Hazard Mitigation Loss Avoidance Study Giles County, Virginia

Acquisition

DR-VA-1544 - Severe Storms, Flooding, and Tornadoes Associated with Tropical Depression Gaston Aug. 30 - Sept. 8, 2004 - Declared Sept. 3, 2004

2025

Developed and published by the Virginia Department of Emergency Management and the Virginia Modeling, Analysis and Simulation Center of Old Dominion University.

Contents

Introduction

The Commonwealth of Virginia has a history and exposure to a wide array of natural hazards as demonstrated by 75 federal disaster declarations occurring since 1953 (Table 1).[1] As such, the Commonwealth has a long-established commitment to hazard mitigation in the encouragement, promotion, assistance with, and funding of the implementation of measures to reduce or eliminate long-term risk to people and property from natural hazards and their effects.

Table 1: Federally Declared Disaster Declarations in Virginia and the County of Giles

Incident Type	Virginia (#)	Giles (#)
Severe Storm	19	5
Flood	16	3
Hurricane	16	4
Fire	8	
Other*	6	3
Snowstorm	6	3
Tropical Storm	2	2
Winter Weather*	2	
Total	**75**	**20**
***Includes Subcategories**		

Since 1990, nearly $395 million of Hazard Mitigation Assistance (HMA) funding has been allocated to Virginia communities and agencies funding more than 617 projects and mitigating nearly 1,300 properties.[2] Of those dollars $236,888 has been spent on various projects in Giles County, including $117K on property acquisition in the Town of Pembroke Table 3).

To document and evaluate the impact of this funding, and update the Commonwealth of Virginia Hazard Mitigation Plan, VDEM determined that it is appropriate to examine a selection of completed mitigation projects and estimate the real-world losses avoided through those projects.

[1] FEMA Data Visualization (Disaster Declaration): https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties

[2] FEMA Data Visualizations (Hazard Mitigation Assistance): https://www.fema.gov/data-visualizations/hazard-mitigation-assistance-obligations

Table 2: Hazard Mitigation Assistance (HMA) grants 1990 – 2024 Virginia

HMA Project Type - Virginia	$ Amount	# Projects
Acquisition	$81,595,735	146
Activities supporting development of applications	$1,268,956	3
Codes and standards	$118,712	1
Conduct meetings, outreach and coordination with subapplicants and community residents	$207,520	2
Develop or conduct engineering, environmental, feasibility and/or benefit cost analyses	$606,961	3
Education and awareness	$924,359	21
Elevation	$67,721,043	90
Evaluate facilities to identify mitigation actions	$476,190	1
Feasibility, engineering and design studies	$461,076	6
Flood control	$23,385,111	15
Floodproofing	$36,542,056	6
Generator	$17,533,651	36
Management costs	$24,173,782	49
Mitigation reconstruction	$798,317	4
New plan	$11,619,258	85
Other	$7,508,921	50
Plan update	$6,192,207	38
Planning related activities	$332,692	3
Relocation	$141,811	3
Retrofit	$1,023,035	5
Stabilization and restoration	$3,789,971	4
Technical assistance	$152,104	3
Utility and infrastructure protection	$105,984,509	13
Warning system	$1,953,136	20
No Data	$335,591	10
Grand Total	**$394,846,703**	**617**

Table 3: Hazard Mitigation Assistance (HMA) grants 1990 – 2024 Giles County

HMA Project Type – Giles County	$ Amount	# Projects
Acquisition	$119,265[3]	1
Plan update	$100,000	1
Warning system	$17,623	1
Grand Total	$236,888	3

[3] Note, the project cost has been adjusted to $117K to reflect a project cost based on actual amount paid at 75% federal cost share according to FEMA Open Data. https://www.fema.gov/about/openfema/data-sets#hazard

This report presents the study in the following sections: 1) Study Summary, 2) Project Summary, 3) Study Methodology, and 4) Loss Avoidance Calculations.

