.
- **Woodland Drive** will benefit from an upstream stormwater facility that VDOT will build as part of the Interstate 81 widening. The City worked with VDOT to place it to protect both Woodland Drive and Waterman Drive.
- **The Pleasant Hill Road, Rex Road, and Central Avenue area** is the next candidate for study, and a study application is pending in the City's drainage improvement program.

The City is awaiting outside funding decisions for Waterman Drive and Suter Street. If those applications succeed, it would apply for CFPF funding for the Northeast neighborhood. All three priority neighborhoods qualify for the CFPF's reduced 10 percent local match.

Beyond the priority neighborhoods, the City receives stormwater complaints from nearly every neighborhood. Most are caused by aging and failing infrastructure rather than floodplain flooding, and some pipes in older neighborhoods may be up to 100 years old. City staff track these complaints in a citywide spreadsheet, which documents the full extent of the need.

The City's 2024 Stormwater Improvement Plan identified more than 100 potential stormwater projects, including stream restorations, wet ponds and wetlands, and bioretention facilities, and gave additional ranking points to projects that would reduce flooding. Meeting the local water quality targets for Blacks Run, Cooks Creek, and Smith Creek would require about $95 million in projects. At the City's current pace of about one project every three years, the plan estimates those targets would not be met until about 2370. The City's stormwater utility fee, established in 2015, is not priced to address flooding and drainage problems, so drainage projects compete with water quality requirements for the same limited funds.

Residents can request City-funded drainage improvements through the City's Drainage Improvement Program. The Stormwater Advisory Committee reviews applications, which are ranked on a 100-point scale that gives the most weight to threats to habitable structures and are studied before City Council approves funding. Every affected property owner must donate the needed easements and sign a long-term maintenance agreement, and a project is dropped if any owner declines. Smaller problems affecting one or two properties are referred to the Harrisonburg Conservation Assistance Program.

Critical Facilities

The City's mapped floodplain includes dry creek channels and reaches where Blacks Run flows through buried culverts but is mapped above ground. As a result, many structures appear in the floodplain without necessarily facing material flood risk. Three locations warrant evaluation:

- **Maryland Avenue.** A fire station and a major electrical substation sit in the floodplain, with Blacks Run exposed behind them.
- **Public Works complex.** Most of the administration building and associated facilities lie in the floodplain or floodway.
- **Downtown.** Several civic and commercial buildings fall within the mapped floodplain.

Floodplain Administration and Outreach

Floodplain administration is housed in the Community Development department, where staff are building foundational procedures:

- **Substantial damage and substantial improvement policy.** The City is developing a formal policy, which is not yet in place.
- **Map revision reviews.** The City recently received its first application for a Conditional Letter of Map Revision and is working through the review with guidance from the Virginia Department of Conservation and Recreation.
- **Training.** Staff requested structured floodplain management training at the FEMA L-273 level.
- **Freeboard.** The City enforces one foot of freeboard. Staff evaluated a higher standard about three years ago but did not pursue it, citing cost to property owners. The option remains open.

The City's flood maps are about 20 years old, and FEMA is updating them. When FEMA updates flood maps, Virginia law requires localities to notify every affected property owner by certified mail, a substantial administrative task for a city of Harrisonburg's size. Henrico County recently completed the same process and has template letters that could serve as a model.

Outreach to floodplain property owners is minimal, and awareness of flood risk is limited because many mapped floodplains correspond to channels that are usually dry. Staff are developing floodplain handouts and a dedicated webpage. The City's 2024 stormwater survey, offered in eight languages, received 147 responses, and residents at the City's public meetings said flooding should rank higher among stormwater priorities. The City does not participate in the Community Rating System (CRS), but floodplain staff expressed interest if the program reopens.

Coordination and Capacity

The City brings strong capacity to these needs:

- stormwater and floodplain staff across Public Works and Community Development;
- a stormwater utility fee;
- four completed stream restoration projects;
- the in-house capacity and intent to apply for CFPF implementation grants as soon as this plan is adopted.

JMU operates its own MS4 within the City and has completed its own stream restorations and studies. JMU's own priorities may offer opportunities for joint projects. The City and JMU coordinate informally, with no formal mechanism for stormwater planning. The City is covered by the joint Harrisonburg-Rockingham-JMU emergency operations plan, which includes a debris management annex. The City has no interest in property buyouts and has not pursued FEMA elevation grants for property owners.

Resilience Actions

Table 4.19 | City of Harrisonburg Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the City's priority stormwater projects** identified in its 2024 Stormwater Improvement Plan.	Mid	—	Regional 1; HMP HA-5, HA-6
2	**Evaluate becoming a CRS participating community** by conducting an assessment of the benefits of program participation in relation to staff capacity.	Near	DCR; VFMA; Wetlands Watch; Town of Bridgewater	Regional 4, 5; HMP HA-2
3	**Coordinate with JMU** stormwater staff to improve communication on shared stormwater issues.	Mid	James Madison University	Regional 1

Additional related HMP actions: HA-3 (natural systems flood mitigation), HA-7 (flood risk outreach in neighborhoods outside the SFHA), HA-8 (stream monitoring), and HA-14 (karst awareness).

Table 4.20 | City of Harrisonburg Stormwater Improvement Plan Projects

#	Location	Description	Cost Estimate
1	1311 W Market	Retrofit Detention Pond to Level 1 Wet Pond	$478,516 (design and construction; planned FY2027)
2	400 Mountain View Dr	Retrofit Detention Pond to Level 1 Wet Pond	[To be provided]
3	938 Garbers Church Rd	Install Vegetated Filter Strip	$39,000 (design and construction)
4	1460 Smithland Rd	Install Vegetated Filter Strip	[To be provided]
5	1260 Founders Way	Install Bioretention	[To be provided]
6	474 Linda Lane	Install Bioretention	[To be provided]

Table 4.21 | City of Harrisonburg Drainage Improvement Program Projects

#	Location	Description	Cost Estimate
7	Chicago Ave and Waterman Dr	Feasibility study completed in 2025. The City applied for grant funding to implement the South Phase (quoted to be $1,059,423.75).	$6,105,498.75 (Full project)
8	Charles St to Madison St	Feasibility study completed in 2022, with 5 alternatives proposed. The City applied for grant funding to implement [phase to be confirmed] (quote to be confirmed).	$3,161,341.86 - $20,185,812.50 (depending on selected alternative)
9	Hill St to N Mason St	Phase 2 of a feasibility study is complete	TBD
10	Hill St to Community St	Phase 1 of a feasibility study is complete	TBD
11	Newman Ave	Pending feasibility study	TBD
12	Pleasant Hill Rd	Pending feasibility study	TBD
13	Country Club Rd	Pending feasibility study	TBD

Sources: City of Harrisonburg 2024 Stormwater Improvement Plan (January 2025); City of Harrisonburg Drainage Improvement Program; City of Harrisonburg MS4 Program Annual Report (2024–2025).

James Madison University *At A Glance*

James Madison University (JMU) is a public university located entirely within the City of Harrisonburg, with approximately 23,000 students and 5,500 employees. The main campus covers about 785 acres and includes academic buildings, residence halls, athletic and assembly venues, parking areas, maintenance yards, a power plant, and the Edith J. Carrier Arboretum. JMU also owns a 30-acre wooded tract about nine miles southeast of campus, which has no storm sewer system.

JMU operates its own stormwater program under a state MS4 permit, separate from the City's, and also administers its own erosion and stormwater management program. A team within Facilities Management: Engineering and Construction manages both programs. The campus drains to Blacks Run, a tributary of Cooks Creek in the North River watershed. About 117 acres drain directly to Blacks Run. The rest drains through Sibert Creek, which joins Blacks Run beside campus, or through Newman Lake, which Sibert Creek feeds and which has a drainage area of about four square miles.

Flood History

Causes and Recurring Problems

Flood risk on campus is localized rather than campus-wide. The tributaries of Blacks Run that cross campus are small creeks, so flooding is concentrated in these areas and exacerbated by aging, undersized, and buried stormwater infrastructure and to flash flooding. The campus's impervious surfaces speed runoff into Sibert Creek, Newman Lake, and Blacks Run, which affect both campus and surrounding City neighborhoods. Flooding of low-lying campus areas and access roads during heavy rain can complicate evacuation and emergency response. Many mapped floodplain areas on campus correspond to channels that are usually dry or run in buried culverts, so awareness of flood risk is low. Because the campus lies within Harrisonburg and drains to Blacks Run, the City's flood history reflects the conditions at JMU.

Major Events

Blacks Run flooded repeatedly since 1896, when it flooded homes along its banks and overflowed onto Main Street in September 1950. Hurricane Diane, August 1955, caused flooding and sewer system back-ups in homes and businesses. The City had federal disaster declarations for Tropical Storm Agnes in 1972, the November 1985 Election Day Flood, and both floods of 1996. In Hurricane Fran in 1996, Blacks Run flooded, though damage in the City was limited. After Hurricane Isabel in September 2003, a JMU student drowned when his canoe overturned on Blacks Run.

Recent Flooding

Storms in May and June 2018 produced rainfall rates of 6 inches per hour in Harrisonburg, flooding downtown businesses, parks and requiring swift-water rescues. In May 2024, an intense storm flooded basements, yards, and roads outside of the typical floodplain, and in late September 2024, the remnants of Tropical Storm Helene caused flash flooding and road closures across the City. On campus, the pedestrian tunnel under Interstate 81 floods regularly during storms, the Norfolk Southern rail line behind Bridgeforth Stadium washes out after major storms, and flooding damaged the stream restoration structures in the Edith J. Carrier Arboretum, which were repaired in spring 2026.

MS4
community

26,781
total population

688
acres

140
flood insurance policies in force

Existing Conditions

Vulnerable Populations

JMU is home to a large, transient student population in a dense campus setting. Many students are unfamiliar with local flood risk and may lack transportation during emergencies. The regularly flooded pedestrian tunnel under Interstate 81, which connects East Campus and the University Recreation Center to the stadium area, poses a particular safety risk to students and faculty.

Infrastructure

JMU maintains more than 120 stormwater management facilitites and 116 MS4 outfalls, all inspected annually, along with structural stormwater practices across campus. GIS staff and student interns are inventorying and assessing campus stormwater infrastructure, and GIS staff have mapped campus buildings in the regulated floodway and floodplain, with their ground floor elevations, to guide development and redevelopment. Because mapped floodplains include dry channels and buried culverted reaches, many campus buildings appear in or near the floodplain without necessarily facing material flood risk. Facilities of note:

- Newman Lake Dam: JMU owns and operates this state-regulated high hazard potential dam, identified in the HMP as the JMU Amphitheatre Dam. It sits over carbonate bedrock, and its failure could affect Interstate 81, Port Republic Road, and downstream commercial and residential properties with little warning.
- Facilities Management Environmental Services complex: Most of the department's operations, equipment, and vehicles are housed at this complex, in the Blacks Run floodplain
- Norfolk Southern rail line. A stretch of the rail line in the floodway and floodplain of Sibert Creek behind the stadium washes out after major storms. JMU assists the railroad with repairs through an informal partnership.

Karst terrain also underlies parts of the campus.

Natural Resources

JMU has completed three stream restoration projects that together have restored more than 7,321 linear feet of stream on campus, including the Edith J. Carrier Arboretum restoration with pocket constructed wetlands. The University has also restored riparian buffers to native meadow or forest, converted several acres of upland turf to native meadow, and planted aquatic benches along the Newman Lake shoreline. Through a partnership with the Arboretum, every fourth-grade student in Harrisonburg City Public Schools takes part in a Meaningful Watershed Educational Experience each year.

JMU stream restoration projects include:

- about 1,030 feet on the East Campus;
- about 1,600 feet along three segments of Sieberts Creek, with an associated bioretention facility;
- about 1,050 feet in the Edith J. Carrier Arboretum, with constructed wetlands.

Newman Lake has planted aquatic benches along its shoreline, and the University has converted turf areas to meadow to reduce nutrient runoff.

Future Conditions

MARISA projects that Harrisonburg will average approximately 22 to 43 days per year at or above 95°F by 2070, compared with about two days per year historically. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches. Heavier rainfall would increase runoff from campus impervious surfaces and add pressure on Sibert Creek, Newman Lake, and Blacks Run. New buildings planned in the Sibert Creek drainage area will also add runoff, which the University is evaluating through its current hydraulic modeling.

Needs

JMU has an established stormwater management program, but continued investment is needed to address drainage deficiencies, water quality requirements, aging infrastructure, and flood risks associated with dams and karst. Key priorities include advancing Sibert Creek improvements, strengthening floodplain management capacity, and coordinating watershed planning with the City of Harrisonburg.

Stormwater, Drainage, and Water Quality

JMU has identified five priority drainage areas (Table 4.23), with the highest priority along Sibert Creek near Bridgeforth Stadium and the Godwin Transit Hub. Improvements are being planned alongside the stadium expansion, Godwin Hall demolition, and transit hub relocation. A FEMA grant supports floodplain reconnection and stream restoration from behind the stadium upstream to Paul Street. Design work includes evaluating changes in peak flows between 2019 and 2025 and developing a two-dimensional flood model. JMU has exceeded its 2028 Chesapeake Bay TMDL reduction targets, primarily through stream restoration. However, the 2019 Blacks Run and Cooks Creek TMDL revision established a phosphorus allocation of 78 pounds per year, requiring a local TMDL Action Plan. JMU's MS4 permit runs from November 2023 through October 2028, and its stormwater program plan was updated following a July 2025 DEQ audit.

Infrastructure, Dam and Karst Risks

Newman Lake Dam's location over carbonate bedrock presents potential risks to downstream properties. The Hazard Mitigation Plan (HMP) identifies the need to improve karst awareness and digitize geotechnical information. The HMP also recommends assessing aging water, sewer, electric, and stormwater infrastructure in coordination with the City, building on JMU's existing GIS inventory. Flood-related sediment and debris accumulation creates ongoing maintenance needs, particularly at the Arboretum, where accumulated sediment impaired stream restoration structures installed in 2016. Corrective work was completed in spring 2026.

Floodplain Management and Emergency Preparedness

JMU must comply with state land floodplain management standards finalized by DCR in December 2025. The University lacks staff trained in floodplain management and relies on the City's floodplain administrator and DCR for technical assistance. Campus flood risk outreach is limited, although a flood safety webpage is under consideration. JMU participates in the joint Harrisonburg-Rockingham-JMU emergency operations plan, but the extent of its debris management provisions is unclear. Facilities Management currently handles post-flood cleanup.

Watershed Coordination and Partnerships

JMU and Harrisonburg share the Blacks Run watershed and maintain separate MS4 programs, but lack a formal process for coordinated stormwater planning. JMU intends to pursue CFPF funding with the City following plan adoption to advance complementary watershed projects. Existing partnerships include a VDOT detention pond at Dukes Drive and Paul Street associated with Interstate 81 widening, the annual Blacks Run Clean-Up Day, and student water quality monitoring.

Resilience Actions

Table 4.22 | James Madison University Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the projects identified in this plan.** The projects are shown in Table 4.23.	Mid	City of Harrisonburg; FEMA; DCR	Regional 1
2	**Formalize stormwater coordination with City of Harrisonburg.** Establish regular joint meetings or written agreement covering shared Blacks Run projects, data sharing, and joint CFPF applications.	Near	City of Harrisonburg	Regional 1
3	**Build floodplain management capacity.** Pursue floodplain training for key staff, document procedures for applying DCR's state land floodplain standards using the University's floodplain building map, and develop flood safety information for the campus community.	Near	DCR; City of Harrisonburg; VFMA	Regional 4,5
3	**Complete campus stormwater infrastructure inventory and condition assessment,** and use results to prioritize and schedule replacement of aging and undersized systems.	Mid	City of Harrisonburg	Regional 2,3

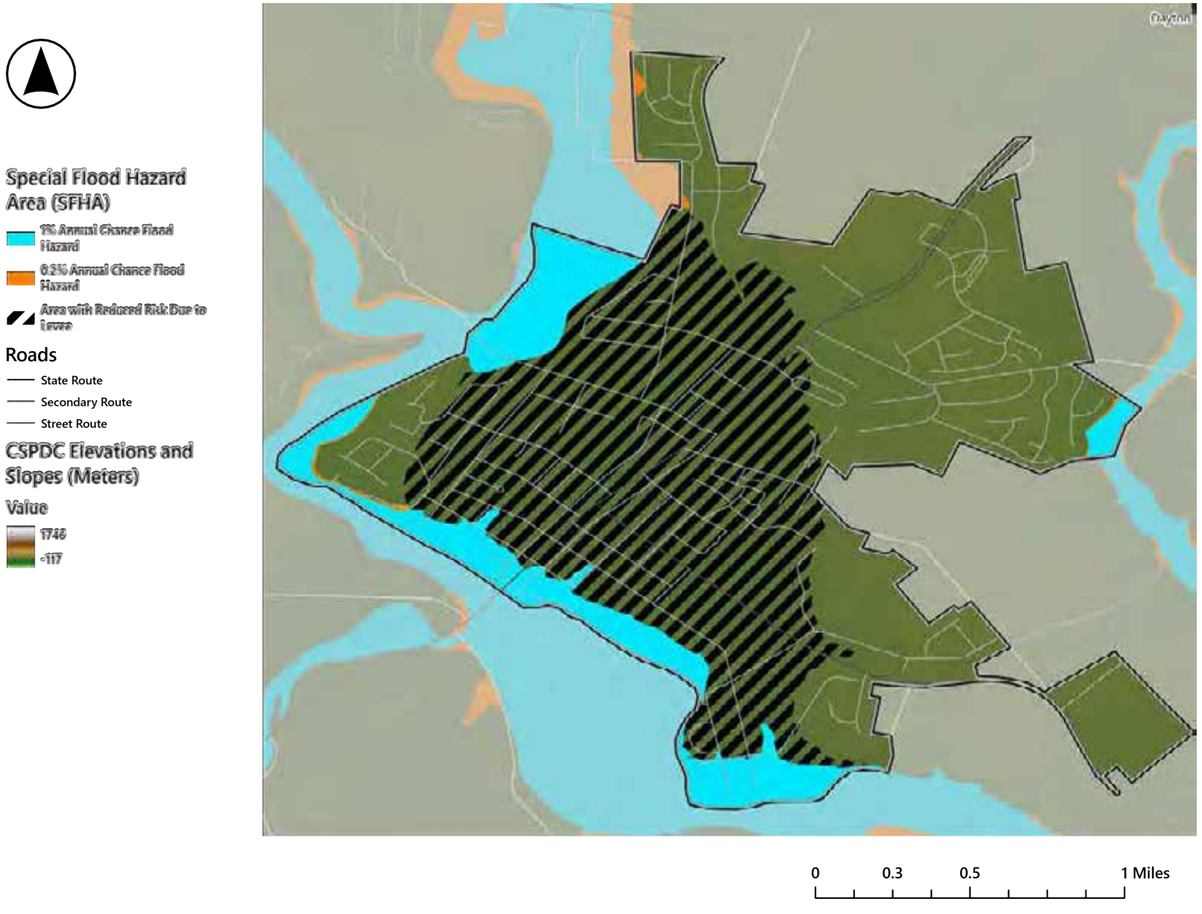
Table 4.23 | James Madison University MS4 Program Projects

Priority	Description	Status
1	**Bridgeforth Stadium and Godwin Transit Hub.** Stormwater and floodplain improvements in the Sibert Creek drainage area next to the stadium, tied to the stadium expansion, Godwin Hall demolition, and transit hub relocation.	In design and planning
2	**Sibert Creek by Mr. Chips**. Floodplain reconnection and stream restoration from behind the stadium upstream to Paul Street, supported by a two-dimensional hydrologic model.	Design funded by a FEMA grant
3	**Pedestrian Tunnel under Interstate 81.** Reduce flooding of the tunnel connecting East Campus and the University Recreation Center to the stadium, including partial removal of an adjacent parking lot in the floodway and alternatives such as a pedestrian bridge.	Parking lot changes in planning and design; alternatives in master planning
4	**Edith J. Carrier Arboretum Stream and Pond.** Continued improvements to the 2016 stream restoration, constructed wetlands, and pond, which benefit downstream University properties.	Corrective repairs completed spring 2026; further work as funding allows
5	**Sibert Creek Adjacent to the Practice Golf Facility.** Drainage study of an eroding reach along Interstate 81, evaluating relocation of the practice golf facility, removal of infrastructure, and floodplain restoration.	Future study

Town of Bridgewater *At A Glance*

The Town of Bridgewater is located in southern Rockingham County, about five miles southwest of Harrisonburg. The Town is the largest participating town by population. Most of the Town lies within the Dry River and North River drainage basin; both rivers rise on the steep, wooded slopes of the George Washington National Forest. A small northeastern segment of the Town drains to Cooks Creek, which joins the North River southeast of Bridgewater. The North River continues south to join the Middle and South Rivers and form the South Fork of the Shenandoah River. The Town has acquired substantial land along the North River and converted it to 14 public parks.

Figure 4.99
Town of Bridgewater Locality Introduction



MS4
community

6,596
total population

390
acres in the 500 year floodplain

Class 8
CRS Community

Flood History

Causes and Recurring Problems

Bridgewater's location along the Dry River and North River exposes it to periodic river flooding, but a levee built after the 1949 flood now protects most of the developed Town. Today's recurring problems stem from intense rainfall on older neighborhoods, particularly the 1970s-era Fountainhead subdivision and the North Main Street corridor, where drainage capacity has not kept pace with runoff.

Major Events

The June 1949 flood was the worst in the Town's history. Water reached the second story of many houses, three people died, one home was washed away, about 100 homes and many businesses were damaged, and 25 to 30 cars were destroyed. The flood's damage kept Bridgewater from sharing in the region's postwar growth until the 1960s and led to construction of the levee. In November 1985, North River flooding exceeded the 100-year level, but the levee spared most of the Town; homes and businesses in the southwestern section, the Town's hydroelectric plant, roads, and the Bridgewater College athletic field were damaged. Hurricane Fran in September 1996 caused more than $1 million in damage and substantially damaged 12 structures in the southwestern part of Town, most of which had also flooded in 1985.

Recent Flooding

Storms in late May and early June 2018 brought rainfall rates of 6 inches per hour to the Bridgewater area, and Hurricane Florence flooded Wildwood Park that September. During summer 2025, a storm delivered roughly 6 inches of rain in about an hour over the Cannery Woods area, flooding homes at the base of the slope; a second storm two weeks later repeated the damage.

Existing Conditions

Vulnerable Populations

Bridgewater's tract-level social vulnerability is relatively low, but the maps indicate a notable share of households without vehicles. Because the North River floodplain borders the Town and can affect key approaches, mobility is the principal equity concern.

Figure 4.100
Town of Bridgewater Social Vulnerability Ranking by Census Tract

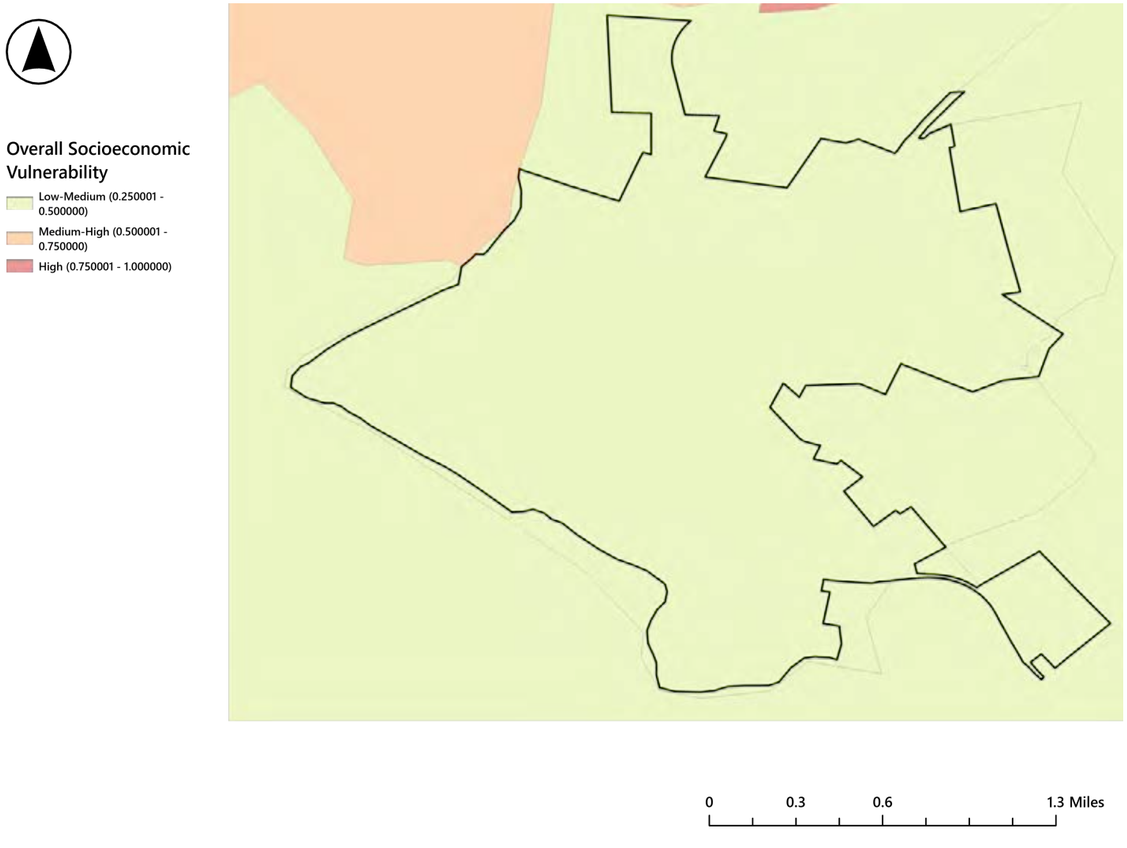
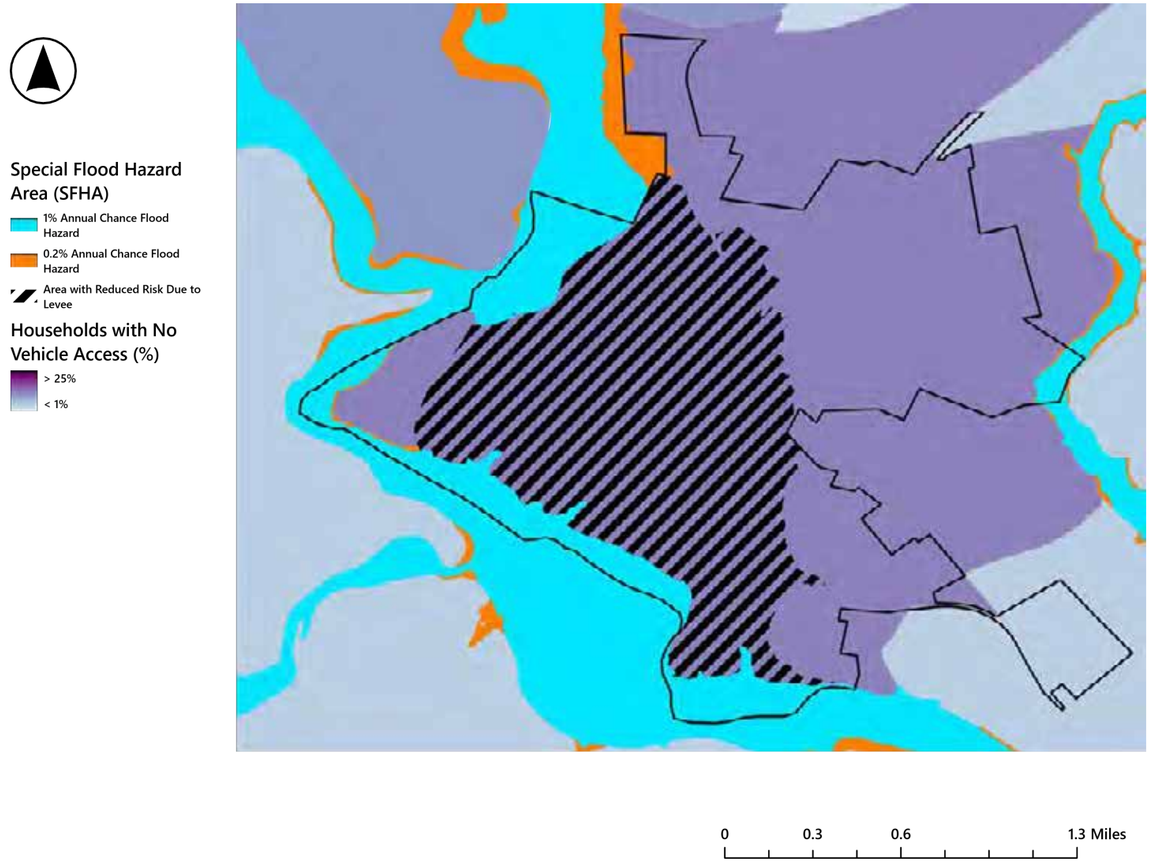


Figure 4.101
Town of Bridgewater Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

The North River floodplain occupies the Town's southern and western edge near developed areas and access routes, and the dam inundation area follows the same corridor. Critical facilities are concentrated in the Town core, but their usefulness depends on reliable crossings and approaches. The Town has one repetitive-loss property.

Figure 4.102
Town of Bridgewater Special Flood Hazard Areas, DEM, and Critical Facilities

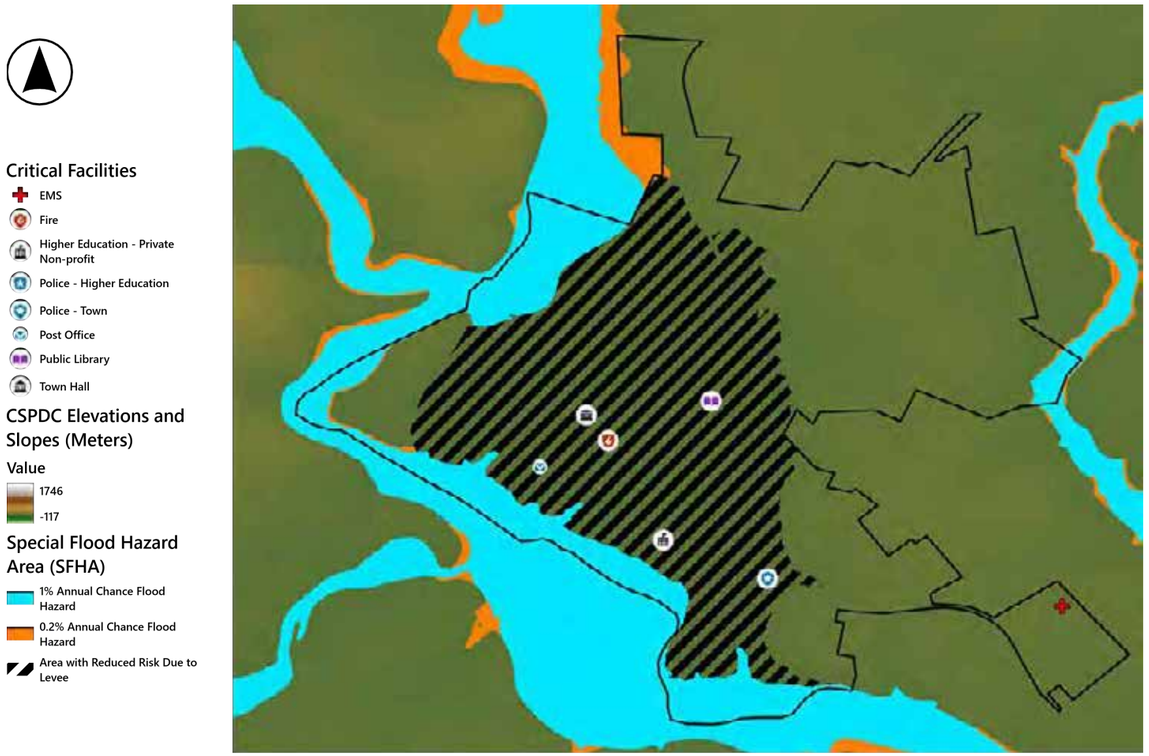
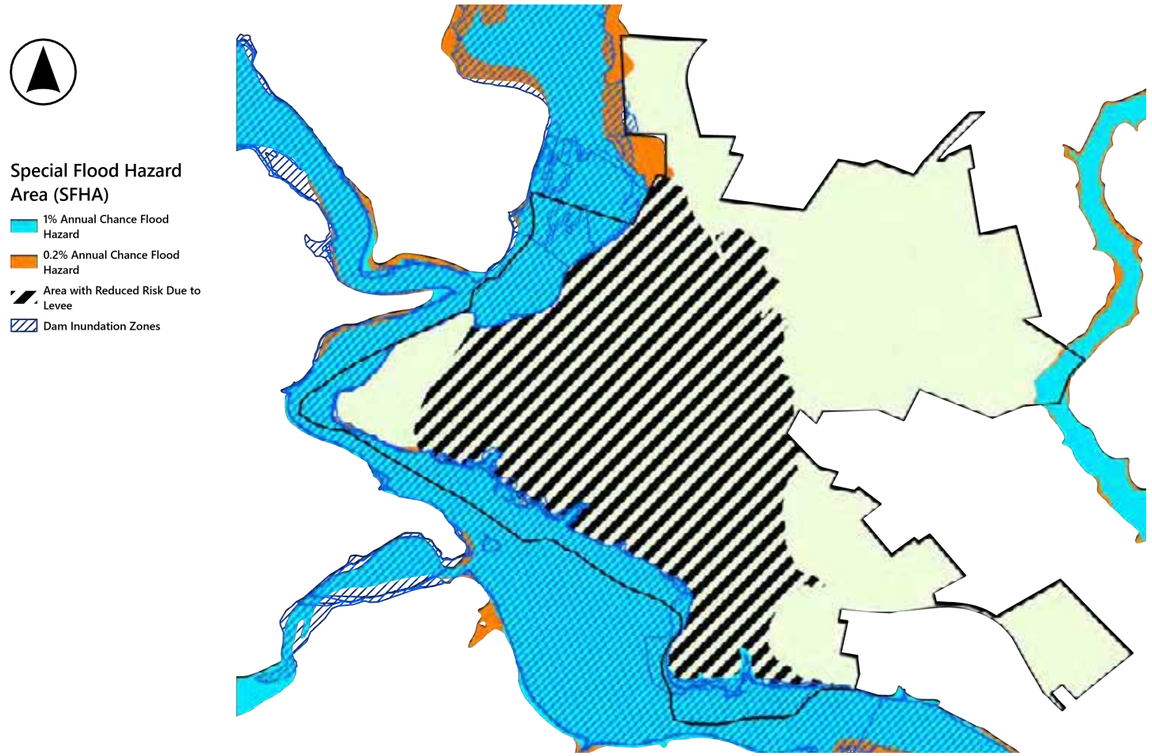


Figure 4.103
Town of Bridgewater Mapped Dam Inundation Zones, Special Flood Hazard Areas



Natural Resources

Conserved land is limited, making the North River floodplain the Town's primary natural-storage corridor. Development and agricultural land closely border the river, while larger ecological cores lie mostly beyond the Town.

Figure 4.104
Town of Bridgewater Conservation Easements and Special Flood Hazard Areas

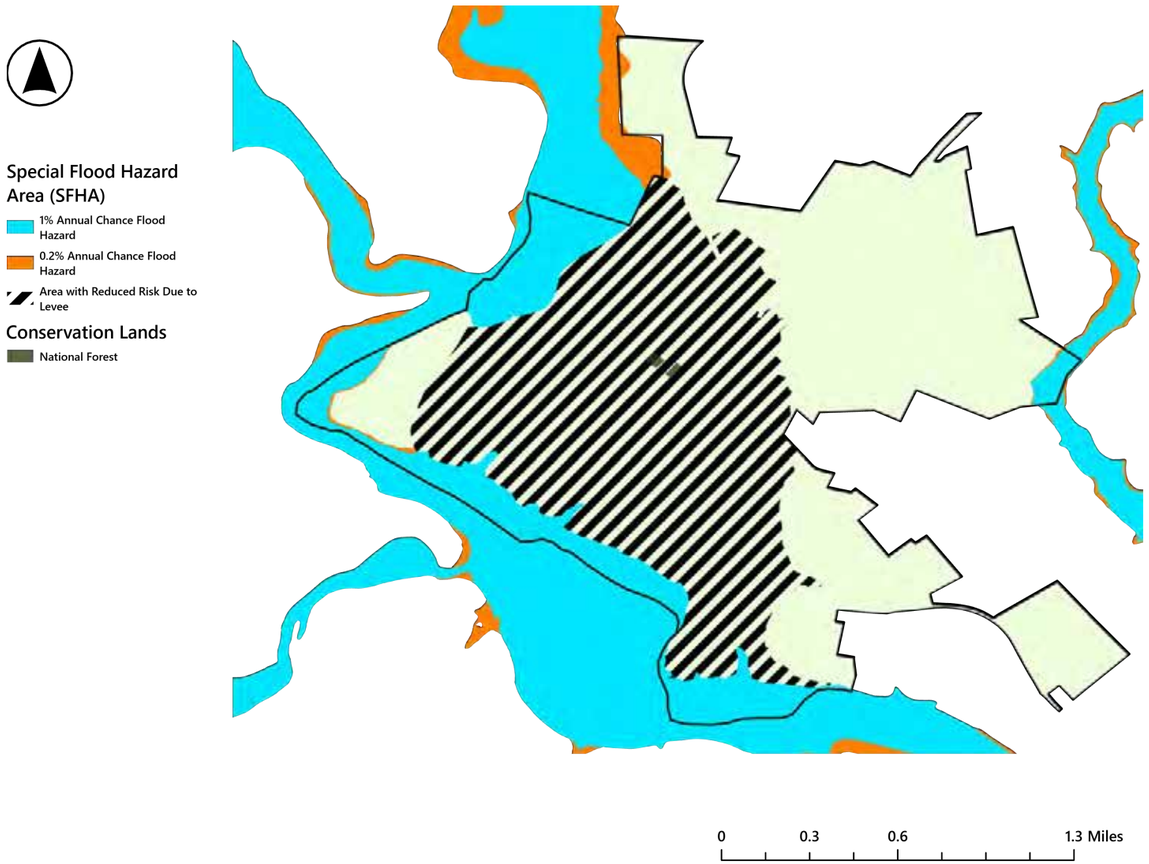


Figure 4.105
Town of Bridgewater Land Cover and Special Flood Hazard Areas

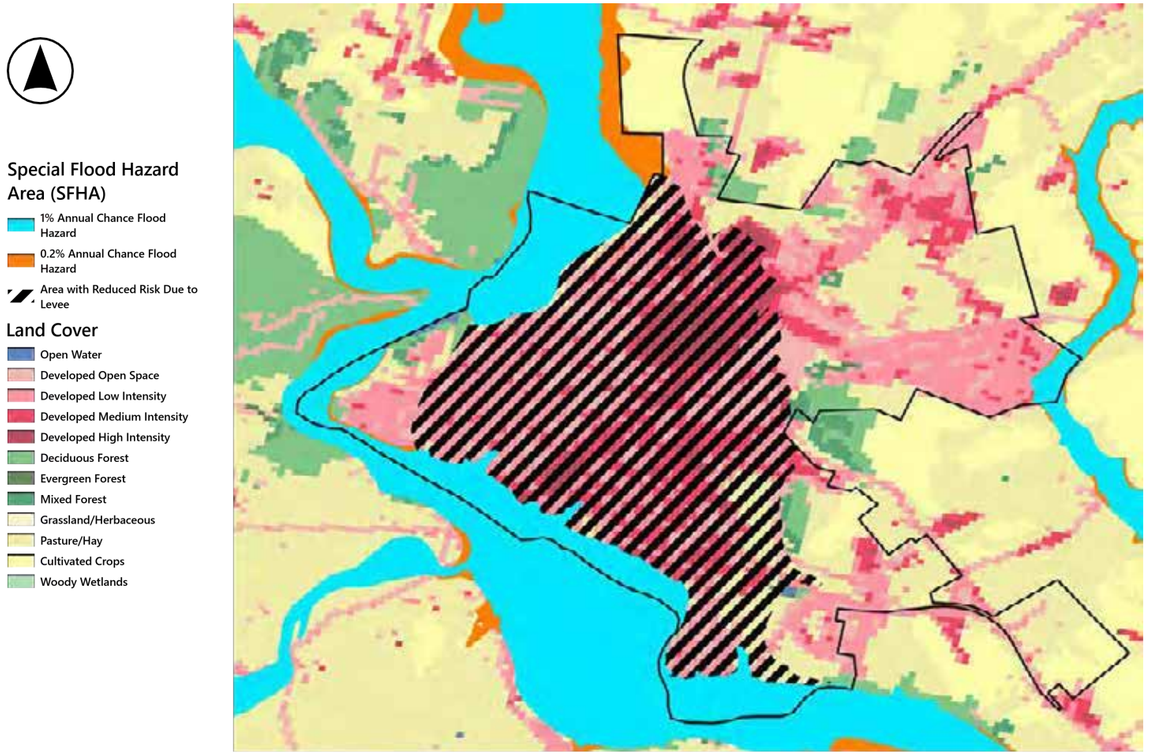
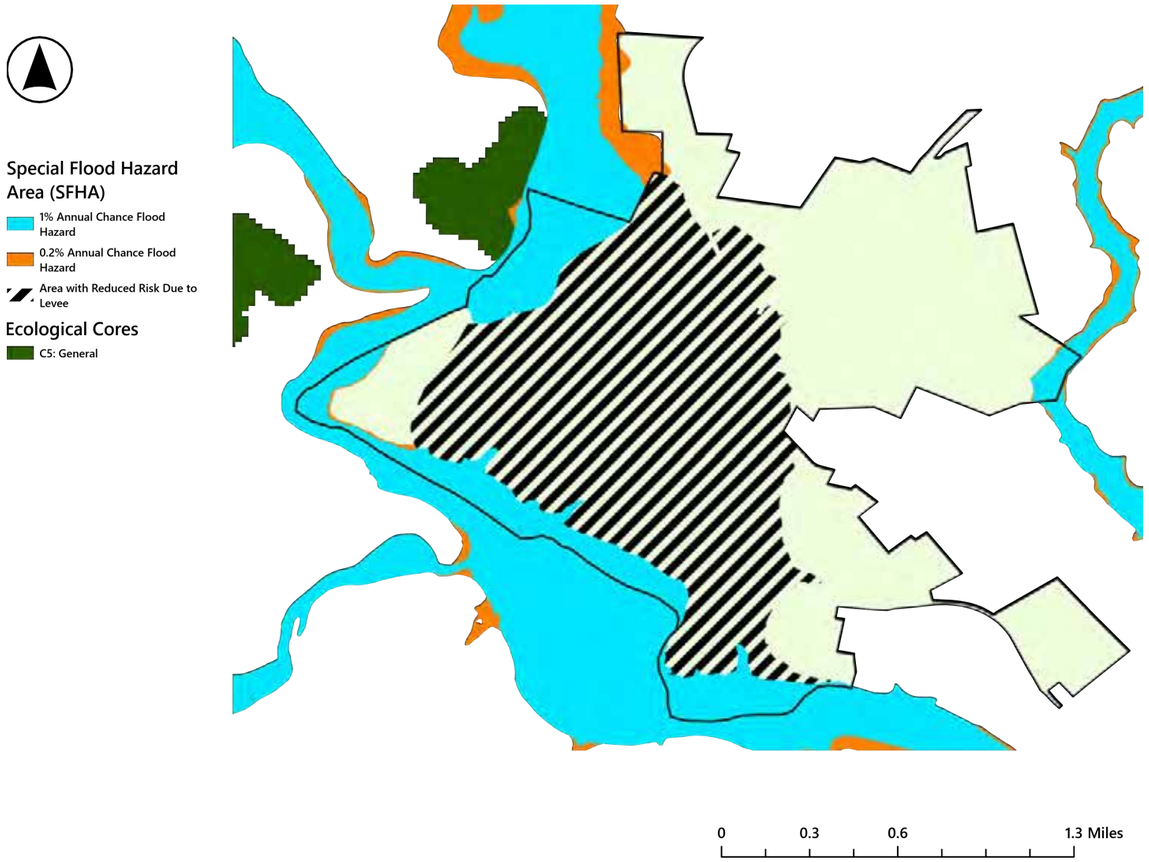


Figure 4.106
Town of Bridgewater Ecological Cores and Special Flood Hazard Areas



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Future Conditions

MARISA does not provide a town-specific outlook for Bridgewater, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. In Bridgewater, heavier rainfall could increase runoff to the North River and intensify drainage and street-flooding problems in areas served by undersized or aging infrastructure.

Needs

Bridgewater's needs center on aging drainage in older neighborhoods and developing new policies and plans.

Drainage and Stormwater Capacity

The Fountainhead subdivision, serving Brian and Cindie Streets and Steven Circle, has inadequate 1970s-era stormwater infrastructure alongside water and sewer deficiencies. A Community Development Block Grant (CDBG) planning grant completed with CSPDC produced a design basis for all three systems. The Town is pursuing CDBG construction funding for water and sewer and needs a separate source, such as CFPF, Town funds, for the stormwater component. Other needs include:

- drainage capacity below Cannery Woods and along Dry River Road, where the Town and County boundary runs through affected backyards;
- inlet and conveyance capacity on North Main Street between Green and Depot Streets, where pipe alignment and condition are not fully documented;
- minor pooling at Green and Westview Streets, where permeable pavers have worked at a similar nearby intersection.

Two townhome developments are under construction: Bridgewater Fields on the east side of Town and The Glen behind Turner Ashby High School. Newer developments generally have functioning detention facilities, but residents report worse flooding below Cannery Woods since development occurred across Dry River Road.

Stream and Riparian Conditions

Banks are eroding along the North River park corridor and at the Cooks Creek Arboretum. The Town plants 1.5 trees for every tree removed and is supportive of conducting an urban tree canopy assessment and prioritized planting plan for public rights-of-way.

Staffing and Procedures

Bridgewater is the region's smallest MS4 and its only CRS participant. CRS administration recently passed to the town manager, and floodplain duties are assigned among staff case by case, so staff requested introductory floodplain training and cross-training. The Town is developing its own emergency operations plan and does not yet have its own debris management procedures. Town staff expressed openness to further property acquisition if funding becomes available.

Resilience Actions

Table 4.24 | Town of Bridgewater Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC	Regional 1; HMP BW-8, BW-14
2	**Coordinate Cannery Woods drainage with Rockingham County,** since the problem area crosses the Town and County boundary.	Mid	Rockingham County	Regional 1
3	**Complete the Town emergency operations plan,** including debris management.	Near	Rockingham County Emergency Management	Regional 4
4	**Complete a tree canopy and conservation planting plan,** with maintenance and vegetation management training for crews.	Mid	Virginia Department of Forestry	Regional 5, 8
5	**Continue CRS participation** by using resources such as CRSresources.org to estimate credits, benefits, staffing, and annual costs, and identify existing activities that may receive CRS credit.	Near	Wetlands Watch; VFMA	Regional 5

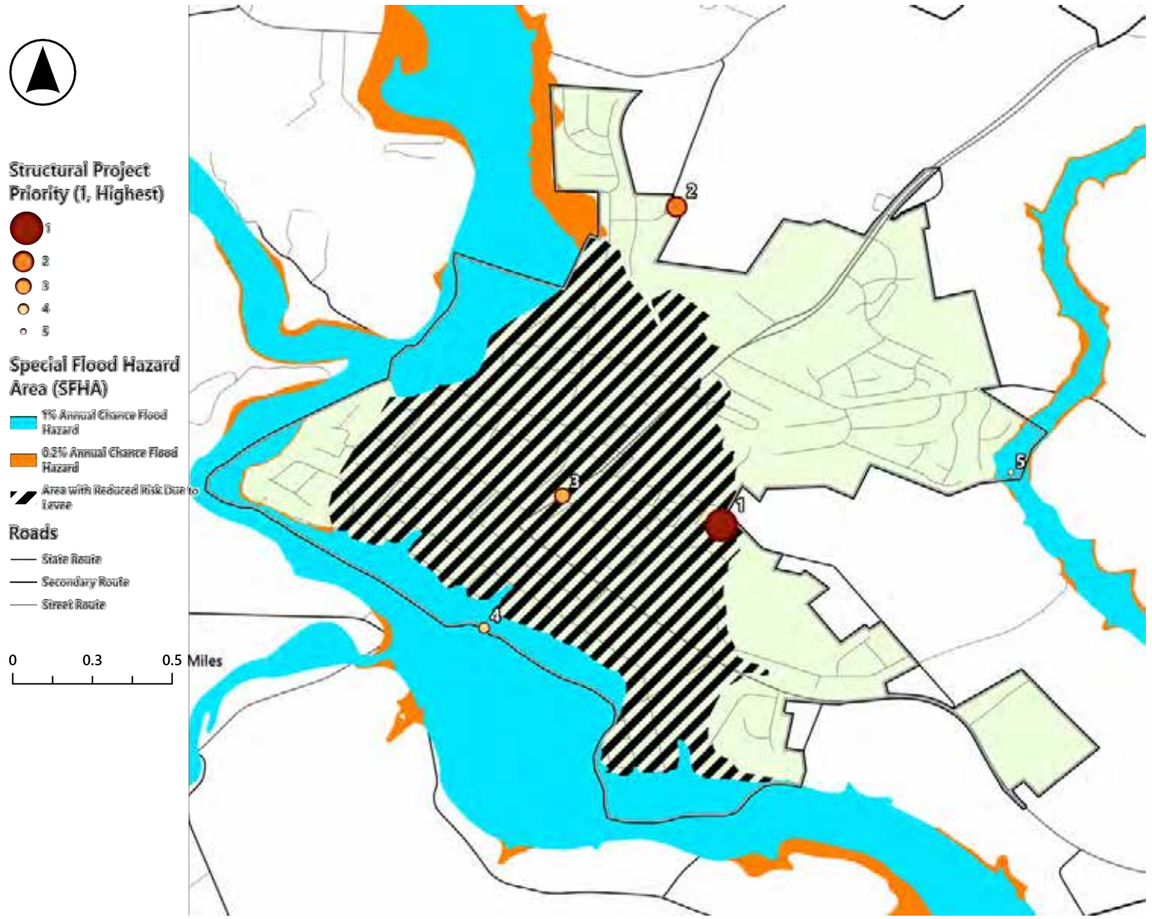
Additional related HMP actions: BW-2 (natural systems flood mitigation), BW-3 (CRS participation), BW-4 (floodplain property acquisition), and BW-5 (Army Corps coordination).

Table 4.25 | Town of Bridgewater Priority Projects

Priority	Project	Severity
1	Fountainhead Subdivision Stormwater System Rehabilitation — Brian, Cindie, and Steven Streets*	HIGH
2	Cannery Woods and Dry River Road Stormwater Detention and Drainage Capacity	MODERATE
3	North Main Street Stormwater Drainage Capacity Improvements — Green Street to Depot Street	MODERATE
4	North River Corridor Bank Stabilization and Riparian Assessment — Wildwood Park to Sandy Bottom Park	LOW TO MODERATE
5	Cooks Creek Arboretum Stream Bank Stabilization	LOW

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

Map 4.107 | Town of Bridgewater Priority Projects



Town of Broadway *At A Glance*

The Town of Broadway is located in northern Rockingham County approximately 13 miles north of Harrisonburg and two miles south of the Town of Timberville, and is the second most populous town after Bridgewater in the region. Broadway's floodplain is formed by Linville Creek, Daphna Creek, and the North Fork of the Shenandoah River. Linville Creek flows north through the middle of Town and discharges to the North Fork of the Shenandoah River, which runs along the Town's western edge and supplies its drinking water. Linville Creek has a narrow floodplain, steep slopes, and rapid runoff, and much of the Town's business district lies within its floodplain.

Figure 4.108
Town of Broadway Locality Introduction



4,273
total population

328
acres in the 500 year floodplain

8
flood insurance policies in force

Flood History

Causes and Recurring Problems

Broadway floods from Linville Creek, which runs through the business district, and from the North Fork of the Shenandoah River. Much of the business district lies within the floodplain. Bank erosion along Linville Creek has undermined sewer infrastructure, and a pedestrian bridge in Heritage Park catches debris during high water and repeatedly floods the entire park. A dam on the Shoemaker River, an upstream tributary of the North Fork, provides no flood protection for the Town.

Major Events

Broadway experienced severe flooding in 1936, October 1942, 1972, and November 1985. In 1942, the North Fork reached 25.3 feet at nearby Cootes Store, then the highest stage on record. Hurricane Fran in September 1996 inundated the business district: more than ten businesses took on eight to ten feet of water, with damage of up to $100,000 per business. Oil tanks washed away from a local oil company and spilled, requiring environmental cleanup, and floodwaters left the Norfolk Southern rail line impassable for seven days. The North Fork set a new record at Cootes Store during the storm.

Recent Flooding

During the storms of late May and early June 2018, a Broadway daycare center flooded and temporarily closed, affecting 95 families. The Town's wastewater pump station floods regularly, and its pumps have failed repeatedly. Bank erosion has already collapsed one sewer line into Linville Creek, and storm runoff and erosion cause turbidity that disrupts the water treatment plant's North Fork intake.

Existing Conditions

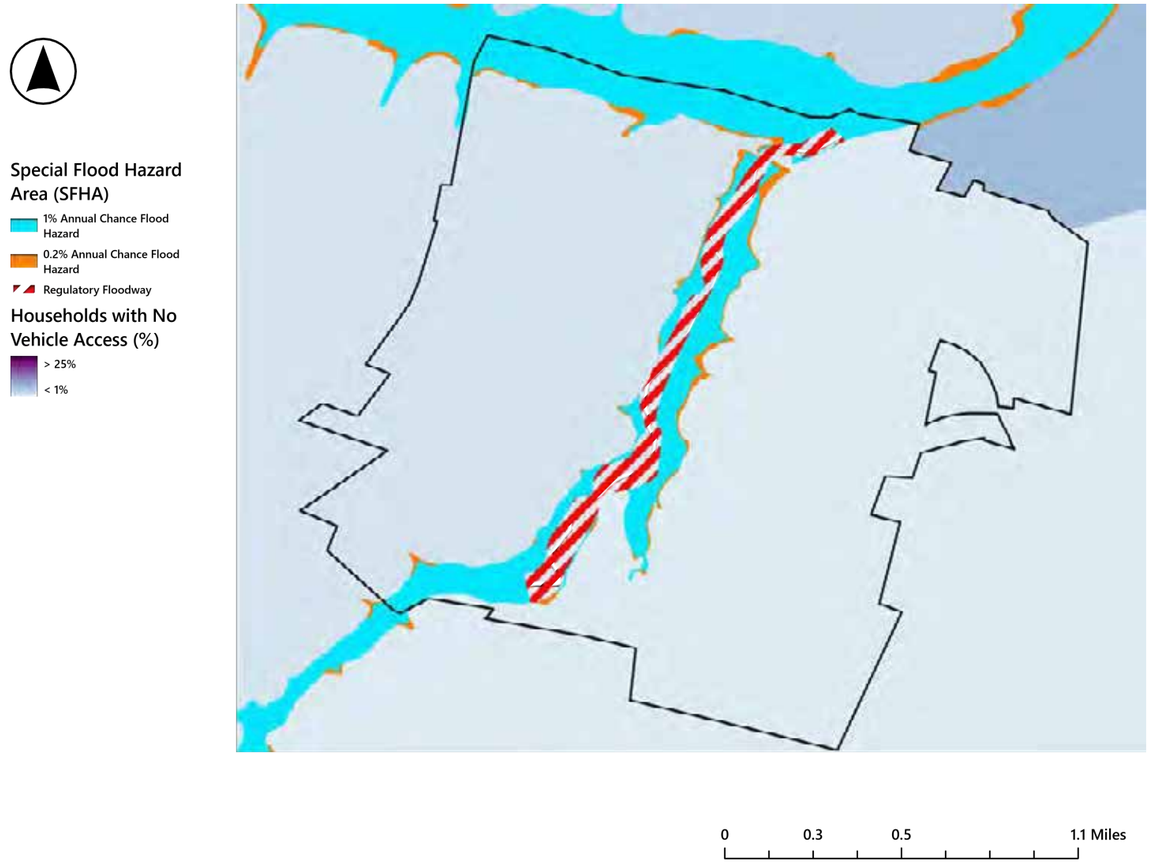
Vulnerable Populations

Broadway shows moderate social vulnerability and limited vehicle constraints. Linville Creek's flood corridor passes through a main street, making nearby residents and businesses more susceptible to flooding.