Study Summary

The study area (Figure 1) is located in the Town of Pembroke, Giles County, which is part of the New River Valley Regional Commission (NRVRC). The NRVRC has identified, through a Hazard Identification and Risk Assessment (HIRA) process, 10 natural hazards most likely to impact the district's communities.[4] Flooding was assessed as the highest risk to mitigate along with severe winter weather and high winds. The project selected for the study included one property acquisition on Little Stony Creek (Figure 2), a tributary of the New River. This area has an extensive history of riverine flooding. It has also experienced post-mitigation flooding necessary for a study such as this one, to determine what losses would have occurred had the facility remained unmitigated to future flooding.

Study Area – Giles County, Town of Pembroke
Hazard Type – Riverine Flooding
Project Type – Acquisition & Demolition
Total Project Cost – $117,420
Total Losses Avoided – $109,910
Return on Investment (ROI) | Benefit-Cost Ratio – 0.94

The mitigation action, while not demonstrating a greater than one benefit-cost ratio during a single post-mitigation event (2024 Hurricane Helene), did nearly achieve an equal return on investment within 17 years of the projects useful life (PUL) of 100-years.

Damages were assessed based on stream gauge data and the most current 2009 Flood Insurance Study. Flood depths at the location may have been greater, especially considering significant predecessor rain events (PRE), but data to confirm actual flood depths at the location were unavailable.

Benefit-cost analysis generated a benefit cost ratio of 5.42 with $636,580 losses avoided over the PUL, including estimated annualized damages and losses of $17,175 pre-mitigation and $0 post-mitigation.

[4] New River Valley Regional Commission Hazard Mitigation Plan (FEMA Approved 2017): https://www.engagenrv.org/hazard-mitigation-plan