Figure 4.109
Town of Broadway Social Vulnerability Ranking by Census Tract



Figure 4.110
Town of Broadway Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

Much of the Town's main development parallels Linville Creek, including critical facilities, road access, bridge-condition concerns, and the mapped dam inundation area. The wastewater pump station, about 50 years old, sits in the Linville Creek floodplain and handles all of the Town's sewage. The facility's electrical components have been raised, but its mechanical equipment remains at grade. The North Fork water intake is shallow and highly sensitive to turbidity, and the backup source, Linville Creek, has compromised water quality. The Turner Avenue bridge, a primary school bus route, is scheduled for structural repairs, and the State Route 259 low-water bridge over the North Fork is impassable during high flows. The Town has two repetitive-loss properties.

Figure 4.111
Town of Broadway Special Flood Hazard Areas, DEM, and Critical Facilities

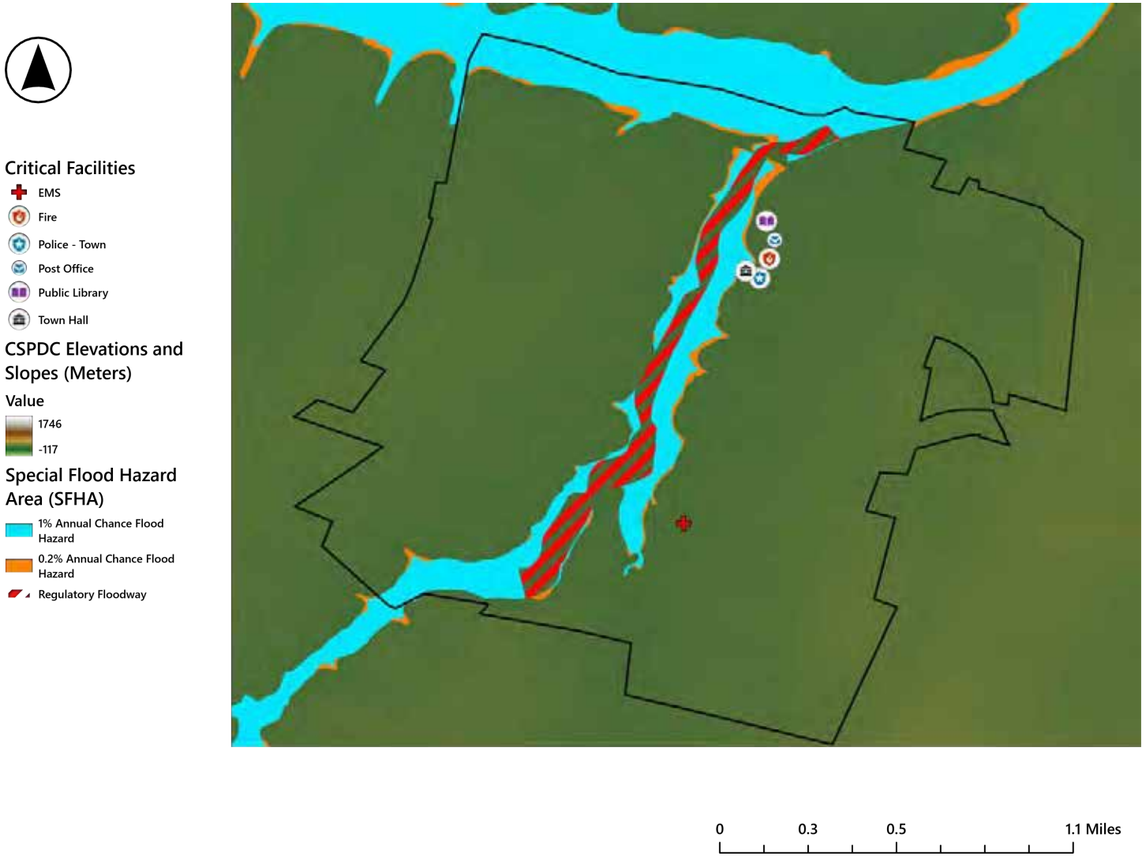
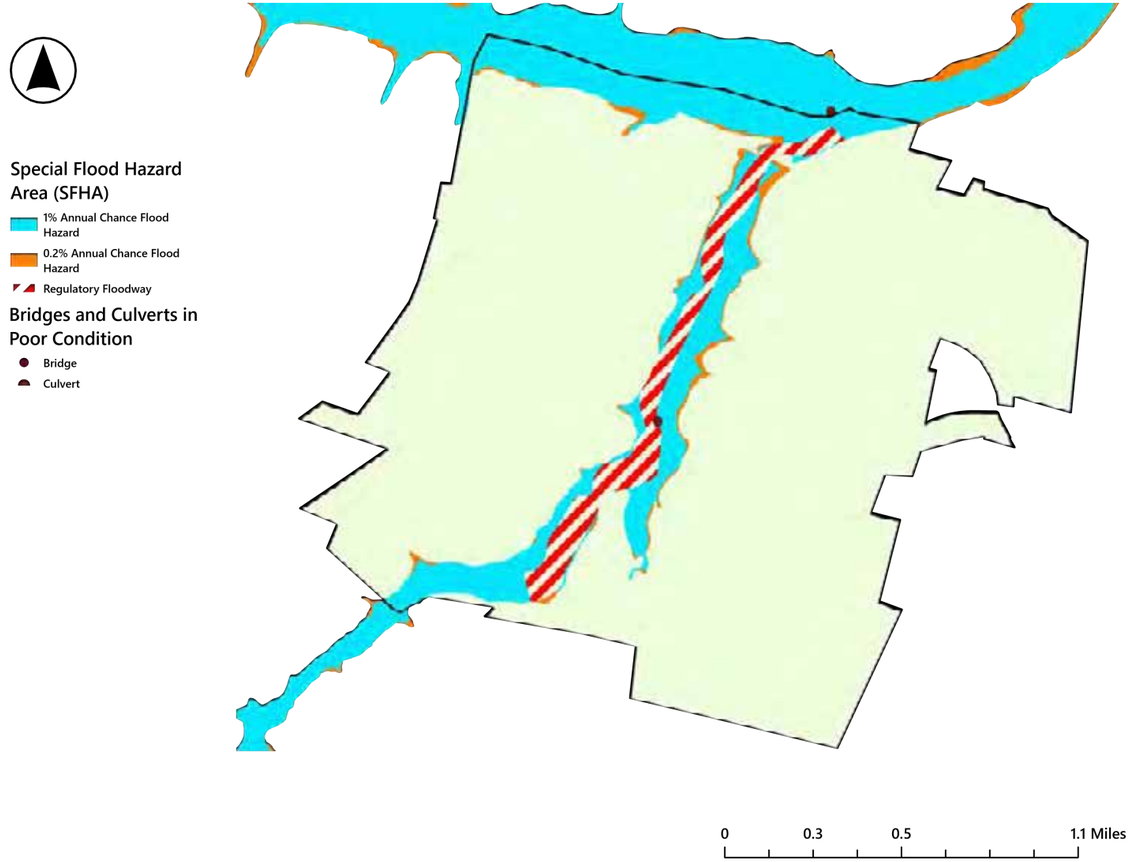


Figure 4.112
Town of Broadway Bridges and Culverts Classified as "Poor" Rating, VDOT, 2024 Overlaid on Special Flood Hazard Areas



Natural Resources

Broadway has little formally conserved land, and development closely surrounds Linville Creek. The creek buffer and remaining floodplain open space are therefore the Town's principal nature-based flood assets.

Figure 4.113
Town of Broadway Conservation Easements and Special Flood Hazard Areas

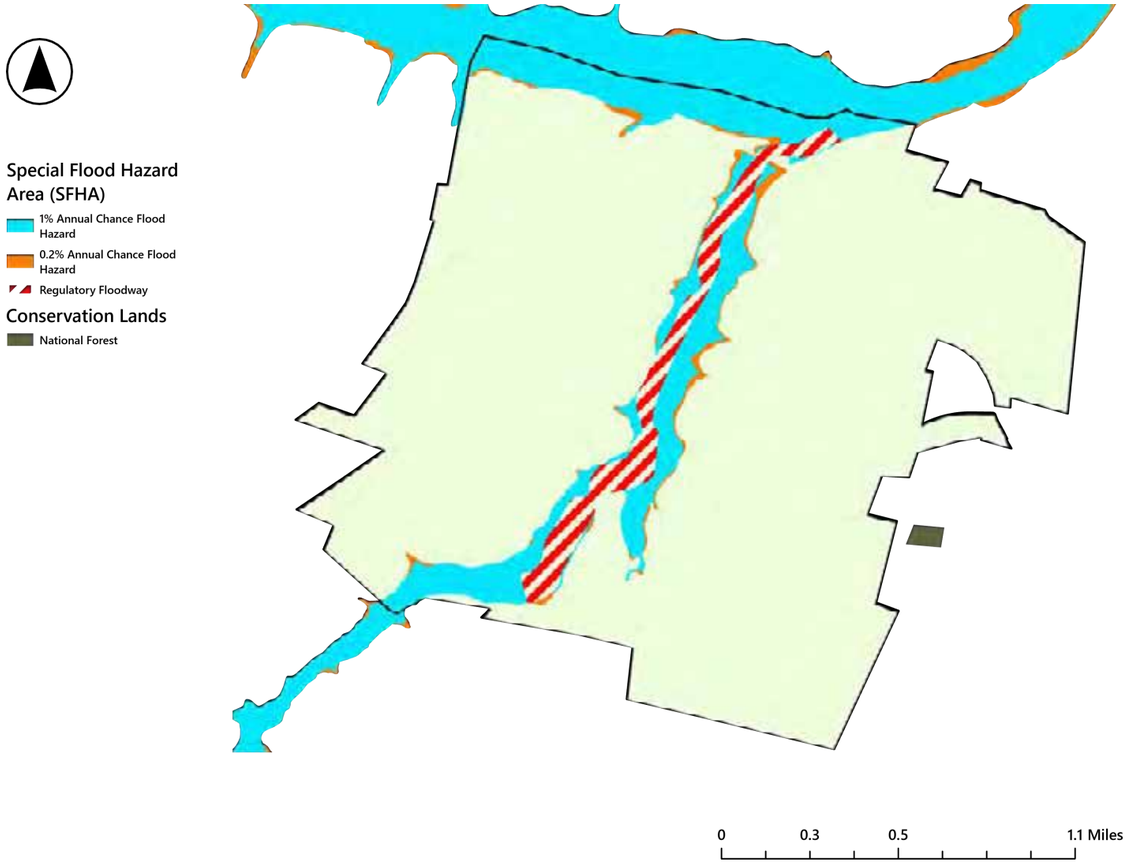
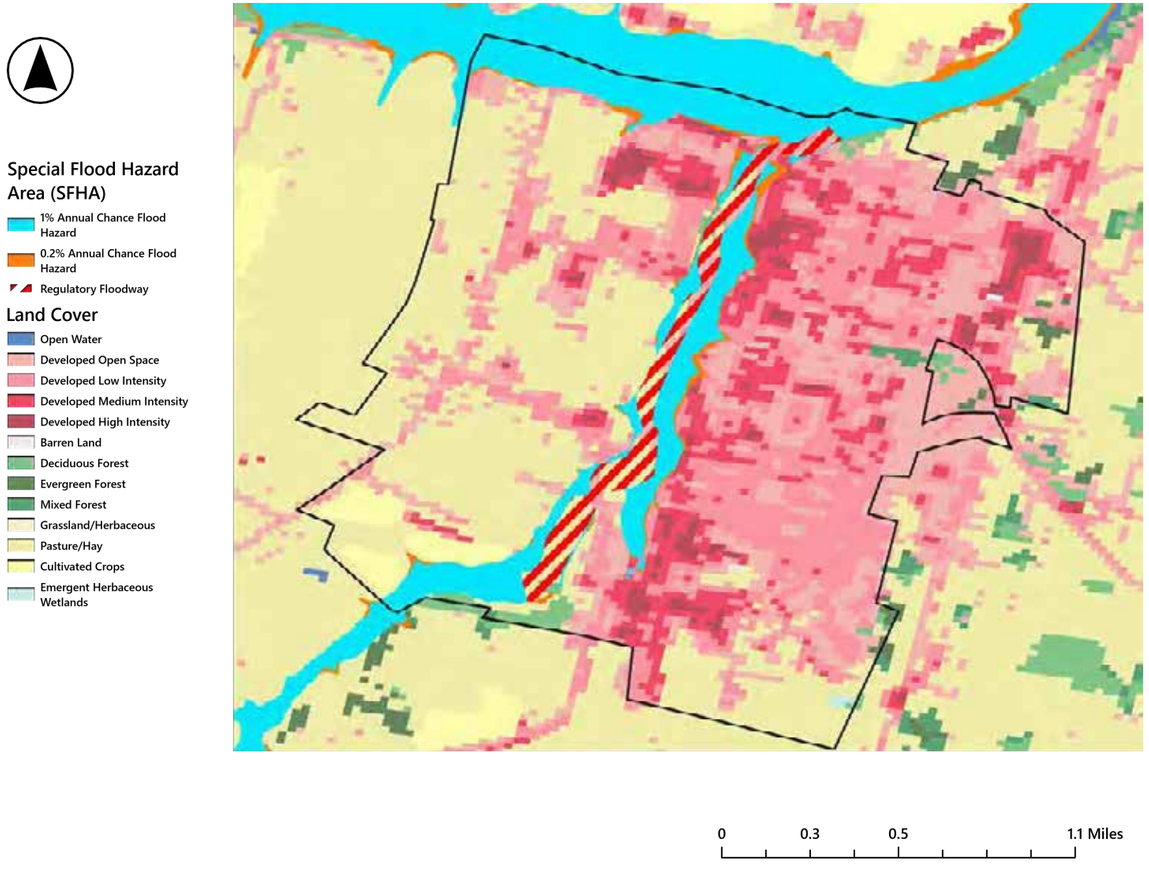


Figure 4.114
Town of Broadway Land Cover and Special Flood Hazard Areas



Future Conditions

MARISA does not provide a town-specific outlook for Broadway, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could increase flows and bank erosion along Linville Creek and add pressure on the Town's culverts, ditches, and outfalls.

Needs

Broadway's needs center on an eroding creek that threatens Town utilities, on protecting its water and wastewater systems, and on identifying more information on the drainage network.

Drainage and Stormwater Capacity

Three development areas affect drainage. The Town is designing a 3.8-acre expansion of Heritage Park south of Turner Avenue and plans to require permeable surfaces instead of asphalt. New residential development in the Holly Hills area near Creekside Lane drains toward the eroding reach of Linville Creek where the sewer line relocation is planned. In the Coyote Run subdivision along Sunset Drive, developers removed a natural retention pond, and runoff from surrounding farms now collects on a corner property at Jewelry Street and West Springbrook Road. The Town's subdivision ordinance contains no stormwater management standards for new development.

Stream and Channel Conditions

Linville Creek needs phased stabilization near Heritage Park and south of Turner Avenue, coordinated with relocation of the exposed sewer line and evaluation of channel sediment. The Heritage Park pedestrian bridge needs an evaluation of whether it causes the park flooding or simply catches debris when the floodplain floods, followed by replacement with a higher clear-span structure if the evaluation supports it.

Critical Facilities

The wastewater pump station needs protection or relocation, along with attention to inflow and infiltration that overwhelms its capacity in wet weather. The North Fork reach near the municipal intake is recovering on its own, so widening the forested buffer is more beneficial than bank stabilization. Protecting the water supply depends more on the intake itself and on backup options, including a possible connection to a neighboring system such as Timberville's.

Data and Development Standards

Much of the Town's stormwater system is unmapped: pipes disappear into private property, and at least three manholes have been paved over. A GIS inventory of pipes, ditches, inlets, outfalls, culverts, ownership, and condition is a foundational need. Karst conditions complicate drainage and utility work; one water main leak drained about 28,000 gallons per hour into a subsurface cavity. The Town needs stormwater standards for new development.

Staffing and Coordination

The town manager carries engineering and grant responsibilities and supports CSPDC administering grant-funded projects on the Town's behalf. Broadway is the only Rockingham County town with its own EOP, which has served as a model for Timberville, but the plan has no debris management section. The North Fork priority will require Rockingham County's involvement, and other work will require easements, landowner cooperation, and railroad and VDOT coordination. The Town indicated willingness to consider voluntary buyouts for repetitive-loss properties.

Resilience Actions

Table 4.26 | Town of Broadway Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC	Regional 1; HMP BR-4, BR-5
2	**Map the Town's stormwater system,** including buried manholes, pipe routing, ownership, and condition.	Mid	CSPDC GIS	Regional 2
3	**Adopt stormwater standards for new development** in the subdivision ordinance.	Mid	CSPDC	Regional 4; HMP BR-6

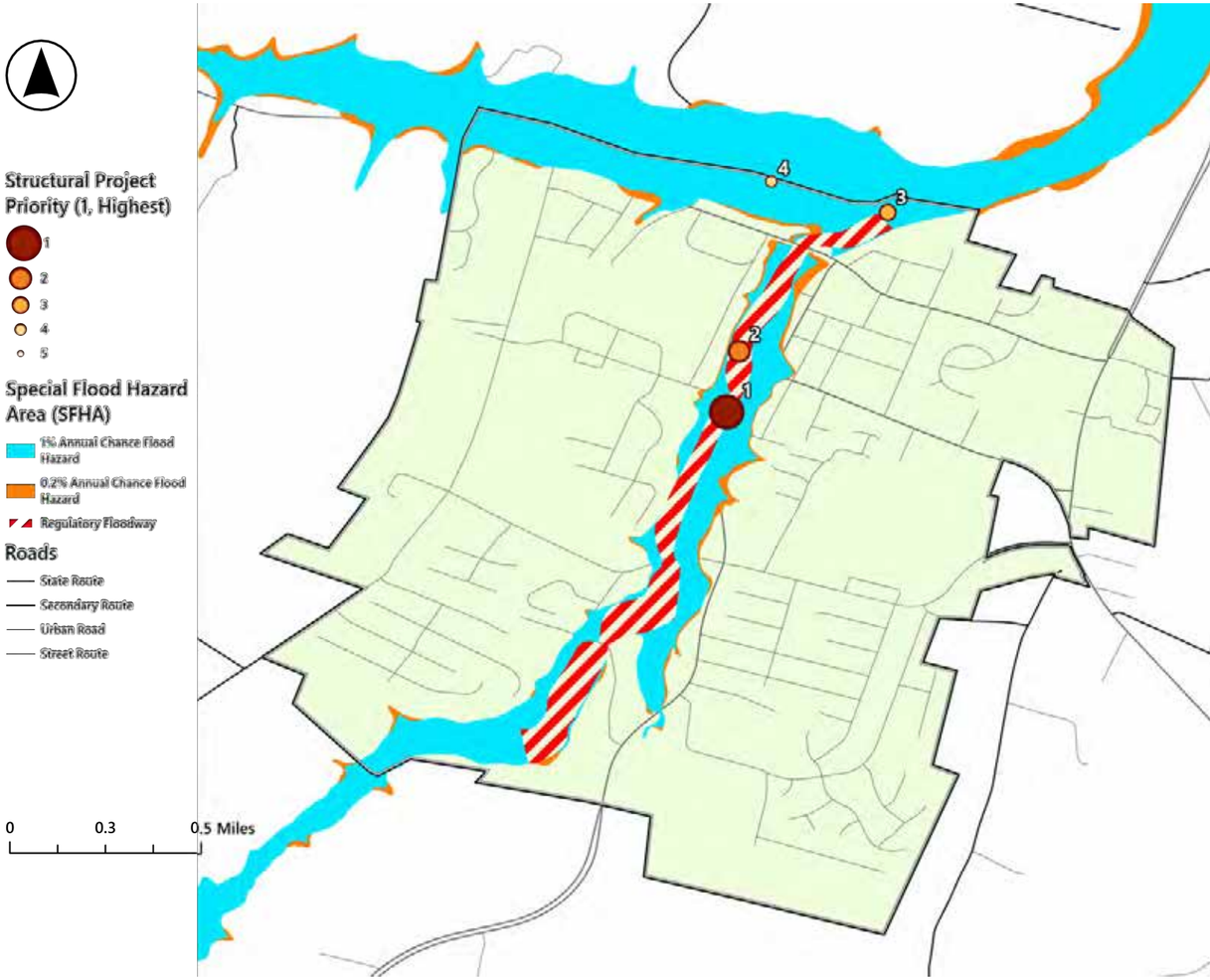
Additional related HMP actions: BR-12 (karst-related water leak), BR-13 (emergency shelters), BR-16 (inflow and infiltration study), BR-18 (debris removal from stormwater and sewer systems), and BR-19 (sewer capacity upgrades).

Table 4.27 | Town of Broadway Priority Projects

Priority	Project	Severity
1	Linville Creek Bank Stabilization Near Heritage Park and South of Turner Avenue	HIGH
2	Heritage Park Pedestrian Bridge Debris Capture and Park Flooding	MODERATE TO HIGH
3	Sewer Pump Station Flood Resilience Improvement	HIGH
4	North Fork Shenandoah River Water Supply Corridor	HIGH

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

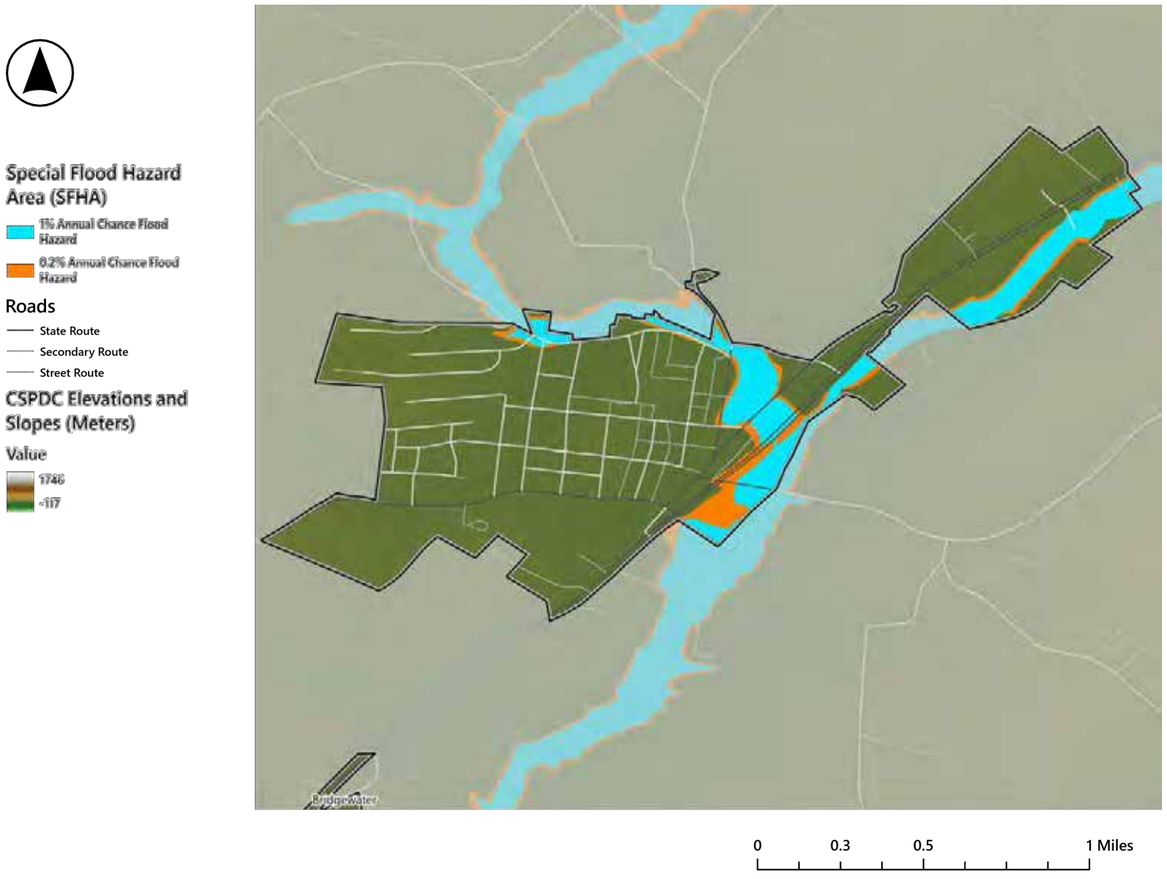
Map 4.115 | Town of Broadway Priority Projects



Town of Dayton *At A Glance*

The Town of Dayton is located in south-central Rockingham County, about three miles southwest of Harrisonburg. It is completely surrounded by the unincorporated County. Dayton lies within the North River drainage basin. A drainage divide crosses the middle of town, and runoff on both sides eventually reaches Cooks Creek. Cooks Creek meanders along the Town's eastern limits before leaving at the northeastern corner and briefly re-entering at the northwestern corner. Sunset Heights Branch flows from the eastern corner of town to Cooks Creek below the Norfolk Southern railroad. The floodplain is about 600 feet wide and covers the northeastern part of town.

Figure 4.116
Town of Dayton Locality Introduction



1,920
total population

100
acres in the 500 year floodplain

7
flood insurance policies in force

Flood History

Causes and Recurring Problems

Flooding in Dayton results primarily from inadequate drainage rather than river overflow. Many areas of town are too flat to drain or sit in depressions with little natural outlet, and the downtown occupies a natural bowl that concentrates runoff from the surrounding hills. Development in and near the floodplain has added impervious surface, and several older culverts and bridges can no longer carry even moderate flows. Areas next to Cooks Creek also flood regularly.

Major Events

Hurricane Fran flooded Dayton in September 1996 along with other Rockingham County communities. During the storms of late May and early June 2018, rain fell at rates of up to 6 inches per hour over Dayton, Harrisonburg, and Bridgewater. Flooding closed State Route 42 in Dayton and forced the Pitman Family Farms poultry plant to suspend operations. Records of local impacts from earlier regional floods, including those of 1942, 1949, and 1985, are limited.

Recent Flooding

In about 2021, Cooks Creek rose during a flash flood and affected the Town's water treatment plant. In 2024, a flash flood that town staff described as the worst in recent memory overwhelmed the downtown stormwater system and flooded the Pitman Family Farms parking lot. During one major flood, rising water floated a box truck at Valley Water Gardens.

Existing Conditions

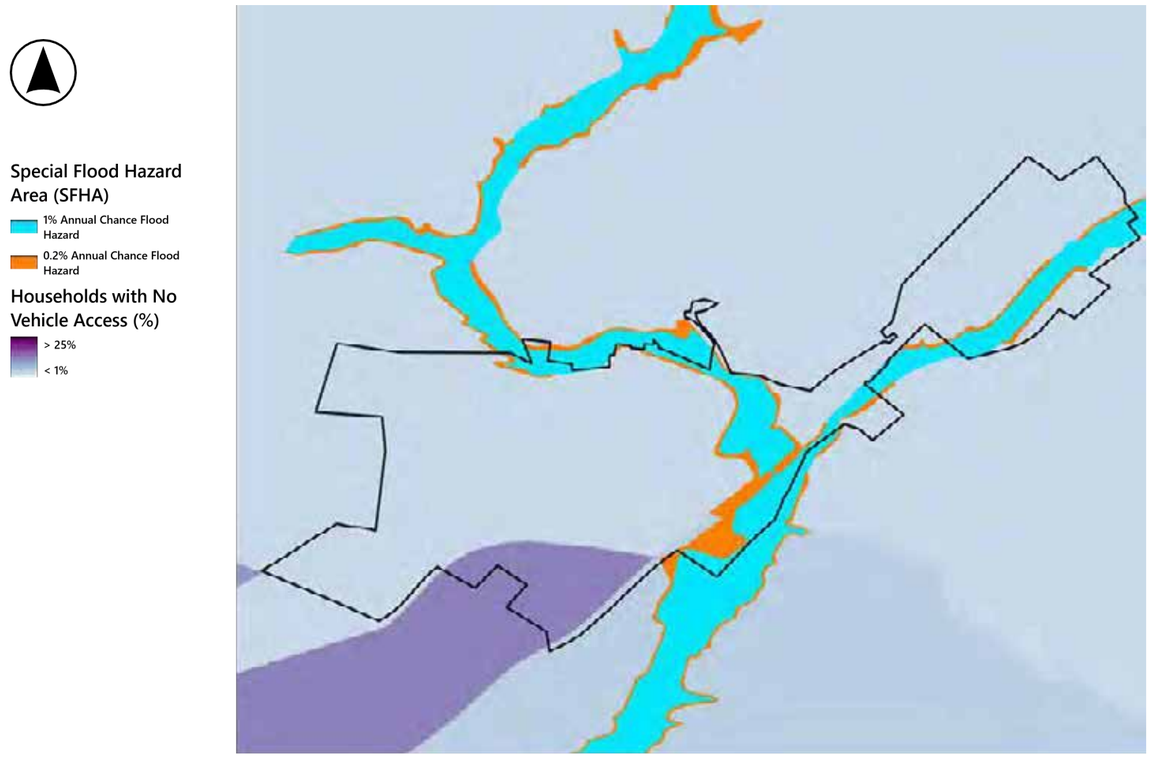
Vulnerable Populations

Higher social vulnerability appears in the northern portion of Dayton, while vehicle access varies across the community. Local drainage and flood-prone areas extend through the central and eastern portions of town, so risk is not uniform.

Figure 4.117
Town of Dayton Social Vulnerability Ranking by Census Tract



Figure 4.118
Town of Dayton Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

Dayton has a small number of critical assets and crossings, so each one matters to the Town's continued operation. The mapped floodplain and drainage corridors lie primarily through and east of town, along State Route 42 and near the Pitman Family Farms facility, which lies entirely within the floodplain. The Town's water treatment plant has also experienced flood impacts from Cooks Creek. Dayton has no repetitive-loss properties.

Figure 4.119
Town of Dayton Special Flood Hazard Areas, DEM, and Critical Facilities

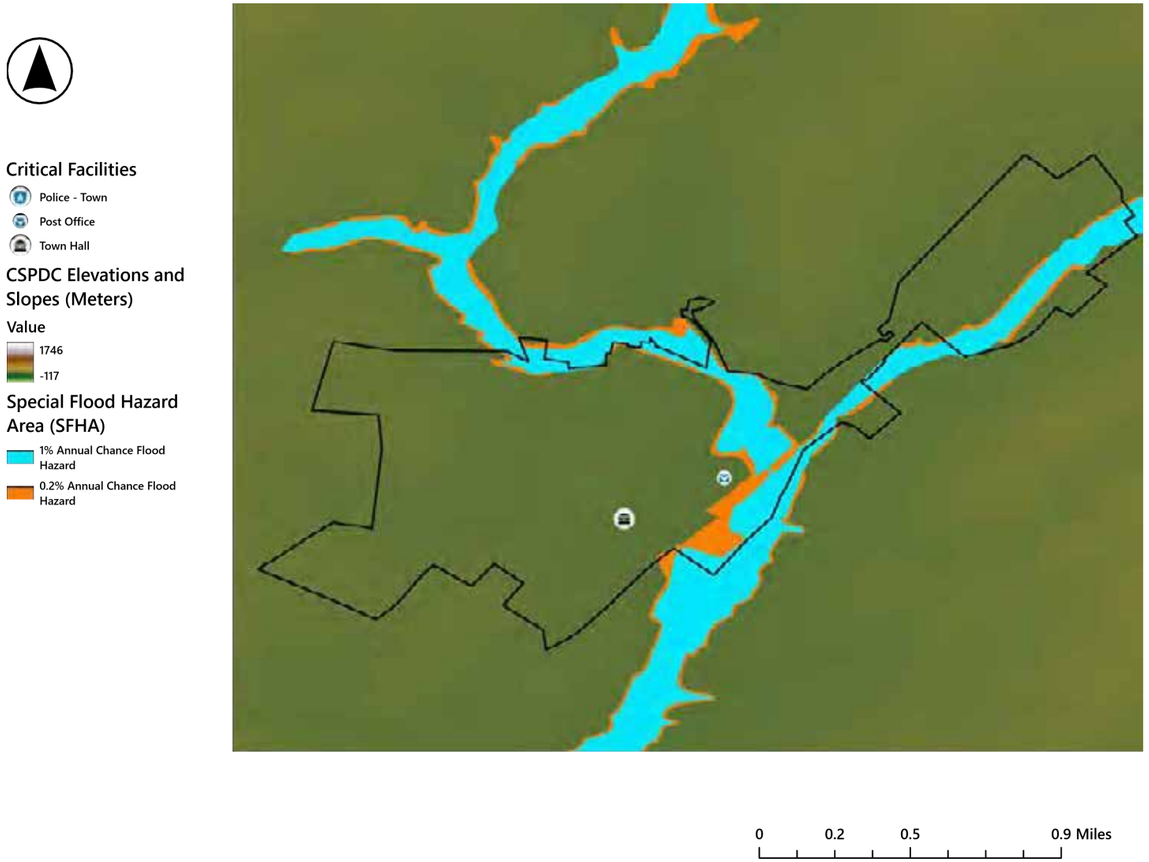
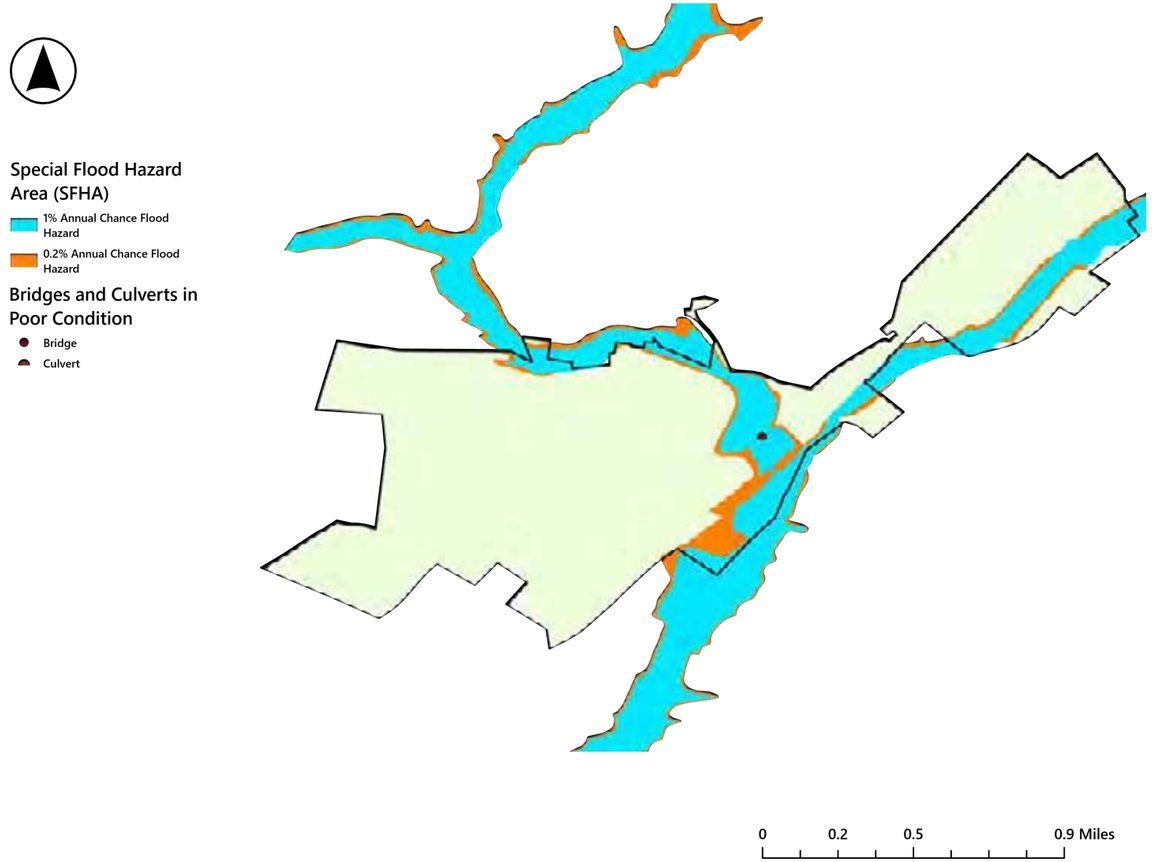


Figure 4.120
Town of Dayton Bridges and Culverts Classified as "Poor" Rating, VDOT, 2024
Overlaid on Special Flood Hazard Areas



Natural Resources

The Town has little conserved land and is surrounded by a mix of development and agriculture. Its stream and floodplain corridor supplies much of the remaining local storage and infiltration capacity.

Figure 4.121
Town of Dayton Conservation Easements and Special Flood Hazard Areas

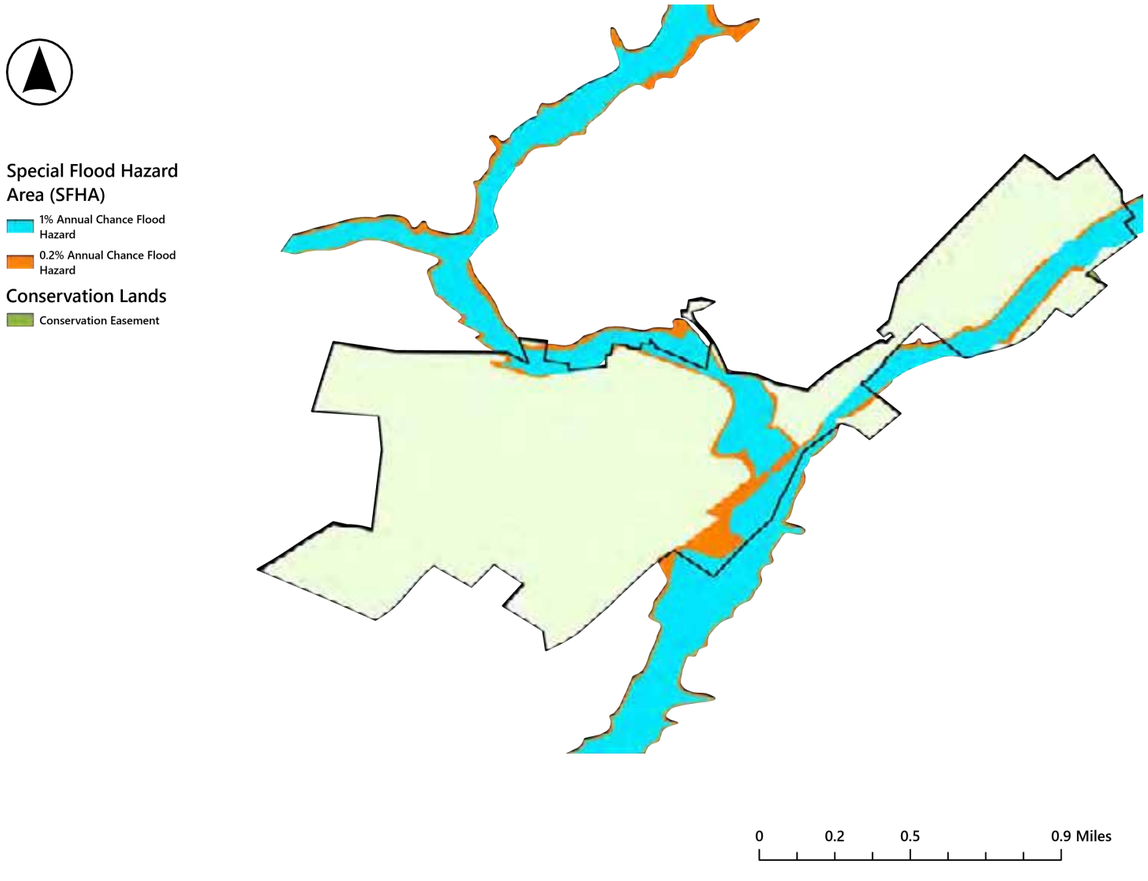
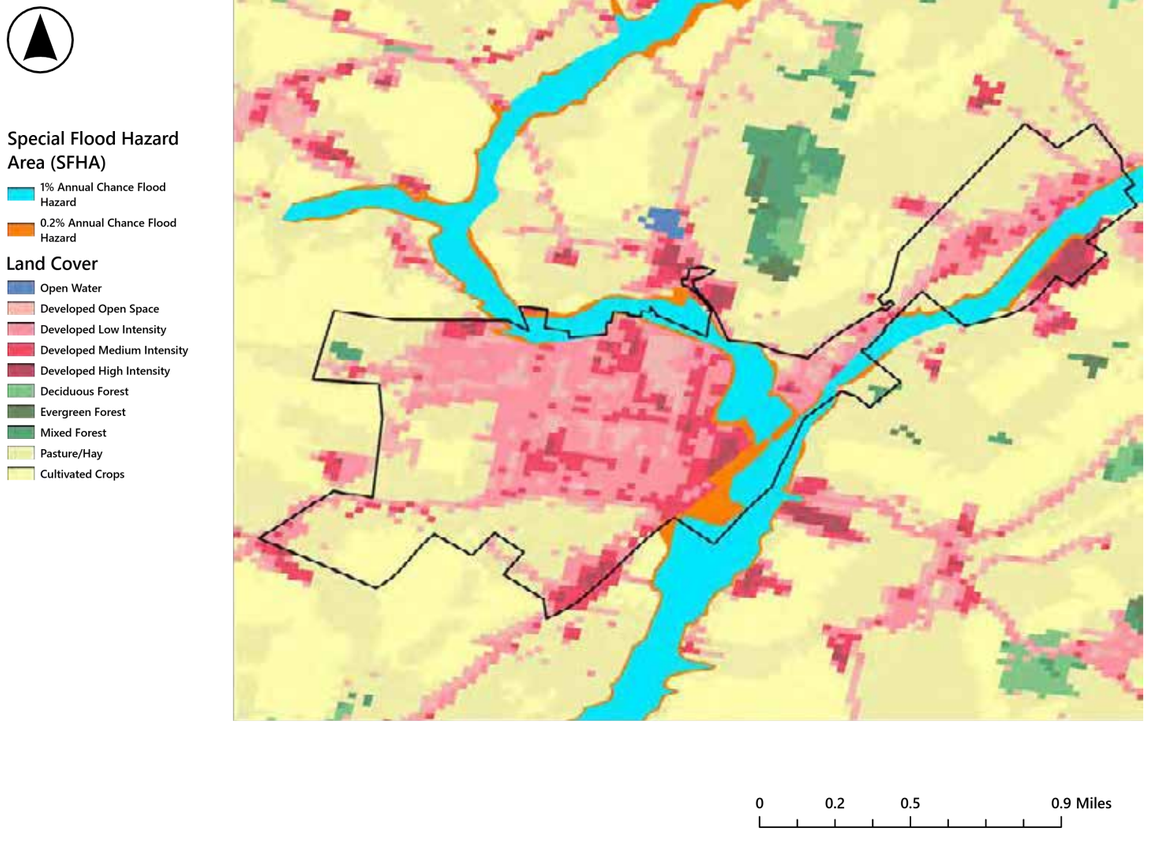


Figure 4.122
Town of Dayton Land Cover and Special Flood Hazard Areas



Future Conditions

MARISA does not provide a town-specific outlook for Dayton, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could exceed the capacity of the downtown stormwater network more often and increase flooding near Thompson Street, Cherry Lane, Ashby Avenue, and other low points. Karst conditions may make subsurface responses less predictable.

Needs

Dayton's flooding stems from an undersized downtown stormwater system and recurring flood exposure along Cooks Creek, compounded by limited system data and staff capacity.

Drainage and Stormwater Capacity

The downtown stormwater system cannot carry runoff from intense storms. Drop inlets on Thompson Street and Cherry Lane feed two small pumps that discharge through a 6- to 8-inch line running through Tunnel Alley and under State Route 42. The system reaches capacity in moderate storms and is overwhelmed during flash floods. A Town drainage pipe crossing private backyards in the Westview and Ashby area was buried too shallow and is now exposed and failing.

Stream and Channel Conditions

Bank erosion along Cooks Creek threatens adjacent properties, including the Pitman Family Farms facility. Flooding near the Meigs Lane bridge and along State Route 42 affects nearby businesses, and the existing floodgate near Valley Water Gardens needs evaluation.

Critical Facilities and Access

The Pitman Family Farms facility is a major source of local employment and tax revenue, so a flood-related shutdown would carry significant fiscal consequences for the Town. The water treatment plant's exposure to Cooks Creek also needs assessment.

Data and Planning

The Town knows the routing of its primary drainage lines, but parts of the downtown system were traced only during post-flood jetting. Karst features near the downtown pump vault require geotechnical evaluation before any subsurface work.

Staffing and Coordination

The Town Administrator also serves as floodplain administrator. The Town relies on the Rockingham County emergency operations plan, and debris removal depends on a small public works crew and volunteers. Several needs require VDOT coordination or easements across private property, and the Town relies on CSPDC for grant development and administration.

Resilience Actions

Table 4.28 | Town of Dayton Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC; VDOT; property owners	Regional 1; HMP DA-3, DA-4, DA-6
2	**Map the Town's stormwater network,** including downtown routing identified during post-flood jetting.	Mid	CSPDC GIS	Regional 2
3	**Investigate karst conditions near the downtown pump vault** before subsurface drainage work.	Near	Virginia Energy	HMP DA-13

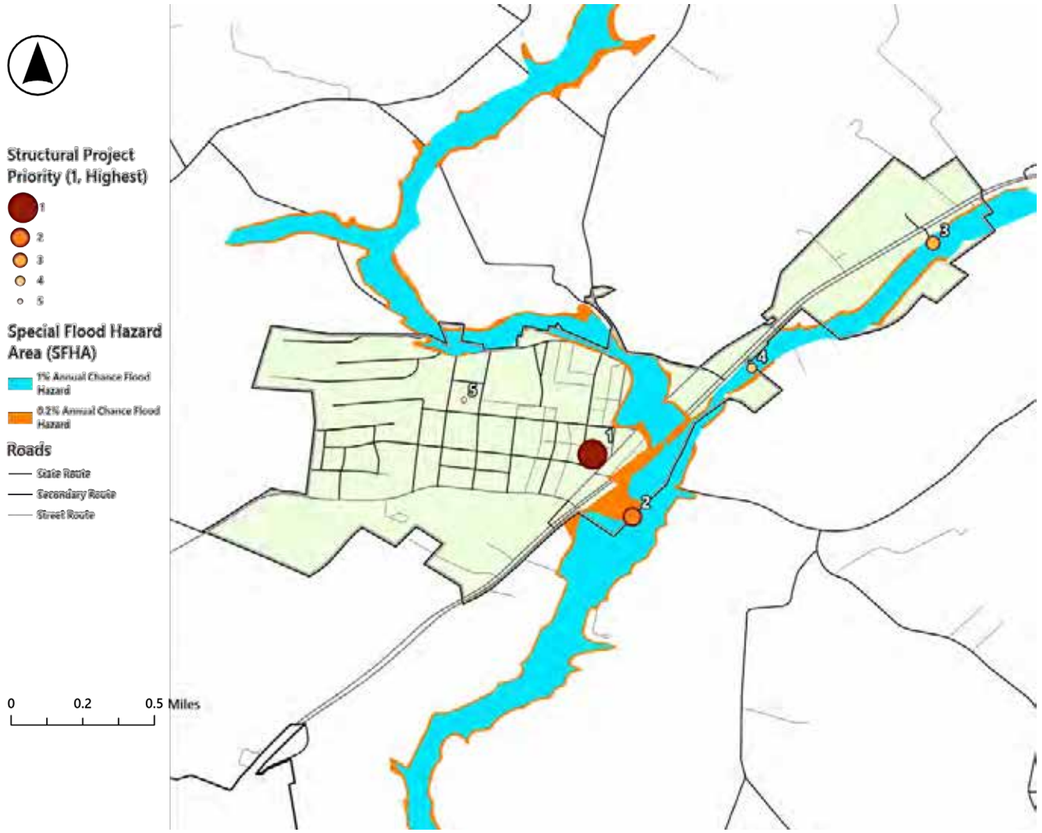
Additional related HMP actions: DA-1 (backup generators), DA-15 (coordination with the poultry processing facility on emergency evacuations), and DA-17 (water and sewer replacement).

Table 4.29 | Town of Dayton Priority Projects

Priority	Project	Severity
1	Downtown Stormwater System — Thompson Street, Cherry Lane, Tunnel Alley, and Route 42 Outfall*	HIGH
2	Cooks Creek Bank Stabilization — Pitman Family Farms Facility Frontage	HIGH (economic risk)
3	Cooks Creek Flood Mitigation Near Meigs Lane Bridge — Valley Meat Processors	MODERATE
4	Cooks Creek Flood Mitigation Along Route 42 — Valley Water Gardens Area	LOW TO MODERATE
5	Westview/Ashby Backyard Stormwater Drainage System Assessment and Repair	LOW TO MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

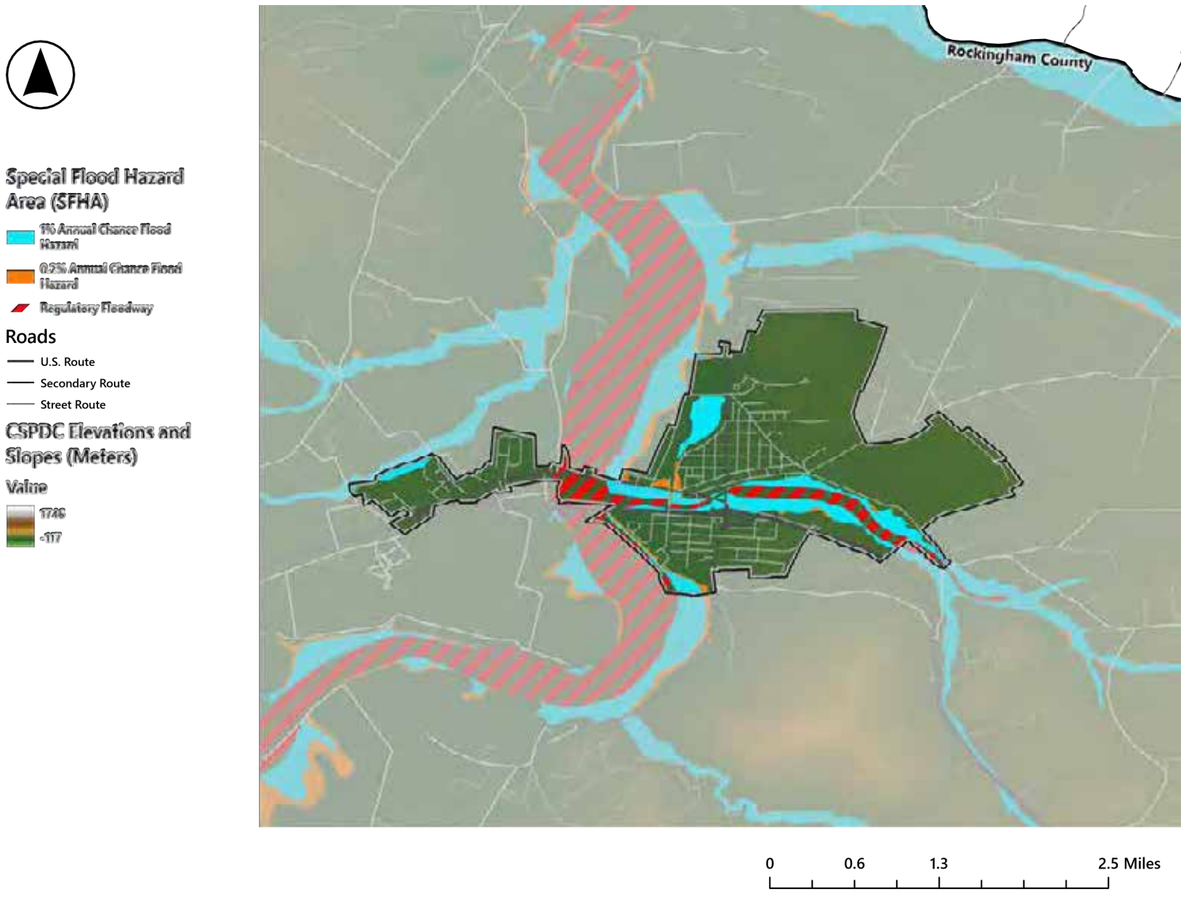
Map 4.123 | Town of Dayton Priority Projects



Town of Elkton *At A Glance*

The Town of Elkton is located in eastern Rockingham County at the slope of the Blue Ridge Mountains. Elk Run drains about 14 square miles above the Town; it rises on the steep, wooded slopes of the Blue Ridge Mountains and flows through Elkton just above its confluence with the South Fork of the Shenandoah River. At Elkton, the South Fork drains about 1,179 square miles, and its flows override those of Elk Run in the floodplain at the downstream town limits. Commercial and older residential buildings sit in the Elk Run and South Fork floodplains, which limit room for business expansion.

Figure 4.124
Town of Elkton Locality Introduction



3,006
total population

419
acres in the 500 year floodplain

18
flood insurance policies in force

Flood History

Causes and Recurring Problems

Elkton floods from two interrelated sources. Downtown, runoff collects in the area around Ashby Avenue and Warren Street with no adequate outlet; as little as a quarter inch of rain produces about four inches of standing water that enters businesses, a problem known for about 30 years. Along Elk Run, the South Fork rises during major floods and prevents the creek from draining, so Elk Run backs up into adjacent homes and businesses.

Major Events

In October 1942, a major flood on Elk Run coincided with flooding on the South Fork, and flood levels in midtown Elkton exceeded the 100-year level. Tropical Storm Agnes flooded homes and businesses in June 1972. The November 1985 Election Day Flood washed out an 1896 railroad bridge in Elkton. During Hurricane Fran in September 1996, residents of the Elkton Manor nursing home were evacuated. The Merck plant south of Town shut down for two days when its power substation flooded, and Carter Lumber was so badly damaged that it never reopened. The Town's wastewater treatment plant and fire and rescue facility have flooded on numerous occasions.

Recent Flooding

Downtown flooding from small storms continues to enter businesses and create safety hazards, and the Elk Run walking trails behind the community center flood during major events.

Existing Conditions

Vulnerable Populations

Elkton is mapped with generally low social vulnerability and limited vehicle constraint, but broad flood exposure remains along the South Fork Shenandoah River and Elk Run. The key concern is therefore the location of residents and routes relative to these two waterways rather than a townwide socioeconomic concentration.