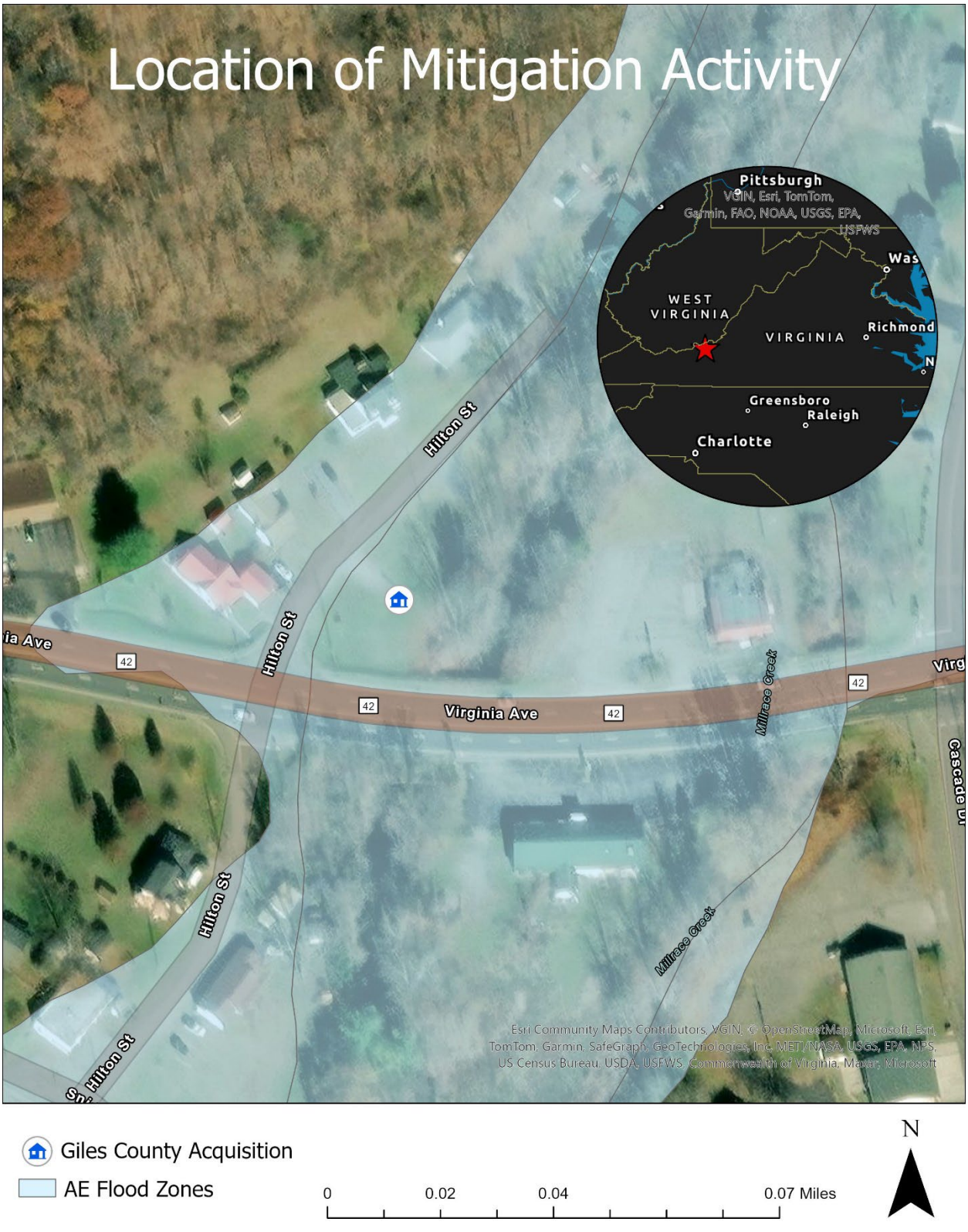

Figure 1: Location of mitigation activity

Figure 2: Study area pictures with mitigated property pre (left) & post (right) mitigation

Image Source: https://nrvrc.org/hazardmitigation/assets/pdf/01_Introduction_Final.pdf

Figure 3: Study area imagery with mitigated property pre (left) & post (right) mitigation

Image Source: Google Earth

Project Summary

The project structure included in this LAS was acquired and demolished, with the remaining land being converted to open greenspace in perpetuity in 2007.

Grant Program - Hazard Mitigation Assistance (HMA)
Grant - DR-VA-1544 - Severe Storms, Flooding, and Tornadoes Associated with Tropical Depression Gaston Aug. 30 - Sept. 8, 2004 - Declared Sept. 3, 2004
Applicant – Giles County (Subrecipient)
FEMA Approved Multi-Hazard Mitigation Plan – New River Valley Regional Commission Multi-Jurisdictional Hazard Mitigation Plan (FEMA Approved 2017).
Flood Zone Designation – AE
Flood Insurance Study – Giles County, Virginia and Incorporated Areas, 51071CV000A, September 25, 2009.
Project Type – Acquisition
Project Useful Life – 100 Years[5]

Pre-Mitigation Problem Description[6]

Giles County is located in southwestern Virginia along the West Virginia border in the Jefferson National Forest. The county is part of the Valley and Ridge Province with elevation ranges for the New River Valley between 1,470 feet above mean sea level at Glen Lyn to 4,348 feet at Bald Knob on Salt Pond Mountain in Giles County. Its topography includes parallel running ridges with accompanying valleys and is considered steep sloped (slopes >20%).

Major flooding issues occur primarily during heavy rainfall events as flash flooding and rapid water level rise due to heavy runoff from surrounding steep terrain. Backwater affects are experienced at downstream portions of tributaries like Little Stony Creek.

The Town of Pembroke, where the mitigated property is located, is in the east central portion of the county. The property itself is located in the floodway of the 100-year floodplain on Little Stony Creek and has experience repetitive flooding.