Figure 4.125
Town of Elkton Social Vulnerability Ranking by Census Tract

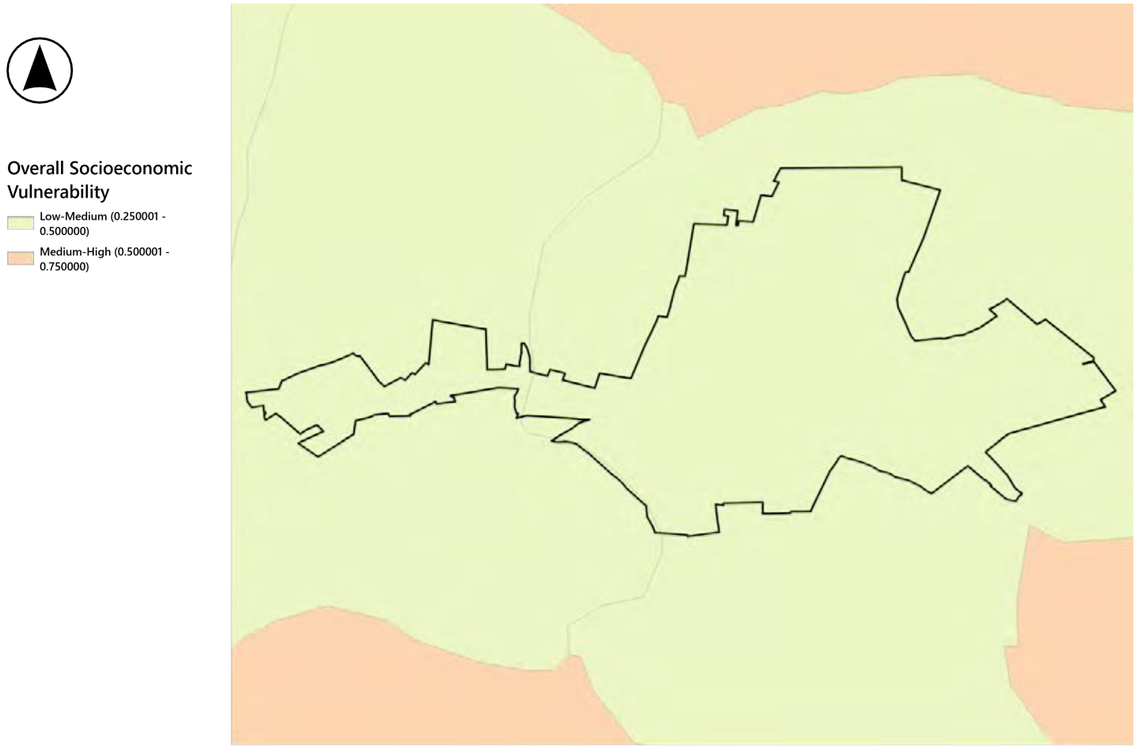


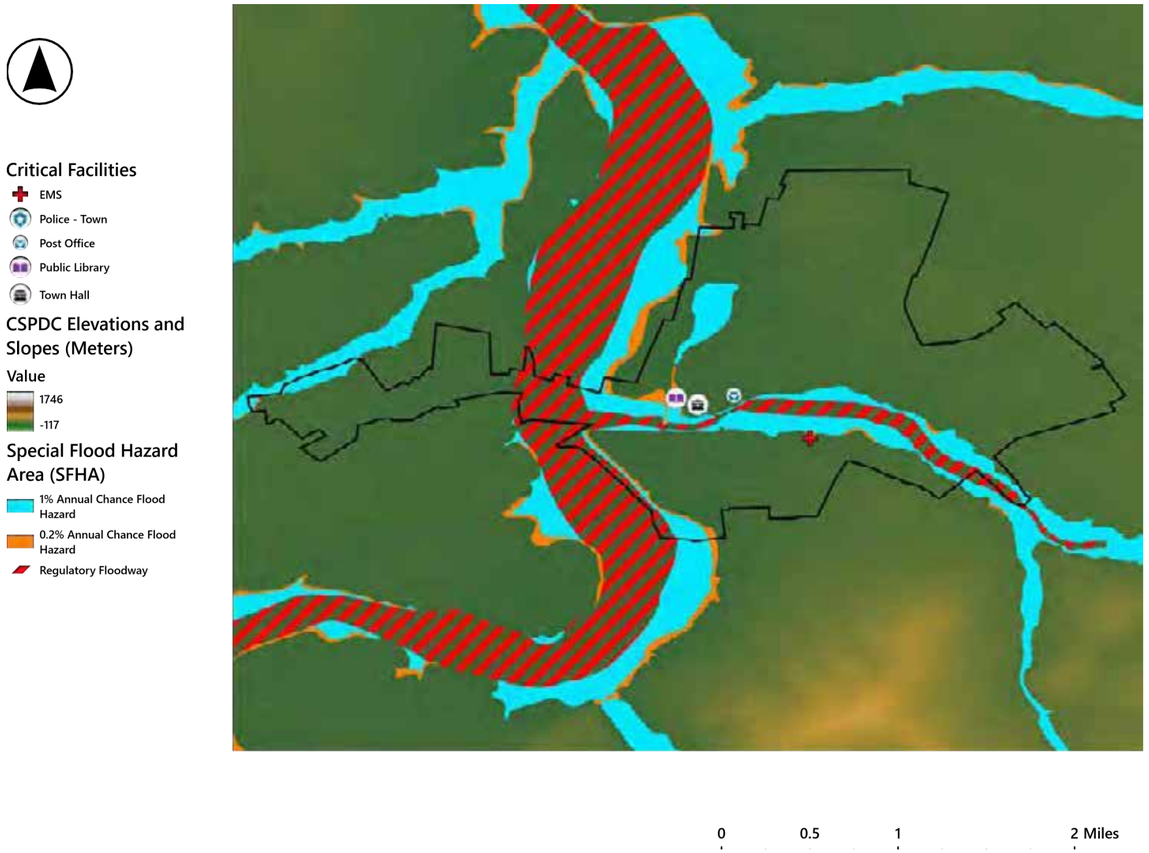
Figure 4.126
Town of Elkton Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

The South Fork floodplain and Elk Run corridor extend into developed parts of Elkton near critical facilities and local streets, so simultaneous river and tributary flooding can disrupt utilities, access, and operations. The wastewater treatment plant sits near the Elk Run confluence and shares its floodplain with an adjacent Rockingham County refuse transfer site. The Stonewall Park well house is exposed to flooding and contamination. The community center lies in the floodplain but was built 2 feet above the BFE. The Town has one repetitive-loss property.

Figure 4.127
Town of Elkton Special Flood Hazard Areas, DEM, and Critical Facilities



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Natural Resources

Conserved land south of town and ecological cores around Elkton frame a broad floodplain along the South Fork and Elk Run. Riparian buffers can connect these larger habitat areas while protecting water quality and flood-storage capacity.

Figure 4.128
Town of Elkton Conservation Easements and Special Flood Hazard Areas

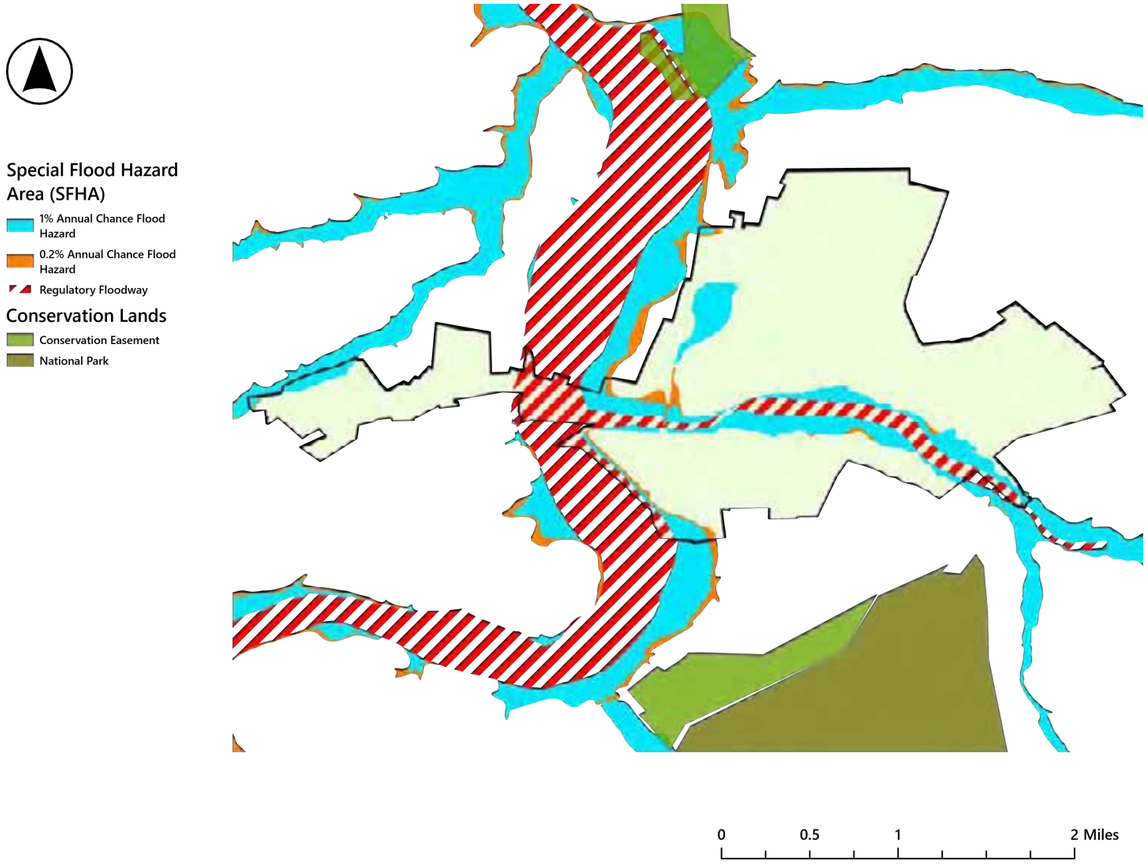
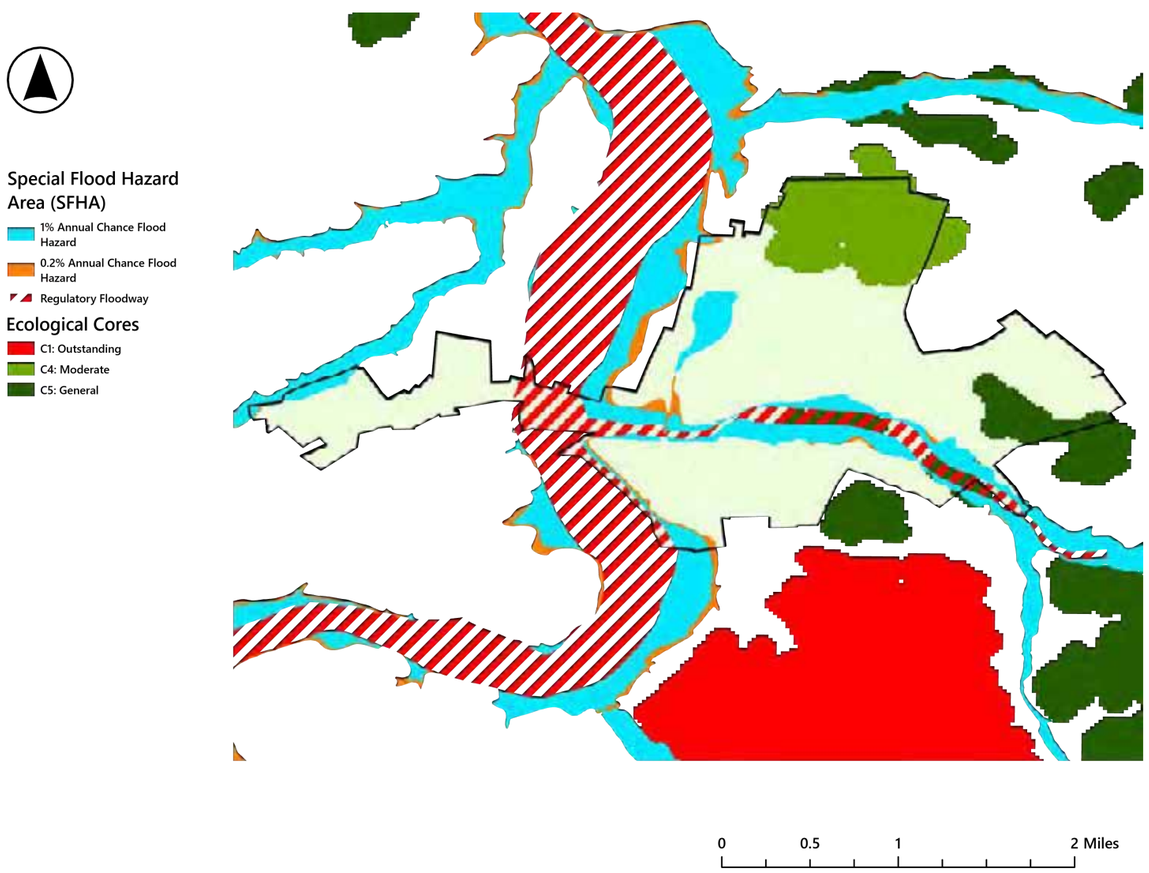


Figure 4.129
Town of Elkton Ecological Cores and Special Flood Hazard Areas



Future Conditions

MARISA does not provide a town-specific outlook for Elkton, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could increase overflow from Elk Run, raise South Fork levels, and overwhelm drainage in the downtown triangle, and flooding may increase the contamination risk at the Stonewall Park well house.

Needs

Elkton's needs center on a long-standing downtown drainage problem, backwater flooding along Elk Run, and protection of its water and wastewater facilities.

Drainage and Stormwater Capacity

The downtown triangle, including Ashby Avenue, Warren Street, and West Spotswood Avenue, needs conveyance to connect its unserved drainage area to the downstream system; a preliminary design review has confirmed the downstream system can accept the added flow. The low-lying Stonewall Park drainage area also needs a controlled outlet.

Growth will add to these drainage needs. A subdivision of about 34 duplexes has been approved on the west end of Town and will add runoff to Town drainage systems. A hotel near the US Route 33 corridor and Blue and Gold Road, partly within the floodplain, is in early, pre-application discussion, and a planned Merck facility expansion beginning around 2028 to 2029 is expected to add further growth pressure.

Riverine Flooding

Properties along Elk Run flood when backwater from the South Fork prevents the creek from draining. The Town does not consider a buyout of its repetitive-loss property a near-term priority.

Critical Facilities

The wastewater treatment plant needs protection of its access, electrical systems, chemical storage, and ancillary components. The Stonewall Park well house needs an elevation survey to confirm whether its equipment is above the base flood elevation, followed by floodproofing if needed, in coordination with VDH.

Staffing and Coordination

Elkton relies on the Rockingham County emergency operations plan but would like to develop its own plan. The Town recently updated its floodplain regulations to require 2 feet of freeboard and clarified fence standards in the floodplain. The Town relies on CSPDC and other partners for grant writing and project coordination and on coordination with the County at the shared floodplain near the wastewater plant.

Resilience Actions

Table 4.30 | Town of Elkton Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC	Regional 1; HMP EL-5
2	**Develop a Town emergency operations plan and debris management annex** using the regional template.	Near	CSPDC	Regional 4
3	**Review drainage and floodplain compliance for new development.**	Near	Rockingham County	Regional 4

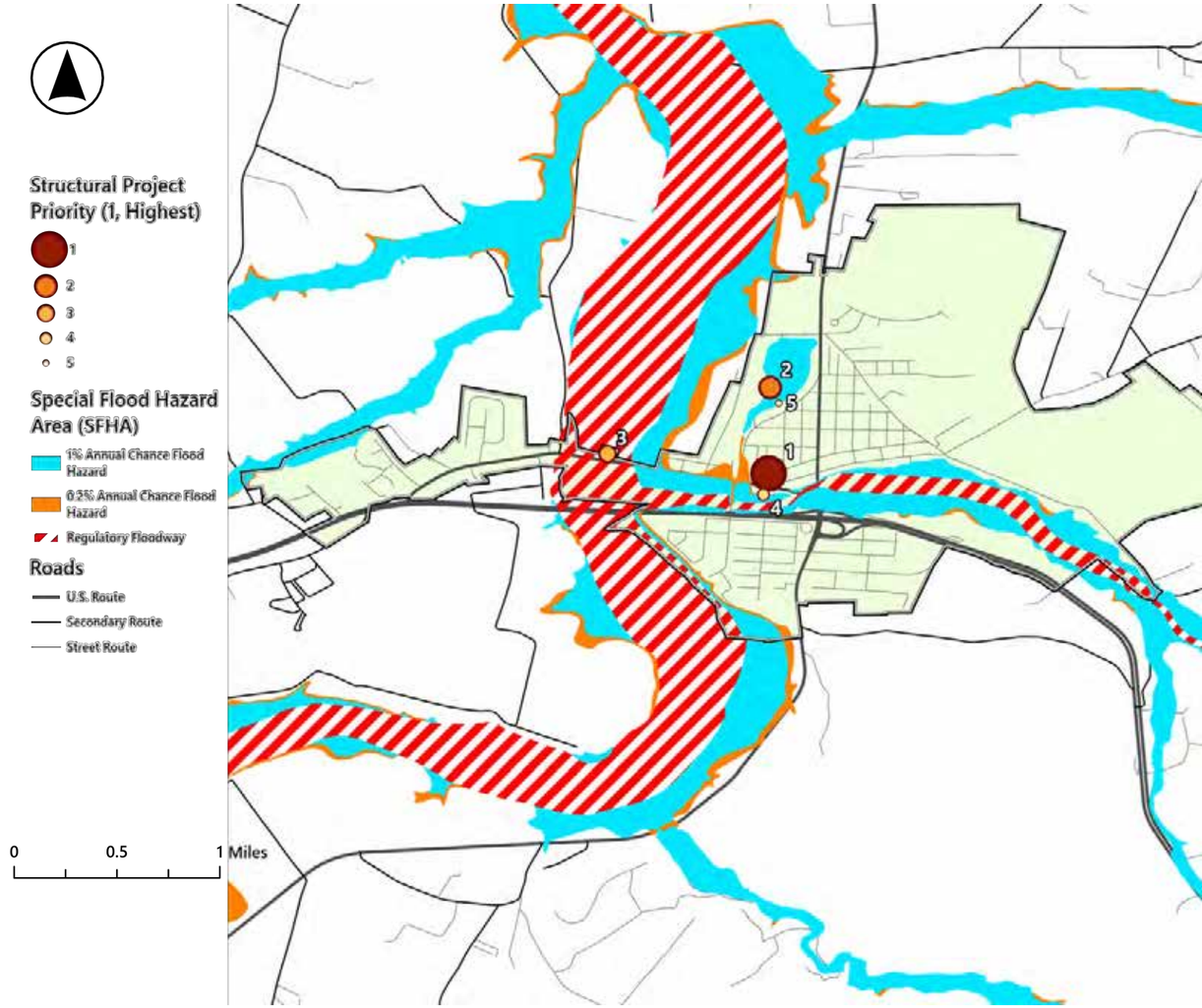
Additional related HMP actions: EL-1 (community center generator) and EL-3 (natural systems flood mitigation).

Table 4.31 | Town of Elkton Priority Projects

Priority	Project	Severity
1	Downtown Triangle Stormwater Drainage — Ashby Avenue and Warren Street*	HIGH
2	Stonewall Park Low-Lying Drainage Area Improvements	MODERATE
3	Wastewater Treatment Plant Flood Vulnerability Mitigation	HIGH (potential consequences)
4	Elk Run Corridor Downtown Residential and Commercial Flooding Mitigation	MODERATE
5	Stonewall Park Well House Flood Vulnerability Improvements	LOW TO MODERATE

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

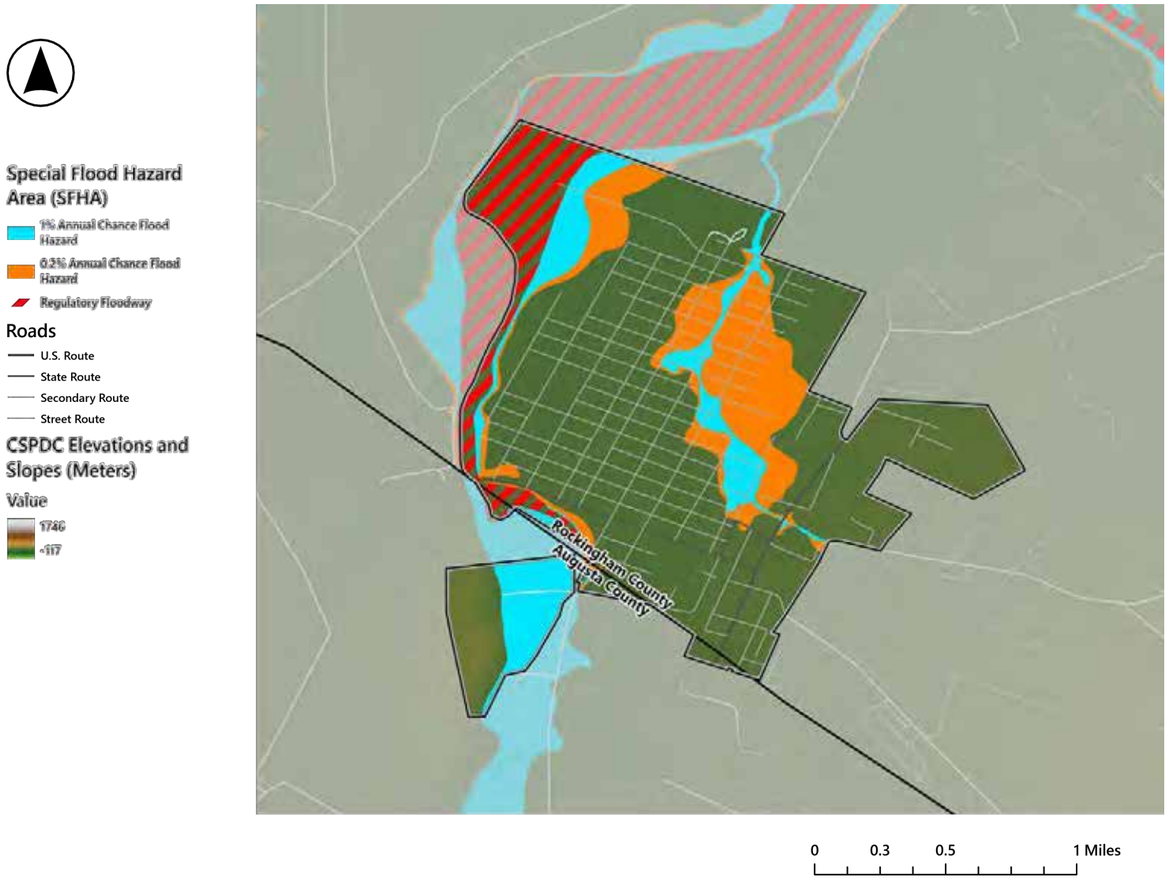
Map 4.130 | Town of Elkton Priority Projects



Town of Grottoes *At A Glance*

The Town of Grottoes is located almost entirely in southeastern Rockingham County, with a very small portion in Augusta County. The Town is about 13 miles southeast of Harrisonburg and 15 miles north of Waynesboro, within the South Fork Shenandoah River basin. The South River bounds the Town on the west. Two drainage divides cross the Town: water south of the first divide flows to the South Fork, while water north of it, and water from the Birch and Aspen Avenue area, flows to Miller Run and then to the South Fork. Grand Caverns and Grottoes Town Park sit along the South River.

Figure 4.131
Town of Grottoes Locality Introduction



2,961
total population

426
acres in the 500 year floodplain

21
flood insurance policies in force

Flood History

Causes and Recurring Problems

Grottoes sits on broad, gently sloping river terraces with many low areas and depressions that pond water. Miller Run and Dry Run overflow during heavy rain, and runoff in Town exceeds that of the surrounding forest and cropland. Flooding typically produces standing water on roads and in yards and crawl spaces rather than structural damage, although the South River floods South River Road and the entrance to Grand Caverns and Town Park during major events.

Major Events

The region's earliest well-documented flood, in September 1870, put the village of Port Republic, just north of Grottoes, under as much as 15 feet of water. Grottoes was also exposed to the region's major floods of 1942, 1985, and 1996, when Hurricane Fran broke nearly every flood record on the Shenandoah River system, although records of local impacts in Grottoes are limited.

Recent Flooding

On August 30, 2018, severe thunderstorms caused localized flooding in Grottoes, with high water reported along Route 340 (Eastside Highway), Dam Town Road, and South River Road. More recently, flooding was recorded in Grottoes on August 9, 2024, although specific property damage and infrastructure impactswere not reported. Ponding and inadequate drainage continue to affect roads, yards, and crawl spaces in the eastern part of Town.

Existing Conditions

Vulnerable Populations

Grottoes lies within a tract showing moderate to higher social vulnerability and includes households without vehicles. Flood exposure occurs in two distinct settings: the South River along the western side and the Miller Run and Dry Run drainage through developed portions of Town.

Figure 4.132
Town of Grottoes Social Vulnerability Ranking by Census Tract

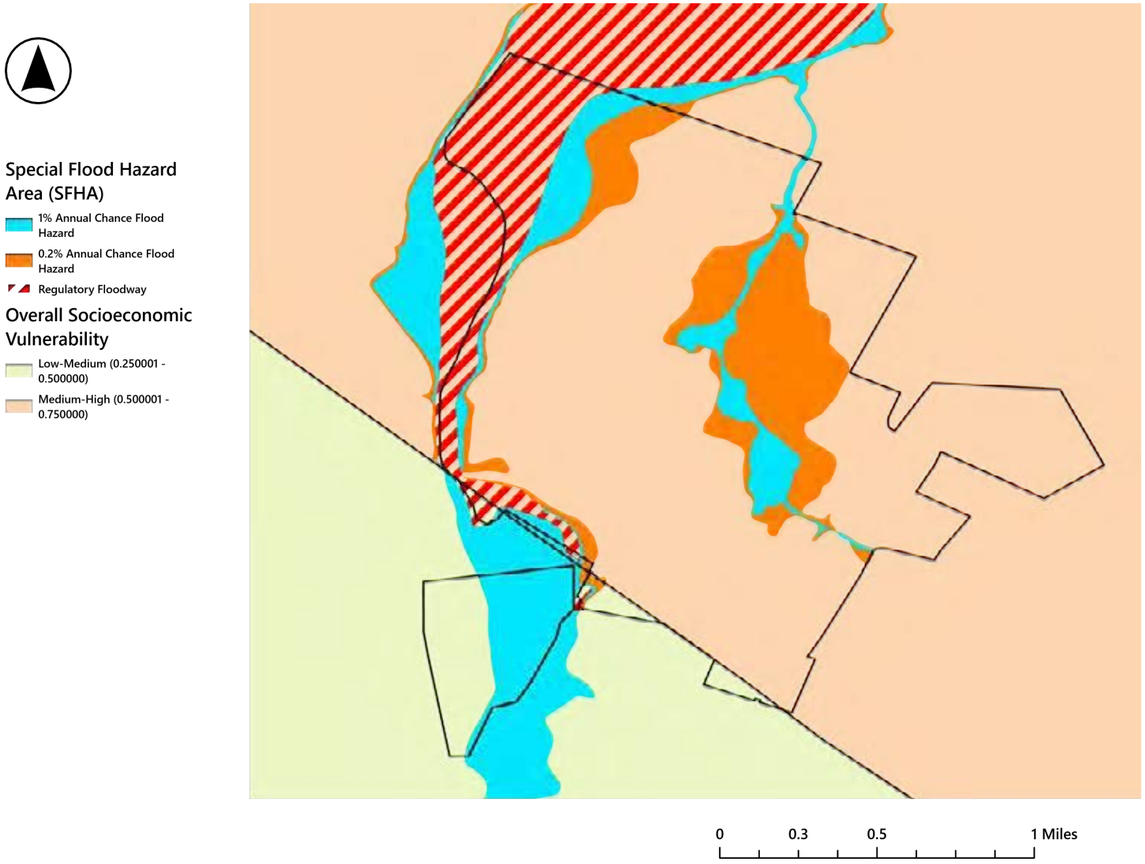
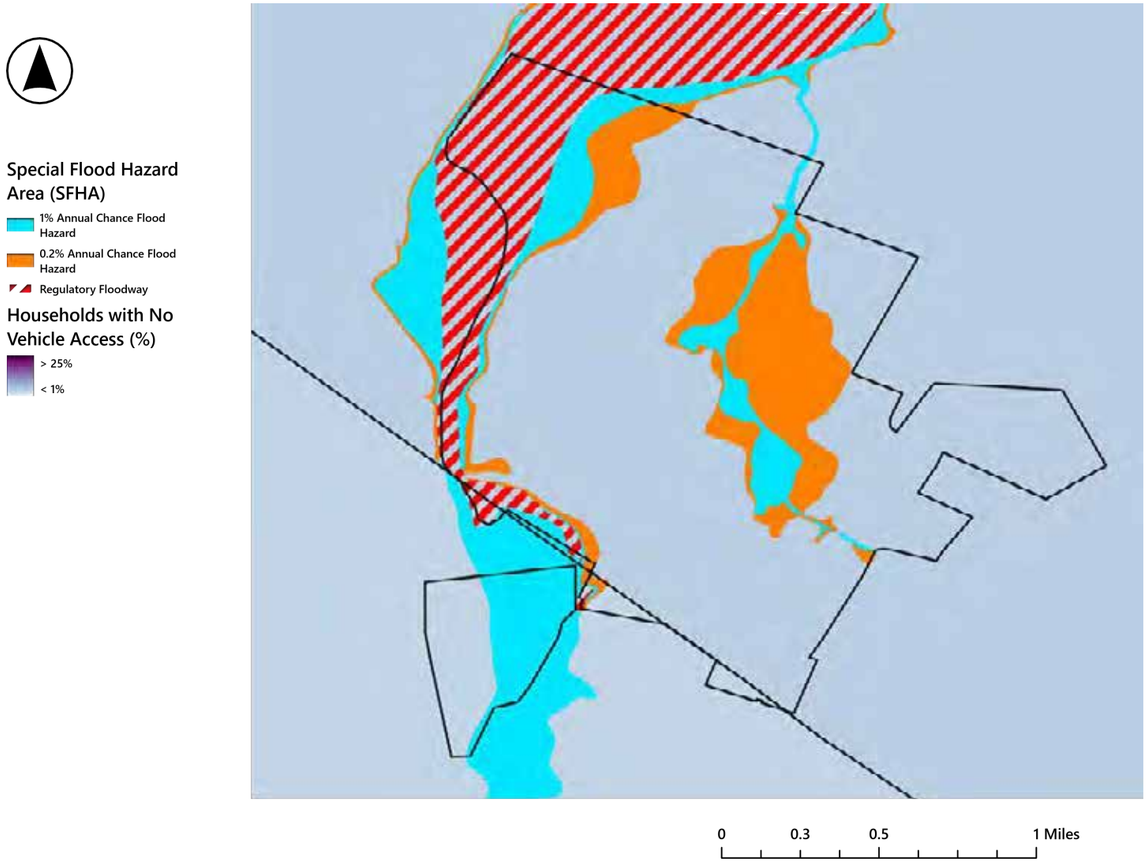


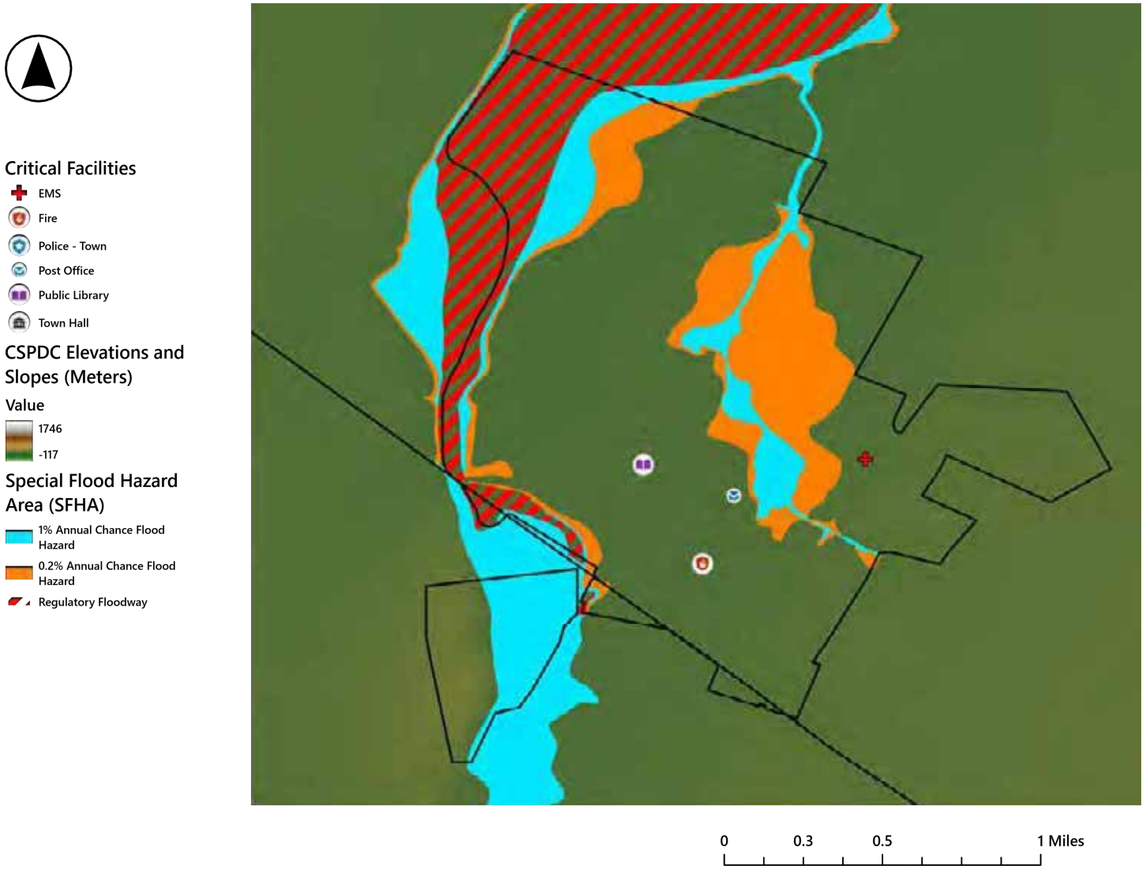
Figure 4.133
Town of Grottoes Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

Grottoes faces two interacting infrastructure risks. The South River affects western access and riverfront areas, while Miller Run and Dry Run carry flood exposure through the Town. A project focused only on the river would miss internal drainage constraints. The Town has no repetitive-loss properties.

Figure 4.134
Town of Grottoes Special Flood Hazard Areas, DEM, and Critical Facilities



Natural Resources

Conserved parcels lie west and south of Grottoes, while larger ecological cores are mainly outside the developed boundary. The South River and internal tributaries are the connections between these natural areas, but development intersects their floodplains.

Figure 4.135
Town of Grottoes Conservation Easements and Special Flood Hazard Areas

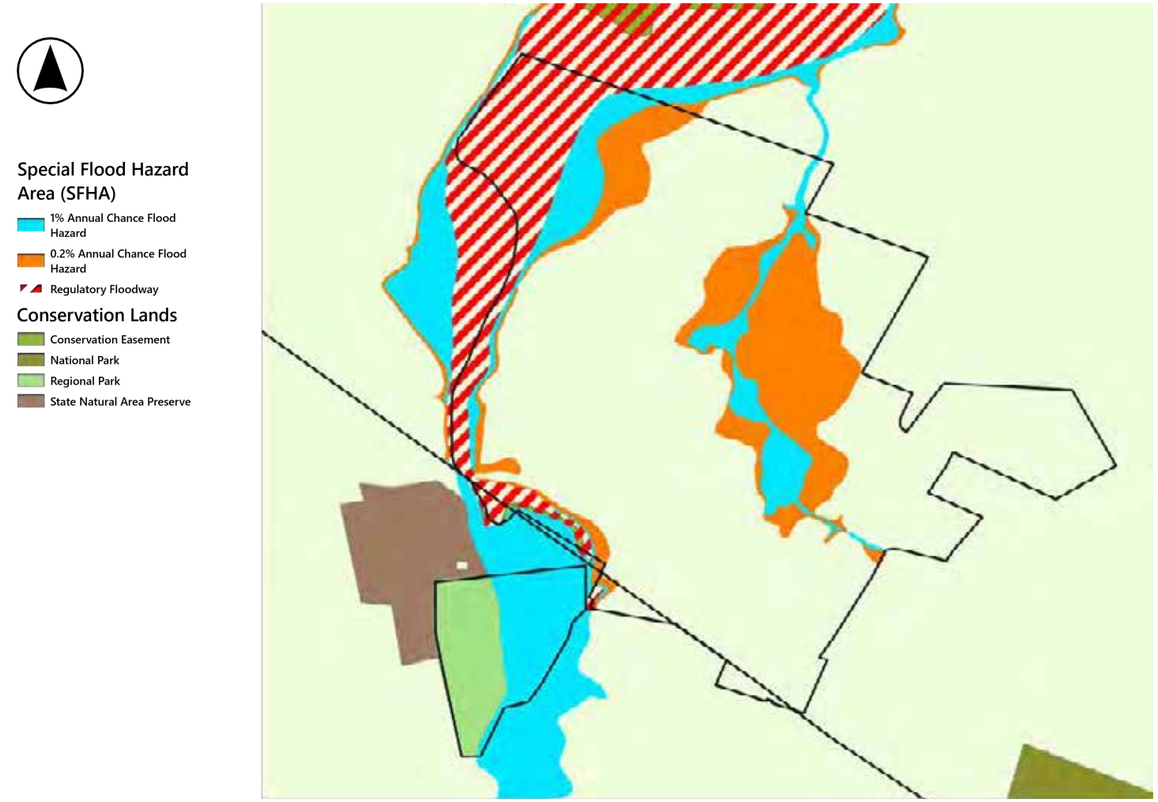


Figure 4.136
Town of Grottoes Land Cover and Special Flood Hazard Areas

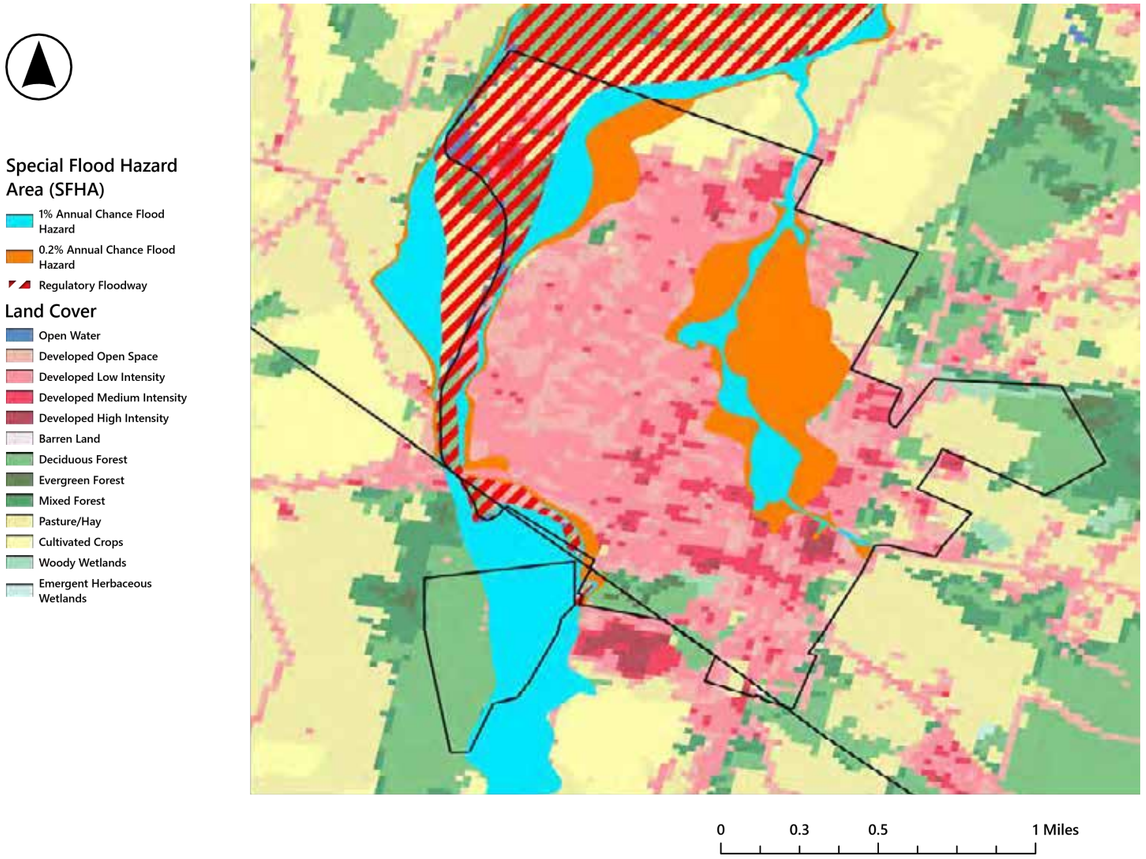


Figure 4.137
Town of Grottoes Ecological Cores and Special Flood Hazard Areas



Future Conditions

MARISA does not provide a town-specific outlook for Grottoes, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could increase runoff to Miller Run and Dry Run and increase flooding along the South River and at the Grand Caverns and Town Park entrance.

Needs

Grottoes' needs center on internal drainage in the eastern part of Town and on periodic South River flooding at its main park and tourism entrance.

Drainage and Stormwater Capacity

Town staff indicated that Grottoes is mostly built out and that any new development will occur east of US Route 340. The Town does not anticipate significant development in the next 10 years that would affect flooding.

The highest need is along Miller Run, primarily between Sixth and Ninth Streets, where ponding places water on roads, yards, and crawl spaces. Town staff estimate that ditch improvements, culvert replacements, and drainage piping could protect 30 to 50 structures. Miller Run is an intermittent channel. Debris collects repeatedly at the Cary Street culvert, which has scour at its outlet, and yard waste dumped into the channel adds to the blockages. Downstream, the channel erodes its banks along the Dogwood Avenue trail.

Along Cherry Avenue between Tenth and Twelfth Streets, drainage ditches are three to four feet deep beside a narrow road. Their depth keeps water moving on very flat ground but creates a hazard for vehicles that leave the road. Rerouting part of the drainage toward Dogwood Avenue could allow the ditches to be partly filled.

Riverine Flooding

South River flooding affects South River Road and the Grand Caverns and Town Park entrance. Extending the existing earthen berm in Town Park, with complementary drainage or nature-based measures, needs evaluation to confirm it would not increase flooding elsewhere. Voluntary floodplain acquisition or permanent open-space protection along the South River is a potential follow-up.

Resilience Actions

Table 4.32 | Town of Grottoes Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC	Regional 1; HMP GR-4, GR-5
2	**Develop a Town emergency operations plan and debris management annex** using the regional template.	Mid	CSPDC	Regional 4
3	**Establish routine debris clearing** at the Cary Street culvert on Miller Run, and have the culvert outlet inspected for scour.	Near	Town Public Works	Regional 3

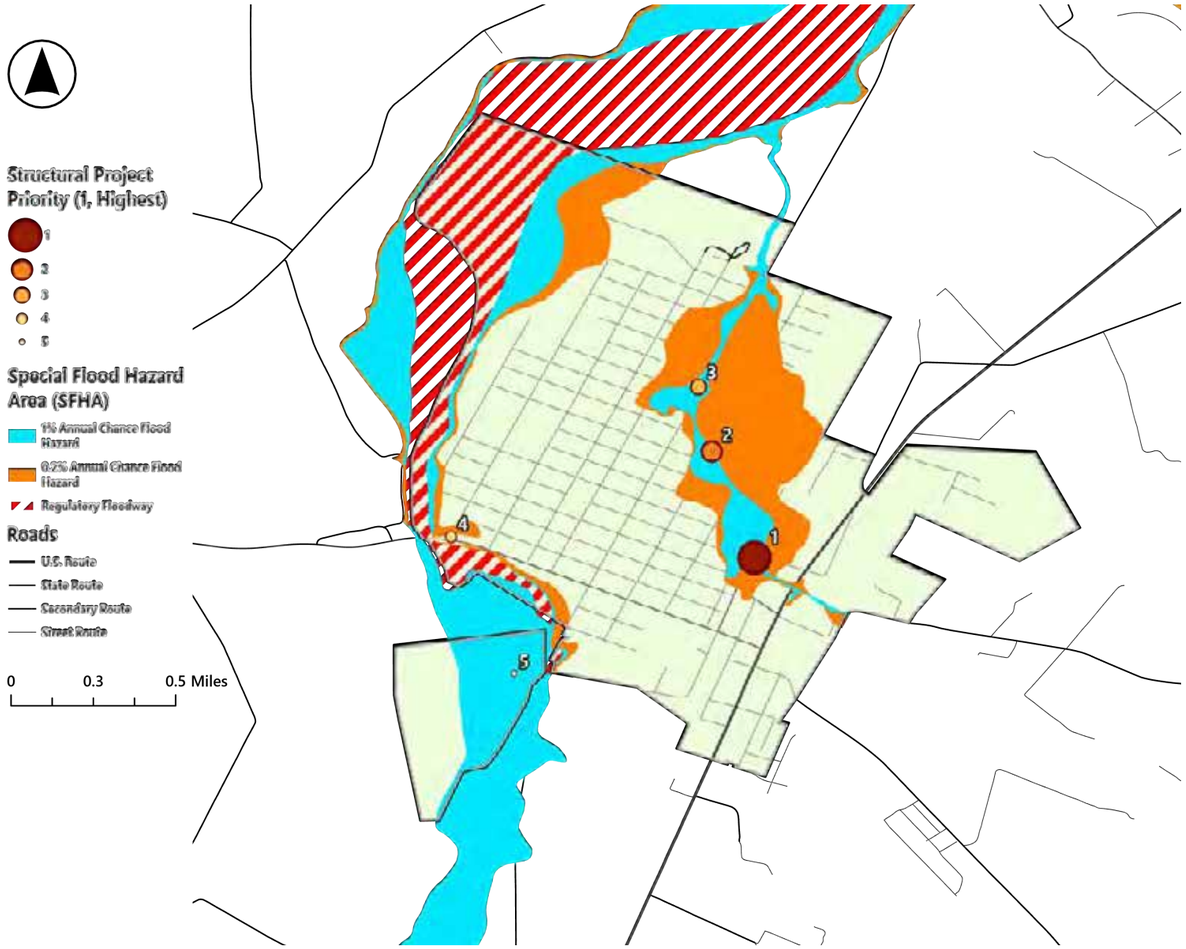
Additional related HMP actions: GR-1 (school generator) and GR-2 (NFIP compliance).

Table 4.33 | Town of Grottoes Priority Projects

Priority	Project	Severity
1	Miller Run Channel Improvements*	HIGH
2	Cherry Avenue at 10th, 11th, 12th Streets Ditch Hazard	MODERATE
3	Dogwood Avenue Trail Erosion	MODERATE
4	Holly Avenue and 3rd Street Flooding	LOW TO MODERATE
5	Grand Caverns and South River Road Improvements	LOW

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

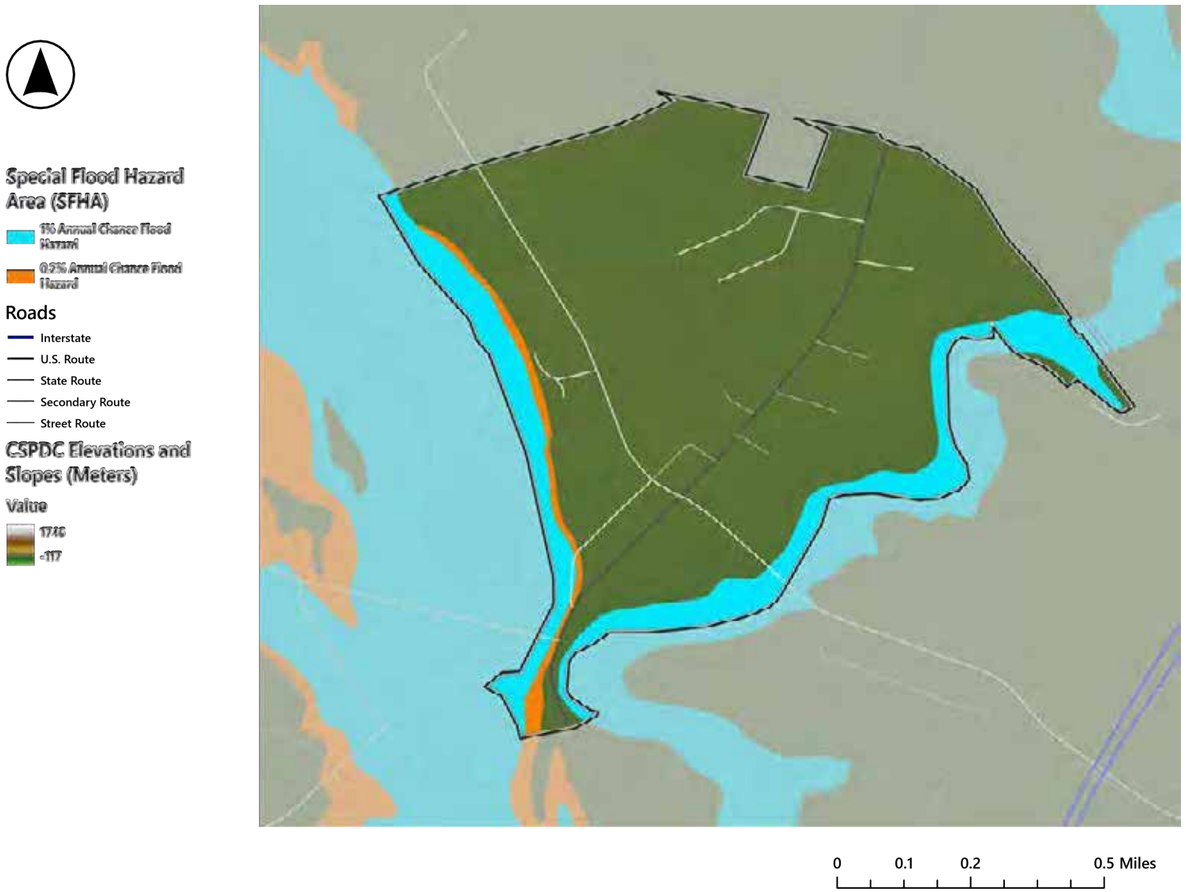
Map 4.138 | Town of Grottoes Priority Projects



Town of Mount Crawford *At A Glance*

Mount Crawford is located in southern Rockingham County about 7 miles south of Harrisonburg. The Town lies within the North River drainage basin, which drains to the South Fork of the Shenandoah River. The North River flows south along the Town's southwestern limits, and Cooks Creek borders the Town to the east. The Cooks Creek floodplain varies from 50 to 400 feet wide, and the North River floodplain averages about 75 feet wide. A drainage divide beginning at the junction of Cooks Creek and the North River sends part of the Town's runoff to Cooks Creek and the remainder to the North River.

Figure 4.139
Town of Mount Crawford Locality Introduction



532
total population

52
acres in the 500 year floodplain

-
flood insurance policies in force

Flood History

Causes and Recurring Problems

Mount Crawford's recurring flooding is driven by stormwater rather than the rivers. Runoff from hillsides on both sides of US Route 11 pools on the roadway and private property because VDOT-maintained drainage is undersized or misaligned. River flooding has historically damaged farmland, roads, and bridges rather than homes.

Major Events

The most damaging flood in the area occurred in June 1949 on the North River near Burketown, just outside Town, with an estimated recurrence interval of 75 years. In November 1985 and again during Hurricane Fran in September 1996, Cooks Creek and the North River flooded Route 687, North River Road, and Mill Street at the Old Mill.

Recent Flooding

Water stands for days after rain at the post office. Runoff also pools on US Route 11 near Parsons Court and the Ruritan Park entrance, a damaged culvert backs water onto Mill Street and Old Bridgewater Road, and the Town Park river landing floods to the bottom step during significant storms.

Existing Conditions

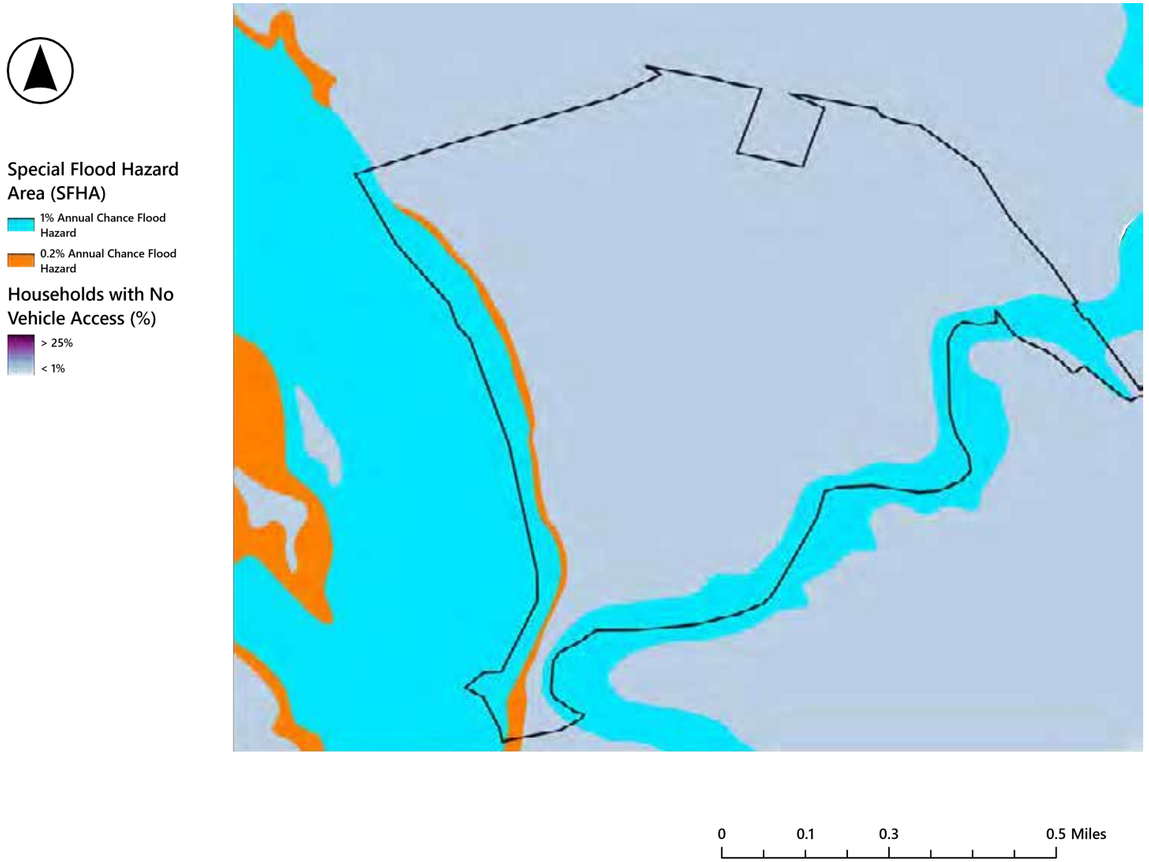
Vulnerable Populations

Mount Crawford is mapped with relatively low social vulnerability and few households without vehicles. Its compact size and position between the North River and Cooks Creek nevertheless create localized risk that tract-level indicators can obscure.

Figure 4.140
Town of Mount Crawford Social Vulnerability Ranking by Census Tract



Figure 4.141
Town of Mount Crawford Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

Floodplains along the North River and Cooks Creek border much of Mount Crawford, while the Town has few critical facilities and alternate routes. An upstream dam inundation area overlaps the western and southern river corridor. The Town has no repetitive-loss properties.