[5] FEMA Benefit-Cost Analysis *BCA Reference Guide*, June 2009 at https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis
[6] New River Valley Regional Commission Hazard Mitigation Plan (FEMA Approved 2017); Flood Insurance Study Giles County, Virginia, and Incorporated Areas, 51071CV00A, September 25, 2009

Post-Mitigation Event[7]

Hurricane Helene caused historic flooding and widespread destruction in Pembroke and Giles County during late September 2024. The storm's impact began September 24–26, when heavy rainfall from a Predecessor Rainfall Event (PRE) saturated the region ahead of Helene's arrival[8] [9]. This event, combined with moisture from the hurricane, primed the area for catastrophic flooding. On September 26, Hurricane Helene made landfall in Florida as a Category 4 hurricane and quickly moved inland toward Georgia and the Southern Appalachians. By September 27, its remnants reached Giles County, bringing record-breaking rainfall that caused the New River to rise rapidly. The river crested at 31 feet, marking the second-highest flood level in recorded history, surpassed only by the Great Flood of 1940.

In Pembroke, homes along Cliff View Drive were inundated, with water levels reaching just below countertops in some houses. Trailers and campers were swept away by floodwaters, and residents were forced to evacuate quickly as water levels rose at a rate of one foot per hour during the peak flooding period[10] [11]. By September 28–29, floodwaters began to recede slowly, though low-lying areas remained submerged for several days. Landslides caused by saturated soils added to the destruction throughout Giles County.

The aftermath of Hurricane Helene was devastating for Pembroke and surrounding communities. At least 47 families in Giles County lost their homes permanently due to flooding, and emergency shelters and housing assistance programs were activated to support displaced residents. Roads, campgrounds, and other infrastructure near Pembroke suffered catastrophic damage, requiring extensive cleanup efforts to clear debris from roads and waterways. Volunteers and local organizations mobilized to assist with recovery efforts,

[7] Virginia Department of Emergency Management (VDME) Predecessor Rain Event & Helene, Oct. 1, 2024 at https://storymaps.arcgis.com/stories/4dcacaac0a68427eb3b330225252bb4d

[8] Tropical Storm Helene: September 26-27, 2024 at https://www.weather.gov/ilm/Helene2024

[9] National Hurricane Center Tropical Cyclone Report at https://www.nhc.noaa.gov/data/tcr/AL092024_Helene.pdf

[10] Local News WSLS 10 *Giles community spirit still shines bright amidst historic New River flood damage*, October 1, 2024 at https://www.wsls.com/news/local/2024/10/02/giles-community-spirit-still-shines-bright-amidst-historic-new-river-flood-damage/

[11] Cardinal *News Pembroke residents among Southwest Virginians with harrowing stories from flooding*, Sept. 30, 2024 at https://cardinalnews.org/2024/09/30/pembroke-residents-among-southwest-virginians-with-harrowing-stories-from-flooding/

while Governor Glenn Youngkin toured affected areas to assess damage and advocate for federal disaster aid[12] [13].