Figure 4.142
Town of Mount Crawford Special Flood Hazard Areas, DEM, and Critical Facilities

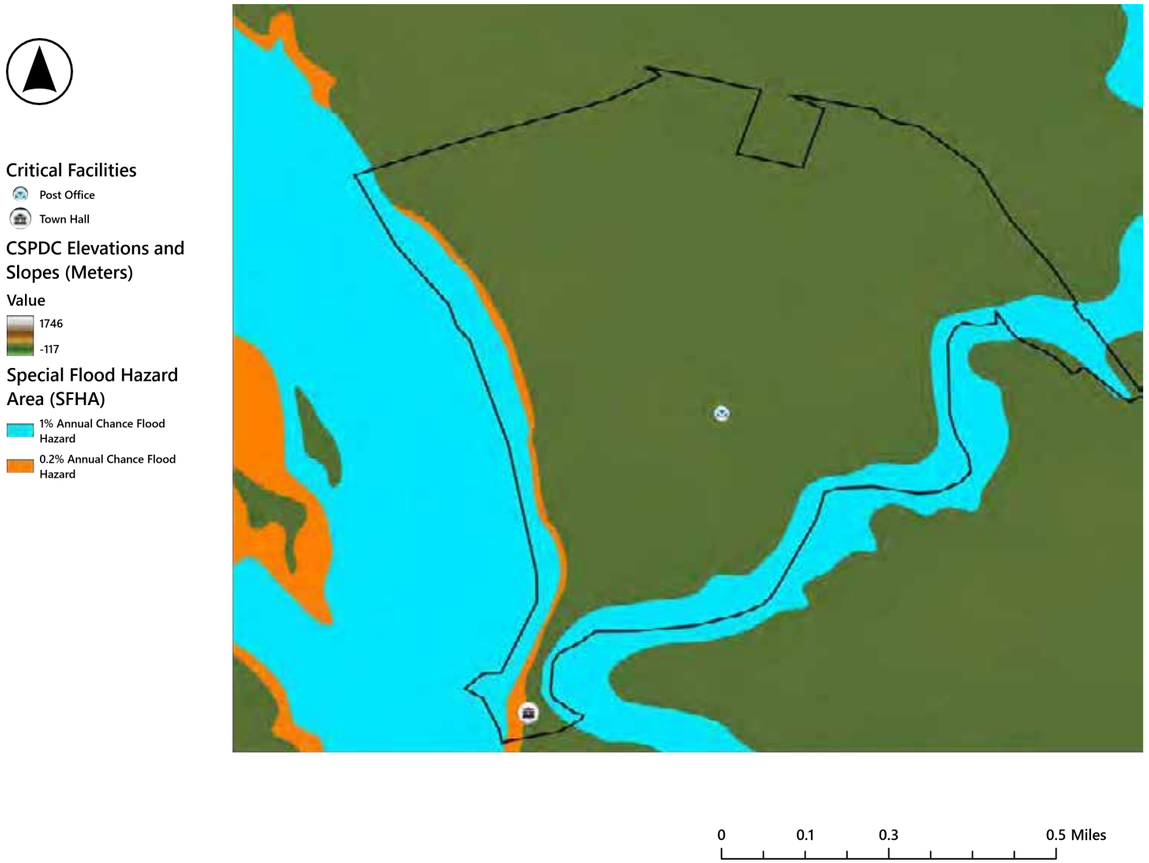
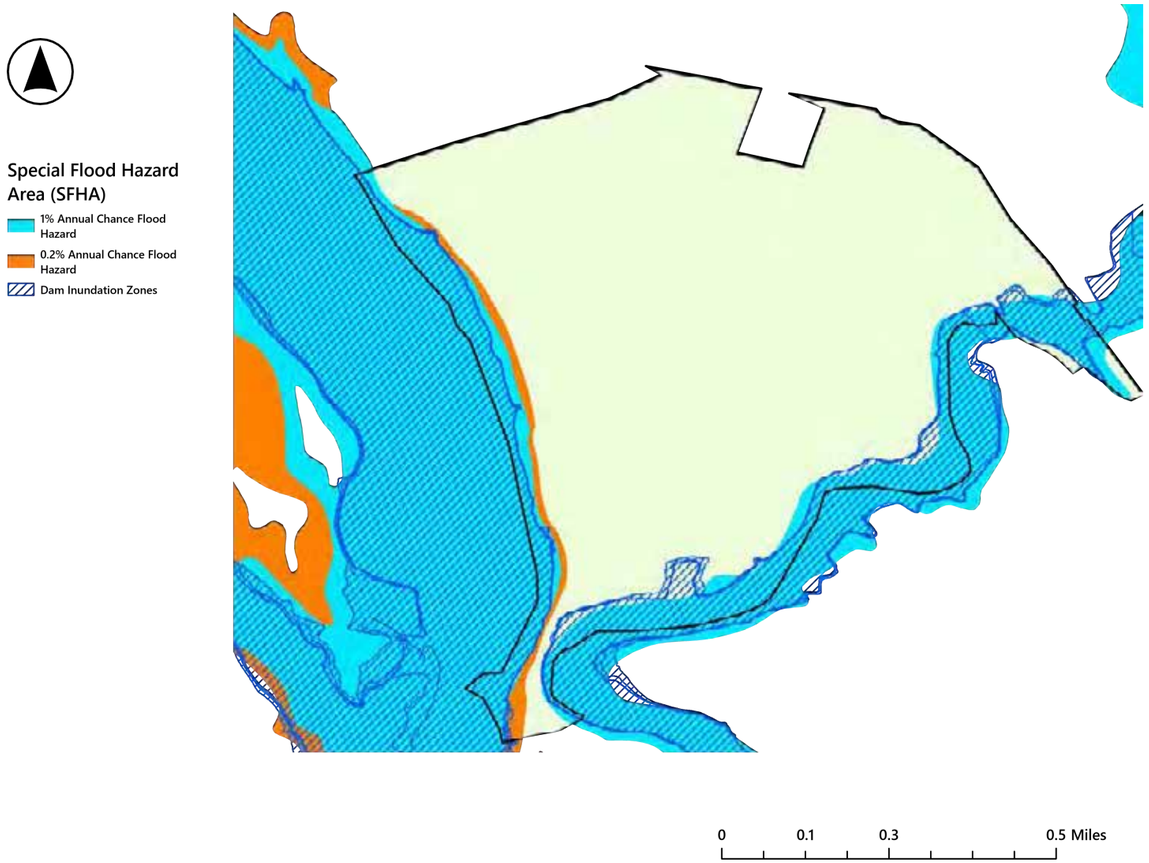


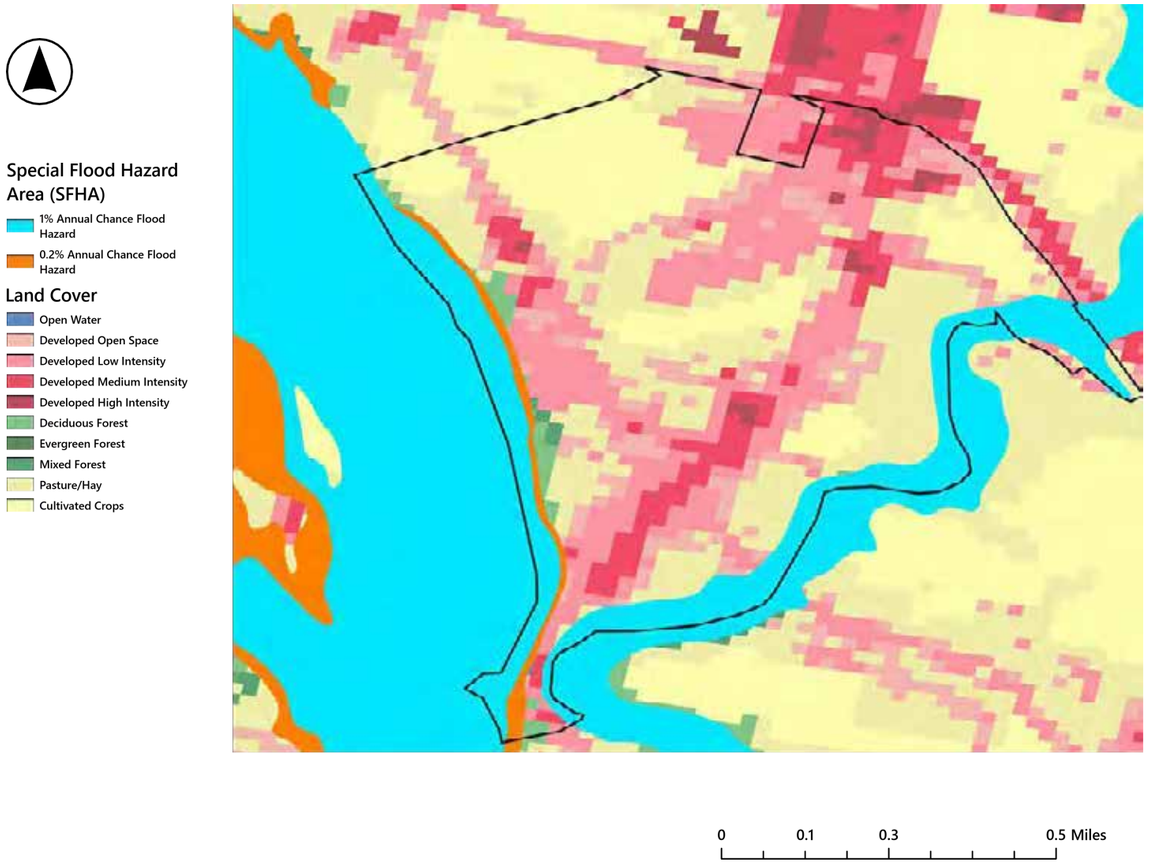
Figure 4.143
Town of Mount Crawford Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



Natural Resources

The town-scale maps do not provide separate conservation or ecological-core layers for Mount Crawford. They do show a broad river-and-creek floodplain surrounded by developed and agricultural land.

Figure 4.144
Town of Mount Crawford Land Cover and Special Flood Hazard Areas



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Future Conditions

MARISA does not provide a town-specific outlook for Mount Crawford, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could increase flooding along the North River and Cooks Creek and worsen ponding near Parsons Court and US Route 11.

Needs

Mount Crawford's needs center on stormwater pooling along VDOT-maintained US Route 11, which the Town cannot address without VDOT.

Drainage and Stormwater Capacity

Mount Crawford's population is growing for the first time since the early 2000s. About 60 townhouses are under construction on part of a 26-acre tract near Cooks Creek; the developer originally proposed 211 units and has installed utilities for 27 more. Three commercial lots remain available along US Route 11, where added impervious surface would drain to the already constrained Parsons Court system. A new connection from Parsons Court to Friedens Church Road now functions as a secondary entrance to Town.

The US Route 11 corridor's drainage problems are interconnected. The most acute points are:

- Parsons Court and US Route 11, where runoff pools on the roadway and along the street frontage, and VDOT has developed two improvement concepts;
- the post office and Ruritan Road area, where a blocked drainage path behind the post office leaves water standing for days;
- Mill Street and Old Bridgewater Road, where a damaged culvert needs replacement or upsizing.

River Access and Riparian Conditions

The Town Park river-access walkway has been rebuilt to correct earlier erosion. Remaining needs include riparian planting, removal of a displaced concrete trash can from the channel, and flood-resistant park furnishings. The Town continues riparian planting and is interested in a tree canopy assessment and right-of-way planting, and riparian planting along Cooks Creek may help offset runoff from the new development.

Coordination and Capacity

All three of the Town's top priorities involve VDOT-maintained roads or culverts. One staff member handles all Town infrastructure and maintenance. The Town relies mostly on external partners such as the CSPDC to facilitate grant development and administration.

Resilience Actions

Table 4.34 | Town of Mount Crawford Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	VDOT; CSPDC	Regional 1, 6; HMP MC-4, MC-5
2	**Pursue near-term fixes on US Route 11 with VDOT,** comparing VDOT's Parsons Court concepts with nature-based alternatives and clearing the blocked drainage path behind the post office.	Near	VDOT Rockingham Residency	Regional 6; HMP MC-4
3	**Expand riparian planting and complete a tree canopy assessment** for Main Street, Parsons Court, and Cooks Creek.	Mid	Virginia Department of Forestry	Regional 8; HMP MC-2

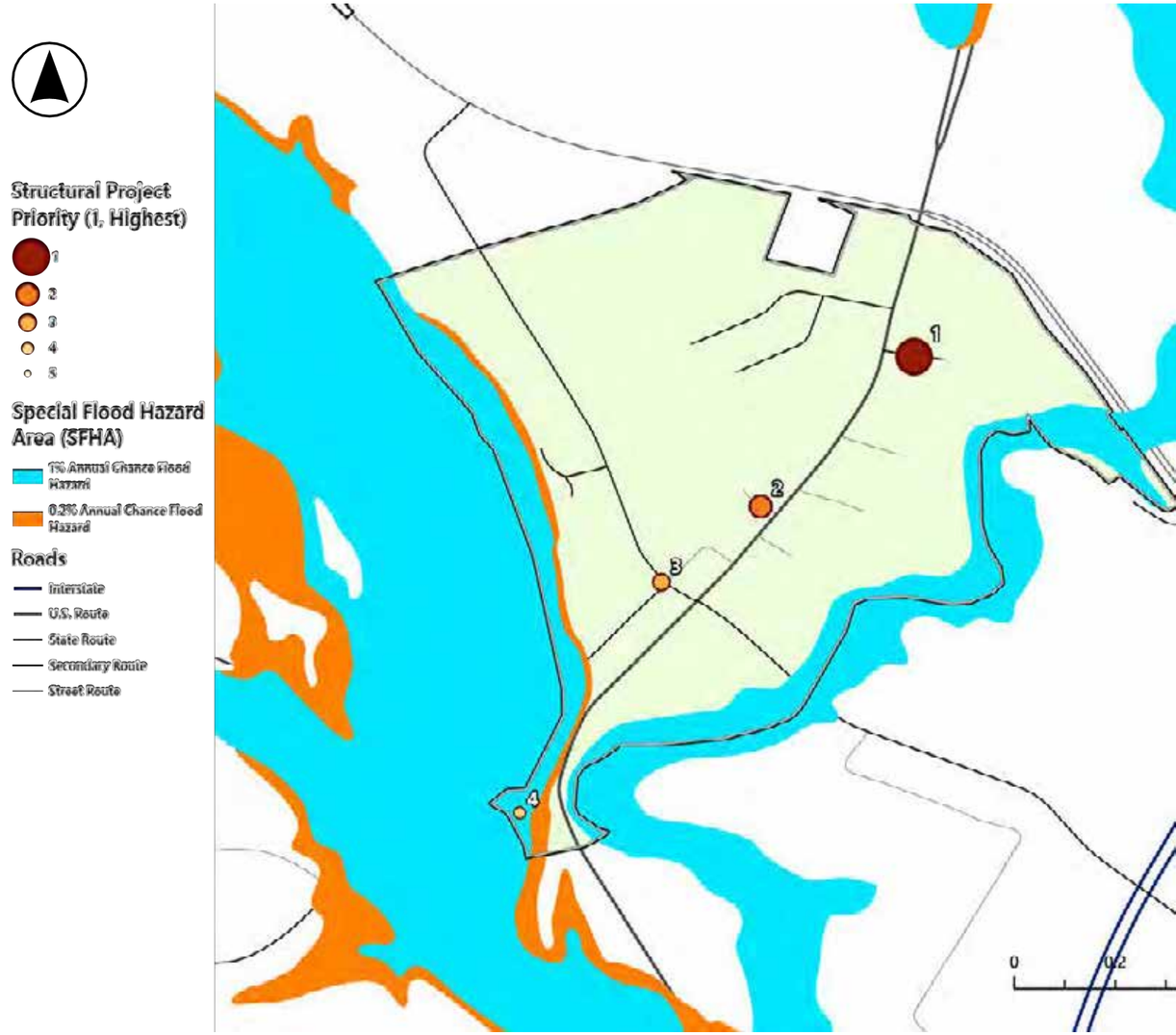
Additional related HMP actions: MC-3 (Town Hall floodplain improvements), MC-9 and MC-10 (sinkhole monitoring), and MC-11 (emergency shelters).

Table 4.35 | Town of Mount Crawford Priority Projects

Priority	Project	Severity
1	Parsons Court and Route 11 Stormwater Drainage Improvements*	HIGH
2	Route 11 / Ruritan Road Post Office and Ruritan Park Drainage Improvements	HIGH
3	Mill Street and Old Bridgewater Road Culvert Replacement	HIGH
4	Town Park River Access and Kayak Landing Flood Vulnerability and Walkway Improvements	LOW

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

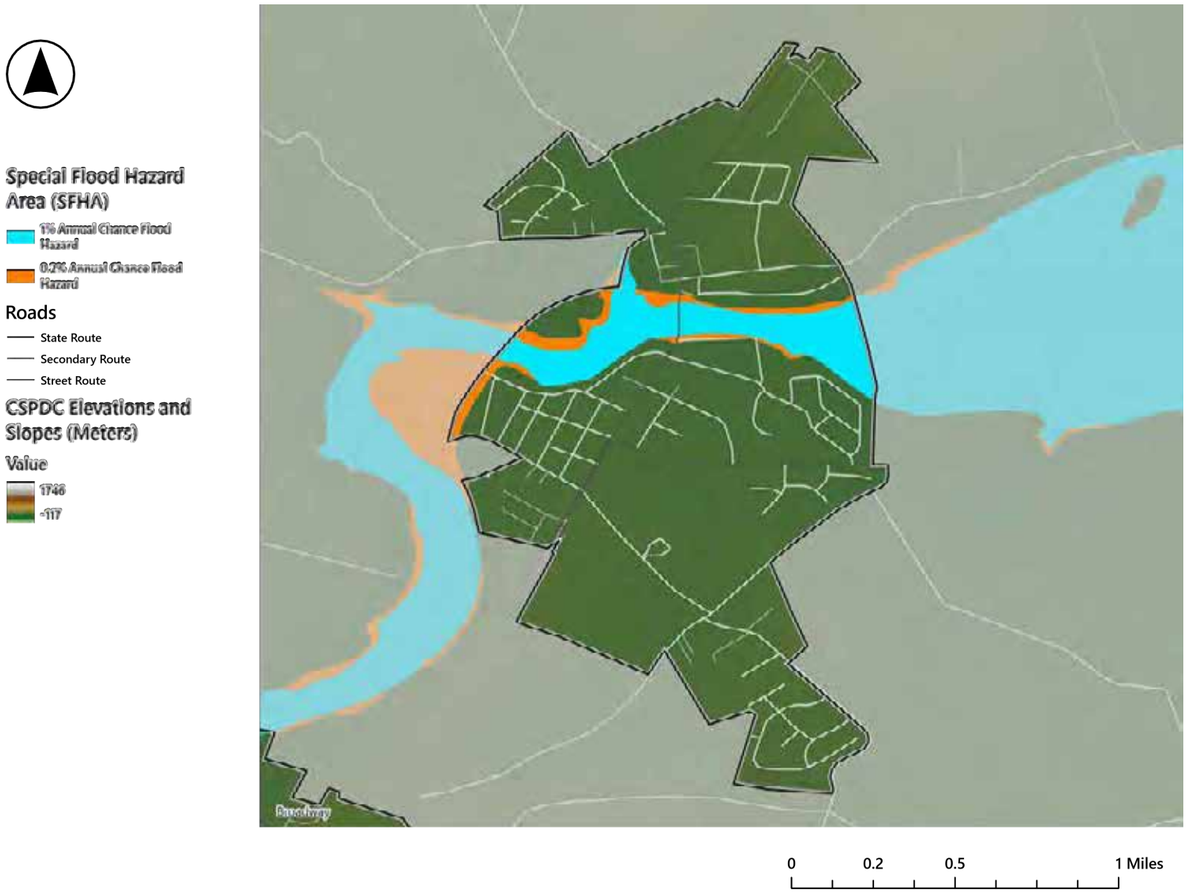
Map 4.145 | Town of Mount Crawford Priority Projects



Town of Timberville *At A Glance*

The Town of Timberville is located in northern Rockingham County, about 12 miles north of Harrisonburg and two miles north of the Town of Broadway. The North Fork of the Shenandoah River flows through the center of Town, creating its floodplain, and State Route 42 (Main Street) also divides the community. The north side of Town is older and largely built out, while the south side is the Town's designated growth area. The North Fork rises on the steep, wooded slopes of the Shenandoah Mountains, whose ridgeline forms the western edge of the basin and the Virginia–West Virginia boundary.

Figure 4.146
Town of Timberville Locality Introduction



3,036
total population

89
acres in the 500 year floodplain

1
flood insurance policies in force

Flood History

Causes and Recurring Problems

Timberville's most persistent problem is stormwater and not river flooding. On the south side of Town, an estimated 544 acres drain to a single point on US Route 211, flooding yards in the Virginia Avenue and Maple Avenue neighborhoods, where water stands for extended periods. The North Fork rises substantially during major storms, but river flooding has generally reached only yards and one outbuilding. Karst geology also affects the Town; 32 sinkholes opened after 7 inches of rain in April 2000.

Major Events

Major North Fork floods occurred in 1936, with a recurrence interval of about 50 years; October 1942, when the river reached 25.3 feet at Cootes Store, the record at the time; and 1973, with a recurrence interval of about 18 years. The river rose substantially again in November 1985, in January 1996 from rain on snow, and in September 1996 during Hurricane Fran, when the North Fork crested near 28 feet at Cootes Store and set a new record.

Recent Flooding

Yard flooding around US Route 211 and the Virginia Avenue and Maple Avenue neighborhoods recurs with significant rain, and the Town's in-house French drain on Maple Avenue has had mixed success. A FEMA flood map update for the Town is under way.

Existing Conditions

Vulnerable Populations

Timberville shows moderate social vulnerability without a pronounced concentration of households lacking vehicles. The North Fork Shenandoah River floodplain borders and enters the northern and western parts of the community, where an interruption could affect access even for residents outside the inundated area.

Figure 4.147
Town of Timberville Social Vulnerability Ranking by Census Tract

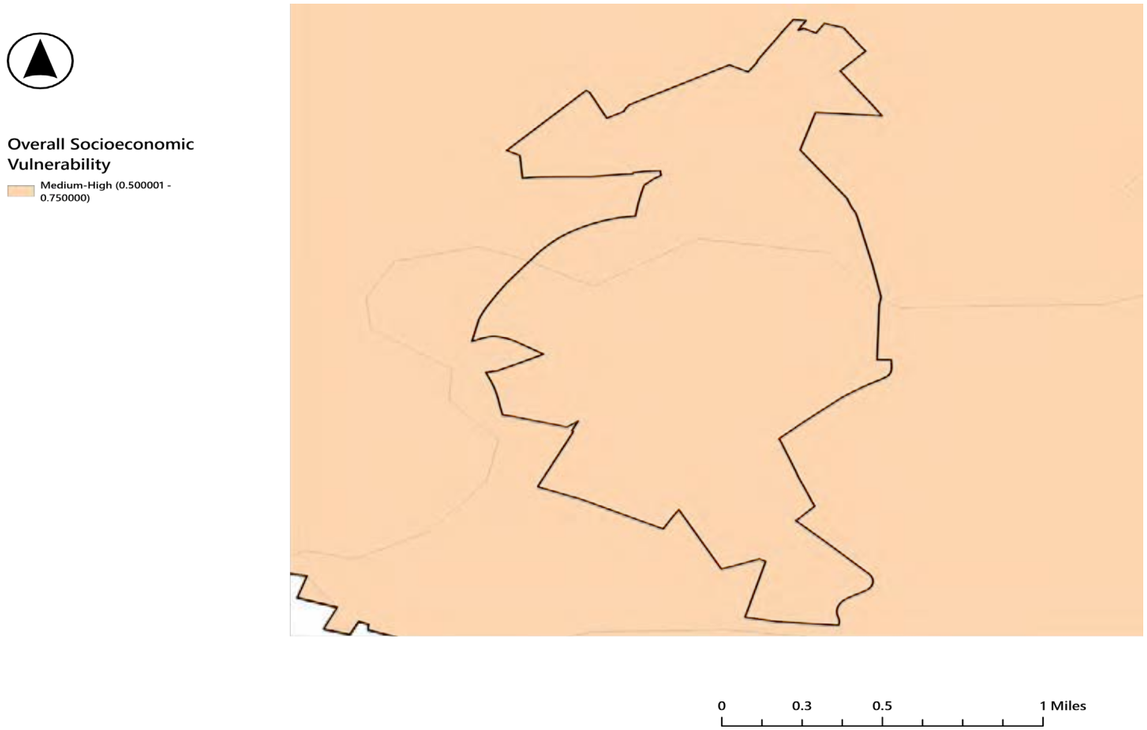
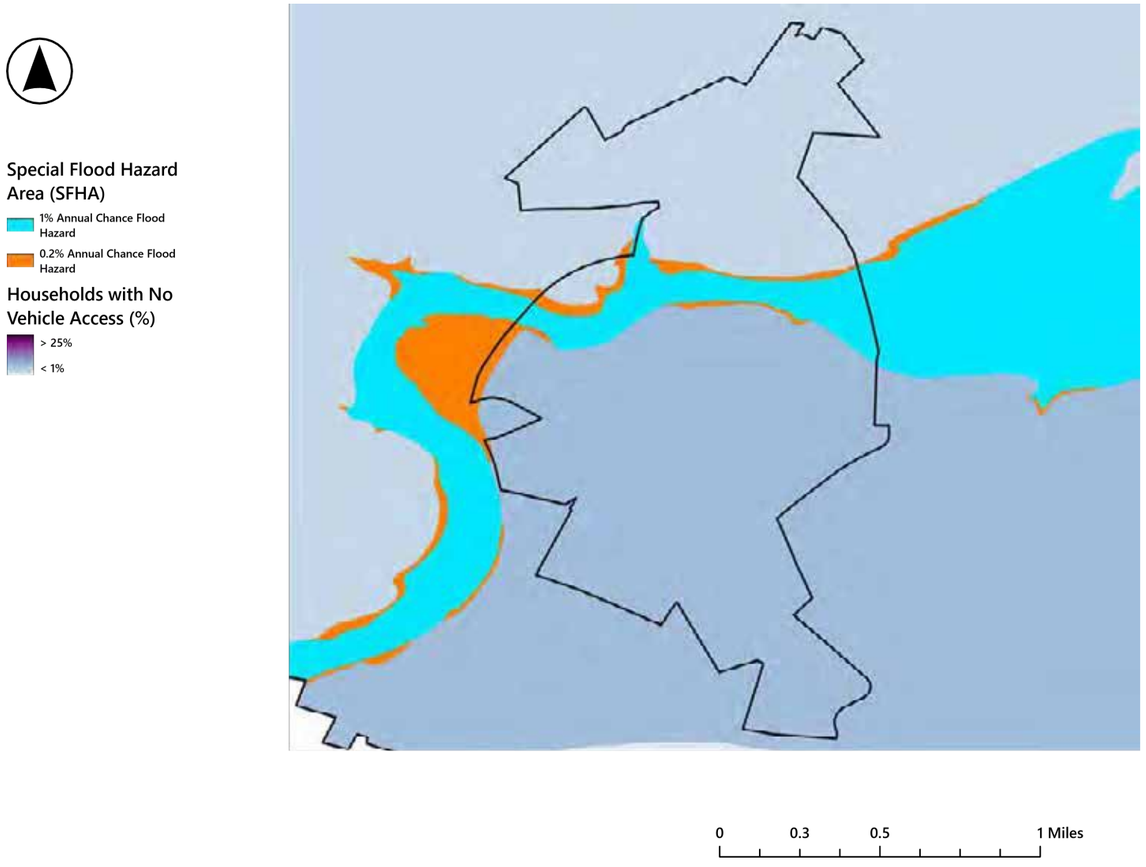


Figure 4.148
Town of Timberville Flood Vulnerability and Vehicle Access (Virginia Department of Conservation and Recreation and US Census (2020)



Infrastructure

The North Fork floodplain and mapped dam inundation area follow the same reach along Timberville's northern side. Critical facilities are generally south of the river, and their access and service areas depend on a limited set of crossings and approaches. No critical facilities, including the assisted living facility, have been reported to flood. The Town has no repetitive-loss properties.