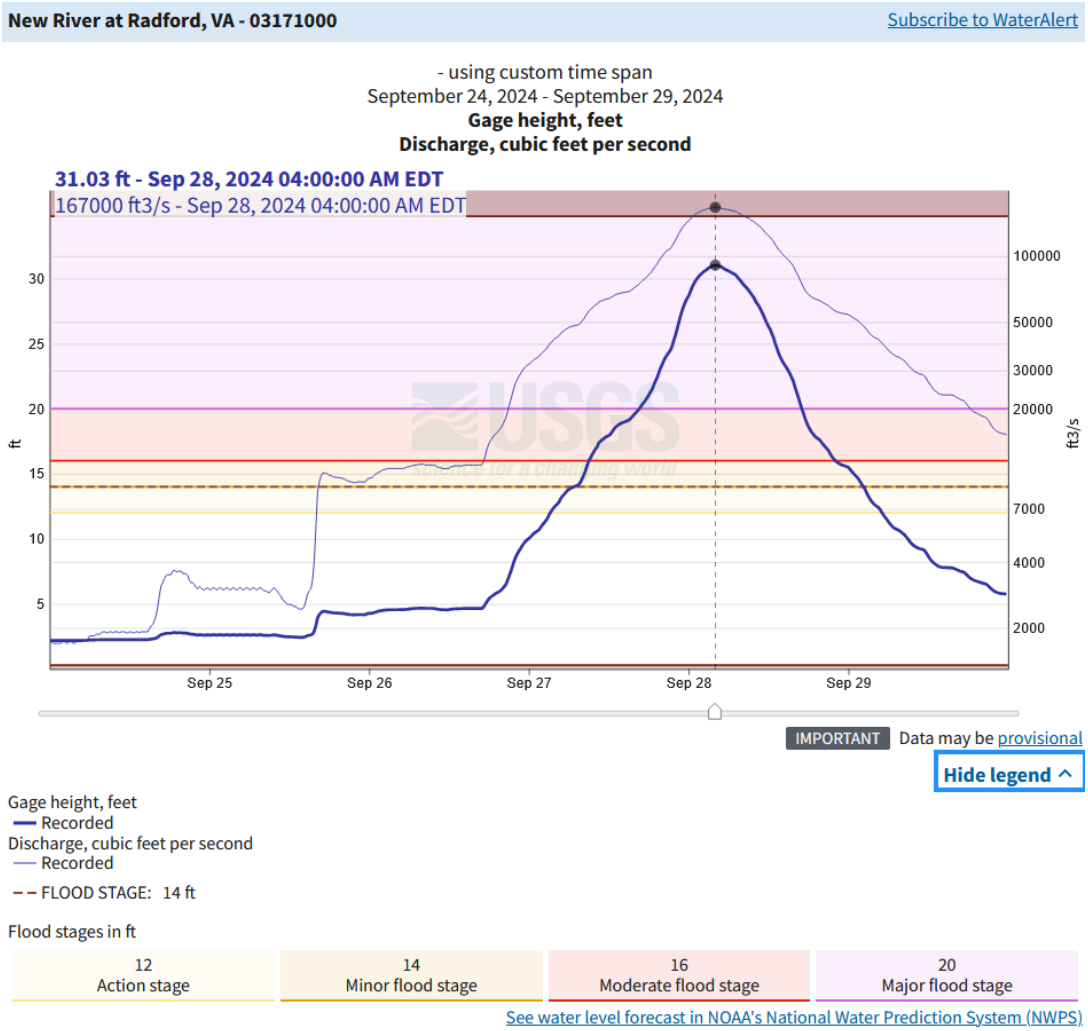

Figure 4: New River gage

Image Source: https://waterdata.usgs.gov/monitoring-location/03171000/#dataTypeId=continuous-00065-0&showMedian=false&startDT=2024-09-24&endDT=2024-09-28

[12] Cardinal News *Storm cleanup continues across Southwest Virginia, as magnitude of devastation becomes clearer, Sept. 30, 2024 at https://cardinalnews.org/2024/09/30/storm-cleanup-continues-across-swva-as-magnitude-of-devastation-becomes-clearer/*

[13] Cardinal News *Second tornado confirmed; 118,000 Va. customers still without power Sunday as storm cleanup continues, Sept. 28, 2024* at https://cardinalnews.org/2024/09/28/long-period-of-cleanup-recovery-begins-from-hurricane-helenes-effects-on-swva/

Figure 5: Flooding in Pembroke
"Houses were flooded and trailers swept away by flood waters in the Giles County town of Pembroke. "I'm overwhelmed, I don't know if there's recovery," Tim Myers, who owns the property shown in this photo, said Sunday. Courtesy of Tim Myers."

Image Source: https://cardinalnews.org/2024/09/30/pembroke-residents-among-southwest-virginians-with-harrowing-stories-from-flooding/

Figure 6: "Images of flooding in Narrows, courtesy of David Verespie. (Copyright 2024 by WSLS 10 - All rights reserved.)"