Figure 4.149
Town of Timberville Special Flood Hazard Areas, DEM, and Critical Facilities

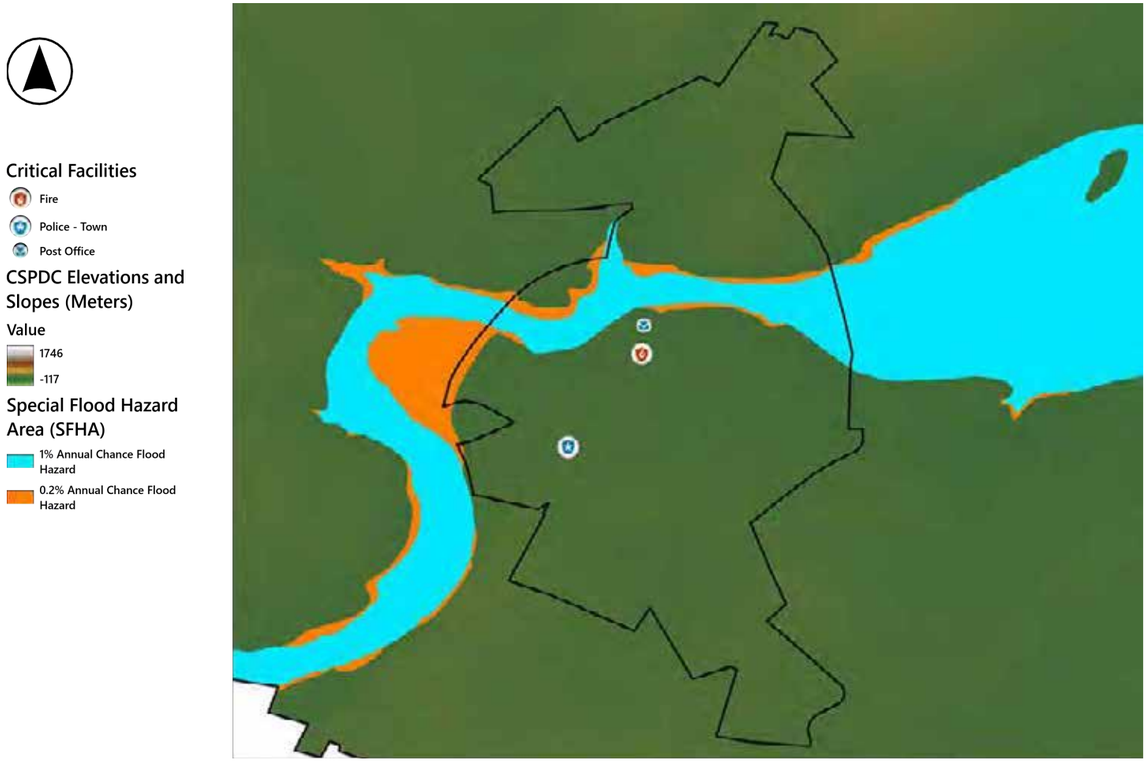
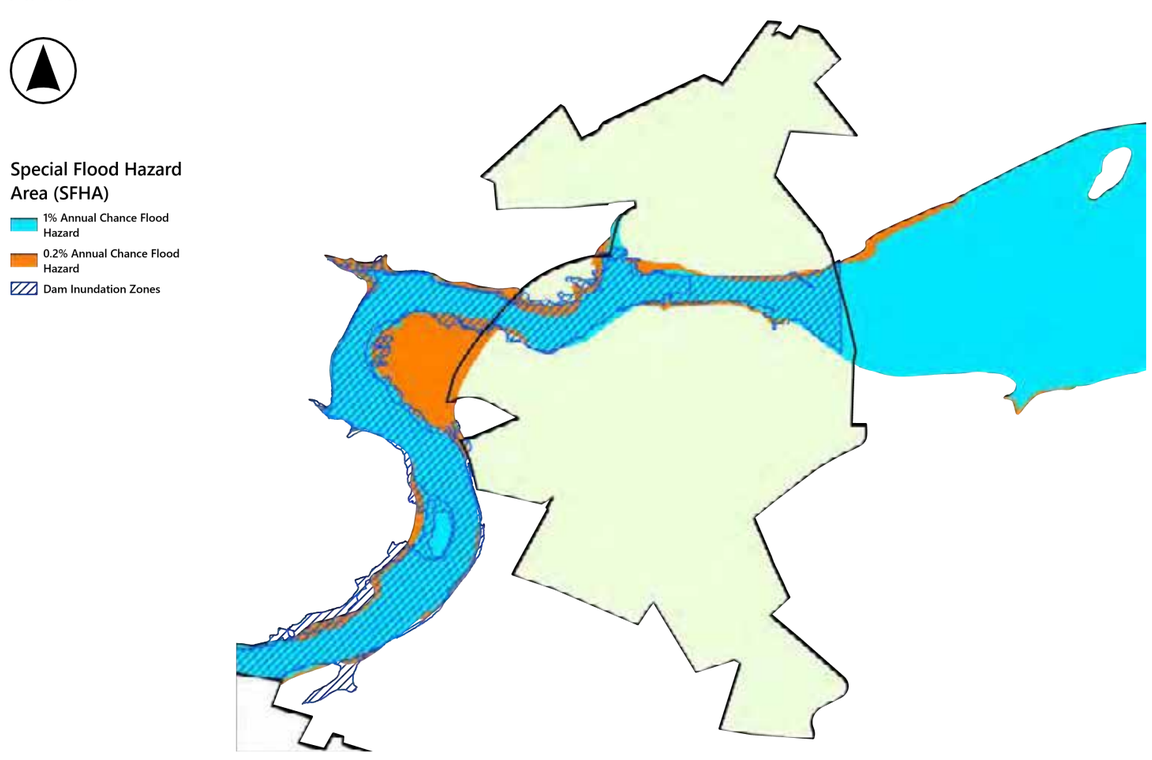


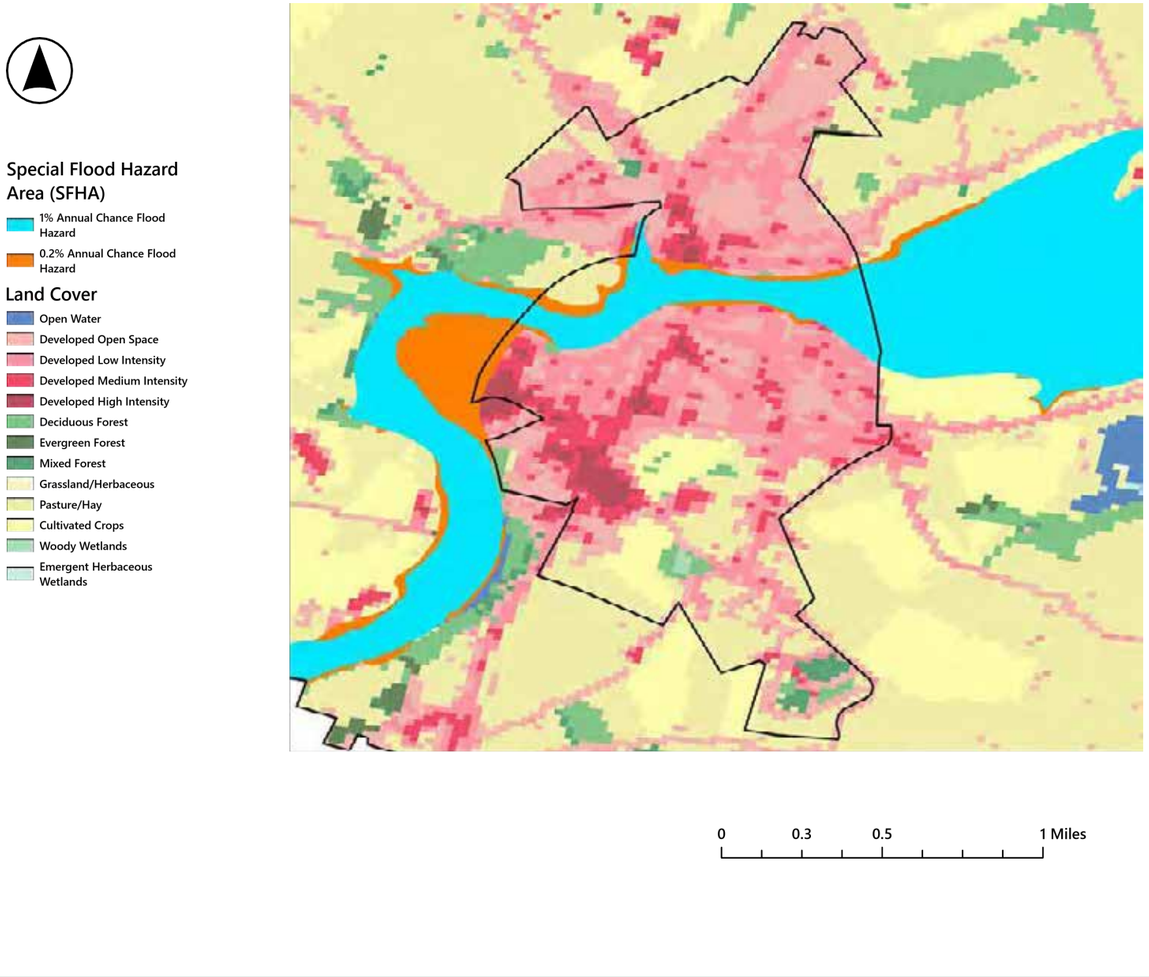
Figure 4.150
Town of Timberville Dams and Mapped Dam Inundation Zones, Special Flood Hazard Areas



Natural Resources

The town-scale maps do not include separate conservation or ecological-core layers. They show developed and agricultural land surrounding the North Fork floodplain, making the river corridor the principal visible green-infrastructure asset.

Figure 4.151
Town of Timberville Land Cover and Special Flood Hazard Areas



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Future Conditions

MARISA does not provide a town-specific outlook for Timberville, so the Rockingham County outlook provides the closest available climate context. Rockingham County currently averages about one day per year at or above 95°F, and the projected 2070 average is 16 to 34 days. Compared with the 1990–2019 average, annual rainfall during 2050–2079 is projected to increase by about 2 inches, and the frost-free period is projected to lengthen by approximately 3 to 6 weeks. Heavier rainfall could increase runoff from the 544-acre US Route 211 drainage area and add pressure on the US Route 211 and State Route 42 systems, local culverts, and the North Fork corridor.

Needs

Timberville's needs center on runoff from its designated growth area, which drains to a single undersized collection point and will worsen as development occurs. A secondary set of needs involves aging drainage in older neighborhoods and conditions along the North Fork.

Drainage and Stormwater Capacity

The Town's most significant and long-standing problem is on US Route 211 (New Market Road), between the Walmart and Tractor Supply developments. An estimated 544 acres drain to a single collection point there, according to County analysis. The drainage area includes the Town's entire designated growth area and the surrounding agricultural fields, and it is exceptionally large for the infrastructure that serves it. During significant storms, flooding spreads around the collection point and into the Virginia Avenue and Maple Avenue neighborhoods to the north.

The Maple Ave. drainage ditch, which serves a neighborhood built in the 1960s, runs through backyards from behind Maple Ave. to the North Fork.

Stream and Channel Conditions

At Memorial Park, river rock and sediment have built up along the near bank of the North Fork for decades, narrowing the channel and pushing it toward the far bank. The Army Corps of Engineers last dredged the channel in the 1980s.

Along C Street East, homes back up to the North Fork. FEMA maps place them in the floodplain, and some owners' mortgage companies require flood insurance. During the 1985 and 1996 floods, water reached yards and flooded one low outbuilding but did not enter any homes, and the Town has written letters documenting that history for homeowners. Because the corridor is entirely private and no public improvement is practical, the need is mainly documentation.

Water Quality

A VDOT-owned pipe collects road runoff along South Main Street and discharges it, unfiltered, through a concrete outfall into the North Fork near the Town park.

Staffing and Coordination

Timberville has limited staff and relies on CSPDC and other partners for grant writing and project development. The Town relies on Rockingham County's emergency operations plan and has no debris management plan. The Town also relies on County and state standards for floodplain management, erosion and sediment control, and stormwater. Because the US Route 211 drainage area extends beyond Town limits, the project will require coordination with Rockingham County.

Resilience Actions

Table 4.36 | Town of Timberville Resilience Actions

#	Action	Timeline	Potential Partners	Related Actions
1	**Advance the priority projects identified in this plan.** The projects are shown on the locality map and described in Appendix A.	Mid	CSPDC; property owners	Regional 1; HMP TI-3, TI-4
2	**Manage growth-area runoff.** Require drainage analysis for new development in the US Route 211 drainage area, and coordinate with Rockingham County on the portion outside Town limits. Consider a pro rata share ordinance under Virginia Code § 15.2-2243 so new development contributes to a regional facility.	Near	Rockingham County	Regional 1, 4
3	**Adopt a Town emergency operations plan with debris management procedures,** building on the plan Broadway has shared with the Town.	Near	Rockingham County Emergency Management; Town of Broadway	Regional 4

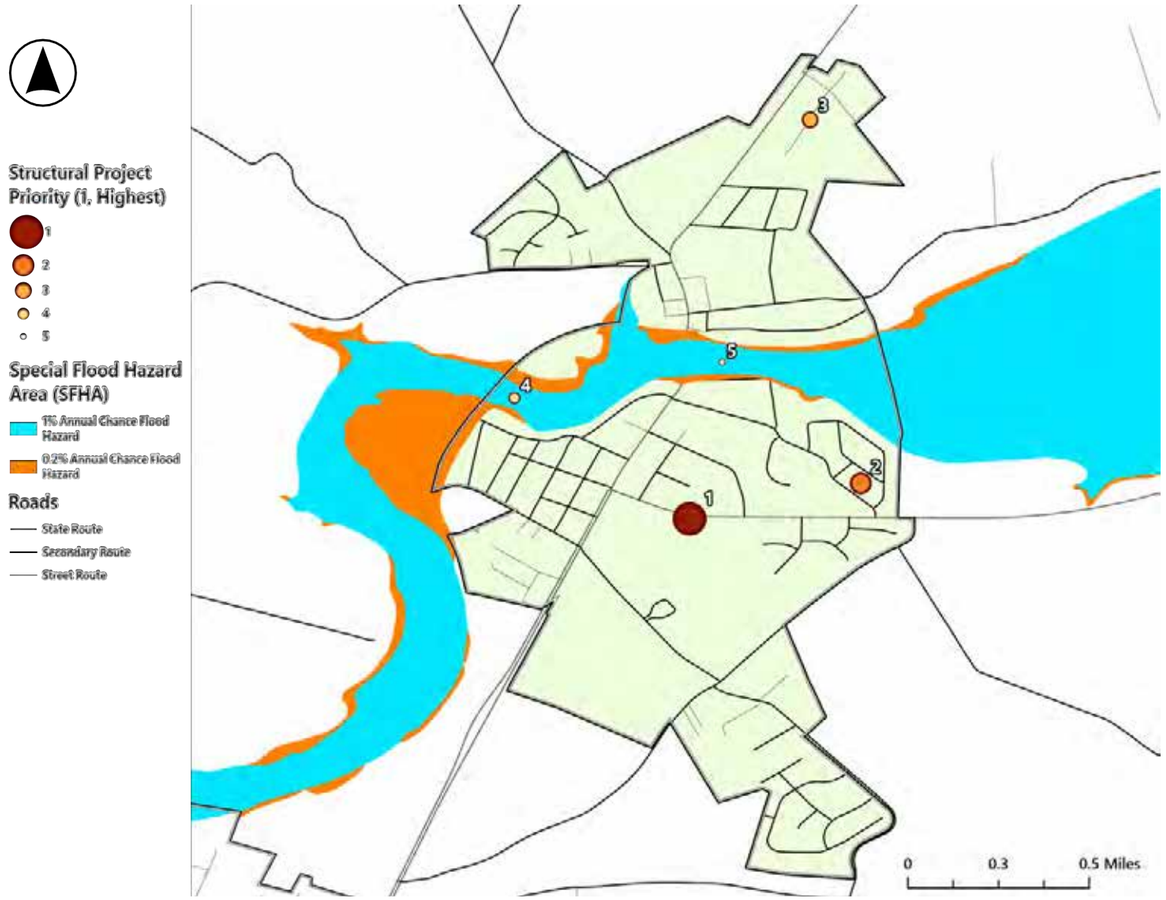
Additional related HMP actions: TI-1 (NFIP compliance), TI-5 (river dredging with the Army Corps), and TI-14 (water system generators).

Table 4.37 | Town of Timberville Priority Projects

Priority	Project	Severity
1	Route 211 Stormwater Concentration Point Drainage Improvements*	HIGH
2	Maple Avenue Drainage Ditch System Improvements	MODERATE
3	Route 42 North / Reservoir Lane / Rill Road Drainage Basin Assessment – Future Development	LOW TO MODERATE
4	Memorial Park River Channel Assessment and Improvements	LOW
5	C Street East and North Fork Shenandoah River Corridor Assessment	LOW

*See Appendix A for detailed memos of each priority project. * Indicates project is a 10% design concept.*

Map 4.152 | Town of Timberville Priority Projects



Appendix A
Projects and Concepts

Overview

Appendix A presents the 61 priority projects developed through this plan and 10% design concepts for selected projects, providing each locality a documented starting point for grant applications, capital planning, and partner coordination.

The appendix covers the 14 participants that developed projects: Augusta, Bath, Highland, and Rockbridge Counties; the City of Lexington; and the Towns of Bridgewater, Broadway, Dayton, Elkton, Glasgow, Goshen, Grottoes, Mount Crawford, and Timberville. Waynesboro, Harrisonburg, and JMU projects come from their existing plans (Chapter 4), and Rockingham County identified areas of concern rather than projects. The appendix opens with Table A.1, which summarizes all 61 projects, followed by the 10% design concepts, and the priority project memos, organized by locality. WSSI scoped projects are listed first in the table, while MS4 projects are located at the end. Concept designs are bolded.

10% Design Concepts and Priority Project Memos

WSSI prepared a memo for each project after visiting each site in June and July 2026. Each memo describes the issue, constraints, recommended approach, planning-level cost estimate, and alternatives. WSSI also developed one priority project per participant, usually the top-ranked project, into a 10% design concept. All cost estimates include a 30 percent contingency and are intended for planning purposes.

Of the 61 projects, 26 projects address undersized or failing drainage systems in neighborhoods and downtowns. Nine reduce riverine flooding in developed areas through studies, floodproofing, berms, and voluntary buyouts, and nine stabilize or restore eroding streams and channels. Eight address road and bridge crossings that flood or erode. Six protect critical facilities, including wastewater treatment plants, a sewer pump station, and drinking water supplies. Three address other needs, such as watershed coordination.

About half of the projects (32) begin with a study or preliminary engineering, 26 are ready for design and construction, and three begin with maintenance or coordination. Most combine approaches: 44 include conventional infrastructure; 39 include nature-based elements such as stream restoration, floodplain benches, riparian buffers, and bioretention; 10 include floodproofing, elevation, or buyouts; nine rely on maintenance or owner requests; and five involve flood warning or planning. Nature-based solutions are critical in importance to flood mitigation, provide ample co-benefits, and were prioritized during the planning and project identification process. However, in addressing failing stormwater infrastructure, there are many mitigation efforts that rely primarily on mixed or gray projects.

Using This Appendix

Study-phase projects are best suited for CFPF study grants, and design-ready projects are candidates for implementation funding. Many involve infrastructure owned by VDOT, railroads, or landowners, so coordination with those owners often comes first. CSPDC will review the list annually, meet with localities to determine feasibilty of pursuing study or project funding regularly, and update the project pipeline as needed under Regional Action 1.

Table A.1 | Priority Projects and Concept-Designs

Locality	Priority	Project	Page
Augusta County	**1**	**Falling Rock Drive and Sugar Camp Lane Drainage Easement Reconstruction — Ridgeview Acres Subdivision***	
Augusta County	2	Mil-Mar Subdivision / Princess Anne Lane — Norfolk Southern Railroad Culvert Upsizing (Stuart's Draft)	
Augusta County	3	Patton Farm Bridge — South River Crossing Replacement	
Augusta County	4	Hotchkiss Bridge Extension and Jennings Branch Upstream Stream Improvements — Churchville	
Augusta County	5	Weyers Cave and Dices Springs Area Subdivision Drainage Improvements	
Bath County	**1**	**Hot Springs Main Street Flooding Along Hot Springs Run***	
Bath County	2	Lower Yard Road and Cabin Creek Channel Sedimentation Improvements	
Bath County	3	Route 220 and Roseloe Lane Drainage Convergence Near Bath County High School	
Highland County	**1**	**Mill Gap Road Stream Bank Erosion and Road Undermining***	
Highland County	2	Bluegrass Valley Road and New Hampden Area Stream Overtopping and Road Flooding	
Highland County	3	Frog Pond and US Route 220 South Culvert and Wetland Area Flooding	
Highland County	4	Mill Gap near Valley Center Road Flooding	
Highland County	5	Cowpasture River Road Channel Migration and Roadway Overtopping	
Rockbridge County	**1**	**The Glades at Natural Bridge Station Drainage Improvements — Route 130***	
Rockbridge County	2	Watershed-Scale Coordination — Lake Meriwether and Little Calf Pasture River Sediment and Water Quality	
Lexington	**1**	**Jefferson Street Subterranean Channel Improvements — Hopkins Green to Massie Street***	
Lexington	2	Randolph Street and Henry Street Culvert Replacement — Town Branch	
Lexington	3	Storm Drain Improvements — Wallace Street to South Main Street	
Lexington	4	Storm Drain Improvements — Myers Street to McLaughlin Street (Jackson Avenue Phase II)	
Lexington	5	Lime Kiln Road and McLaughlin Street Ephemeral Spring Drainage and Pedestrian Safety Improvements (ADA)	
Glasgow	**1**	**Primary Town Drainage Channel Improvements — 4th, 6th, and 7th Streets**	
Glasgow	2	Pocahontas Street / 2nd Street / Shenandoah Road Drainage Corridor Improvements	
Glasgow	3	Blue Ridge Road Mountain Slope Drainage Channel Improvements	
Glasgow	4	Wastewater Treatment Plant Flood Vulnerability Improvements	
Glasgow	5	Town Hall Bioretention Pond Restoration and Maintenance	
Goshen	**1**	**Mill Creek and Calfpasture River Confluence Clearing and Channel Improvement***	

Table A.1 | Priority Projects and Concept-Designs

Locality	Priority	Project	Page
Goshen	2	Mill Creek Berm Completion — Partial Army Corps of Engineers Structure	
Goshen	3	Water System Pump House Flood Vulnerability Mitigation	
Bridgewater	**1**	**Fountainhead Subdivision Stormwater System Rehabilitation — Brian, Cindie, and Steven Streets***	
Bridgewater	2	Cannery Woods and Dry River Road Stormwater Detention and Drainage Capacity	
Bridgewater	3	North Main Street Stormwater Drainage Capacity Improvements — Green Street to Depot Street	
Bridgewater	4	North River Corridor Bank Stabilization and Riparian Assessment — Wildwood Park to Sandy Bottom Park	
Bridgewater	5	Cooks Creek Arboretum Stream Bank Stabilization	
Broadway	**1**	**Linville Creek Bank Stabilization Near Heritage Park and South of Turner Avenue**	
Broadway	2	Heritage Park Pedestrian Bridge Debris Capture and Park Flooding	
Broadway	3	Sewer Pump Station Flood Resilience Improvement	
Broadway	4	North Fork Shenandoah River Water Supply Corridor	
Dayton	**1**	**Downtown Stormwater System — Thompson Street, Cherry Lane, Tunnel Alley, and Route 42 Outfall***	
Dayton	2	Cooks Creek Bank Stabilization — Pitman Family Farms Facility Frontage	
Dayton	3	Cook's Creek Flood Mitigation Near Meigs Lane Bridge — Valley Meat Processors	
Dayton	4	Cook's Creek Flood Mitigation Along Route 42 — Valley Water Gardens Area	
Dayton	5	Westview/Ashby Backyard Stormwater Drainage System Assessment and Repair	
Elkton	**1**	**Downtown Triangle Stormwater Drainage — Ashby Avenue and Warren Street***	
Elkton	2	Stonewall Park Low-Lying Drainage Area Improvements	
Elkton	3	Wastewater Treatment Plant Flood Vulnerability Mitigation	
Elkton	4	Elk Run Corridor Downtown Residential and Commercial Flooding Mitigation	
Elkton	5	Stonewall Park Well House Flood Vulnerability Improvements	
Grottoes	**1**	**Miller Run Channel Improvements***	
Grottoes	2	Cherry Avenue at 10th, 11th, 12th Ditch Hazard	
Grottoes	3	Dogwood Avenue Trail Erosion	
Grottoes	4	Holly Ave and 3rd Street Flooding	
Grottoes	5	Grand Caverns and S River Road Improvements	
Mount Crawford	**1**	**Parsons Court and Route 11 Stormwater Drainage Improvements***	
Mount Crawford	2	Route 11 / Ruritan Road Post Office and Ruritan Park Drainage Improvements	
Mount Crawford	3	Mill Street and Old Bridgewater Road Culvert Replacement	
Mount Crawford	4	Town Park River Access and Kayak Landing Flood Vulnerability and Walkway Improvements	
Timberville	**1**	**Route 211 Stormwater Concentration Point Drainage Improvements***	
Timberville	2	Maple Avenue Drainage Ditch System Improvements	
Timberville	3	Route 42 North / Reservoir Lane / Rill Road Drainage Basin Assessment — Future Development	

Table A.1 | Priority Projects and Concept-Designs

Locality	Priority	Project	Page
Timberville	4	Memorial Park River Channel Assessment and Improvements	
Timberville	5	C Street East and North Fork Shenandoah River Corridor Assessment	
Waynesboro	**1**	**Market Avenue, West 12th and West 14th Streets**	
Waynesboro	2	Glenwood Boulevard	
Waynesboro	3	North Bayard Avenue, Bath Avenue, and 5th Street	
Waynesboro	4	North Augusta Avenue, North Bayard Avenue, and 7th Street	
Waynesboro	5	Randolph Avenue	
Waynesboro	6	New Hope Road (Wayne Hills)	
Waynesboro	7	Bookerdale Road (West)	
Waynesboro	8	Park Road and Laurel Avenue	
Waynesboro	9	North Elkin Avenue	
Waynesboro	10	Washington Avenue	
Waynesboro	11	Lovers Lane and Northgate Avenue	
Waynesboro	12	Bookerdale Road (East)	
Waynesboro	13	300 Block of 13th Street	
Harrisonburg	**1**	**1311 W Market — Retrofit detention pond to Level 1 wet pond**	
Harrisonburg	2	400 Mountain View Drive — Retrofit detention pond to Level 1 wet pond	
Harrisonburg	3	938 Garbers Church Road — Install vegetated filter strip	
Harrisonburg	4	1460 Smithland Road — Install vegetated filter strip	
Harrisonburg	5	1260 Founders Way — Install bioretention	
Harrisonburg	6	474 Linda Lane — Install bioretention	
Harrisonburg	7	Chicago Avenue and Waterman Drive — Drainage improvement project	
Harrisonburg	8	Charles Street to Madison Street — Drainage improvement project	
Harrisonburg	9	Hill Street to North Mason Street — Drainage improvement feasibility study	
Harrisonburg	10	Hill Street to Community Street — Drainage improvement feasibility study	
Harrisonburg	11	Newman Avenue — Drainage improvement feasibility study	
Harrisonburg	12	Pleasant Hill Road — Drainage improvement feasibility study	
Harrisonburg	13	Country Club Road — Drainage improvement feasibility study	
James Madison University	**1**	**Bridgeforth Stadium and Godwin Transit Hub — Sibert Creek Stormwater and Floodplain Improvements**	
James Madison University	2	Sibert Creek by Mr. Chips — Floodplain Reconnection and Stream Restoration	
James Madison University	3	Pedestrian Tunnel under Interstate 81 — Flood Mitigation	

Table A.1 | Priority Projects and Concept-Designs

Locality	Priority	Project	Page
James Madison University	4	Edith J. Carrier Arboretum Stream and Pond — Continued Improvements	
James Madison University	5	Sibert Creek Adjacent to Practice Golf Facility — Drainage Study and Floodplain Restoration	

** Indicates project is a 10% design concept.*

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