Image Source: https://www.wsls.com/news/local/2024/10/02/giles-community-spirit-still-shines-bright-amidst-historic-new-river-flood-damage/

Study Methodology

A loss avoidance study (LAS) provides a justification for existing and future mitigation projects and activities. The ability to assess the economic performance of mitigation projects over time is important to encourage future funding and continued support of mitigation projects, activities, and programs. An LAS requires that the project(s) studied be completed prior to the event(s) analyzed, as losses avoided through the mitigation measure are determined by comparing the damage that would have been caused by the event had the projects not been implemented.

The following list provides examples of standard data inputs for conducting an LAS of this type:

- Cost of the mitigation measure
- First floor elevations (pre-mitigation)
- First floor elevations (post-mitigation – Elevations only)
- Base Flood Elevations
- Building type
- Number of stories
- Foundation type

- Square footage of the structure
- Acreage of property parcel
- Building replacement value
- Number of residents, and number employed (for residential properties)
- Depth of flooding in project area (post-mitigation event)

Assumptions

- Building replacement value is based on Hazus default values of $128.20 per square foot based on single-story residential structure of average construction with no basement.[14]
- Contents replacement value is based on FEMA BCA 6.0 Toolkit defaults of 100% (Residential RES1).
- Depth damage function values are based on FEMA BCA 6.0 Toolkit to determine avoided building, contents, and displacement costs during the post-mitigation event.
- For residential properties an annual social benefit is calculated assuming on average a 2-person household with at least one person working.[15]
- Flood depth at property locations were estimated based on river gauge data and the regulatory Flood Insurance Study (FIS) at the 50-year recurrence interval.[16]
- First floor elevations without data are assumed one foot above grade (slab on grade).[17]

Loss Avoidance Calculations

To complete this study, the following calculations/inputs were used to estimate losses avoided through mitigation from the Hurricane Helene post-mitigation storm event:

- Stream Discharge
- Flood Depth Elevation
- Ground Elevation
- Building depth-damage costs
- Building contents depth-damage costs
- Displacement costs

[14] Hazus Inventory Technical Manual Hazus 6.0, November 2022. https://www.fema.gov/sites/default/files/documents/fema_hazus-6-inventory-technical-manual.pdf
[15] US Census Quick Facts Giles County, VA https://www.census.gov/quickfacts/fact/table/VA,gilescountyvirginia,US/PST045224
[16] USGS gage at New River at Radford, VA – 03171000; Flood Insurance Study Giles County, Virginia, and Incorporated Areas, 51071CV00A, September 25, 2009.
[17] Hazus Inventory Technical Manual Hazus 6.0, November 2022. https://www.fema.gov/sites/default/files/documents/fema_hazus-6-inventory-technical-manual.pdf

- Social benefits
- Expected annual ecosystems benefits
- Benefit cost ratio

Losses Avoided

Losses avoided and the benefit-cost ratio are reported below. Table 4 reports the property ID, total project cost, estimated depth of flooding[18] from the Hurricane Helene storm event, value of damage to the building and contents, displacement costs, expected annual social and ecosystems benefit, total damage losses avoided[19], and benefit cost ratio.

[18] Flood depths are rounded to the nearest whole number.
[19] Calculation includes a single year for social and ecosystem benefit reflecting the benefit for this single event.

Table 4: Losses avoided

ID	Total Project Costs	Flood Depth (ft.)	Building Damage Value	Contents Damage Value	Displacement Damage Value	Expected Annual Social Benefit	Expected Annual Ecosystems Benefit	Total Damage Losses Avoided	Benefit-Cost Ratio
1	$117,420	1.12	$47,841	$27,308	$10,170	$22,358	$2,233	$109,910	0.94
	$117,420	**1.12**	**$47,841**	**$27,308**	**$10,170**	**$22,358**	**$2,233**	**$109,910**	**0.94**