INCIDENT SPECIFIC ANNEX 5

FLOOD WARNING PLAN

TABLE OF CONTENTS

Section	Page
I. Introduction	1
A. Purpose	1
B. Scope	1
II. Situation and Assumptions	1
A. Situation	1
B. Assumptions	2
III. Concept of Operations	3
A. Mitigation	3
B. Weather	4
C. Data Collection and Flood Threat Detection	4
D. Evacuation/Sheltering/Re-Entry	6
IV. Direction and Control	6
A. Central Warning Point	6
B. Emergency Operations Center	6
V. Information Collection, Analysis, and Dissemination	7
A. Flood warnings...	7
B. Flood Warnings for Functional and Access Needs Groups	7
C. Public Information	8
VI. Organization and Assignment of Responsibilities	8
A. Organization	8
B. Assignment of Responsibilities	9
VI. Administration, Finance, and Logistics	10
A. Administration	10
B. Finance	10
C. Logistics	10
VIII. Annex Development and Maintenance	11
IX. List of Appendices	11
Appendices	**Page**
Appendix 1 – Flood Hazard Mapping	12
Appendix 2 – Flooding Information for Shenandoah & Potomac Rivers, and Opequon Creek	19
Appendix 3 – Rainfall and Stream Gauge Information	23
Appendix 4 – Overview of the Flood Risk	25

INCIDENT SPECIFIC ANNEX 5 – FLOOD WARNING PLAN

Primary Agencies:	Jefferson County Homeland Security & Emergency Management
Support Agencies:	Jefferson County Emergency Communications Center Jefferson County Sheriff and Law Enforcement Departments Jefferson County Fire Companies Jefferson County Engineering Department Jefferson County GIS West Virginia Division of Highways West Virginia Division of Homeland Security & Emergency Management National Oceanic and Atmospheric Administration National Weather Service United State Army Corps of Engineers United States Geological Survey
Related Federal ESFs:	ESF #2: Communications ESF #7: Logistics Management and Resource Support
Related State ESFs:	N/A
West Virginia Code:	Chapter 8A, Article 5, Section 7 Chapter 8A, Article 7, Section 2 Chapter 15, Article 5, Section 20
References:	Jefferson County Homeland Security & Emergency Management. (2016). *Jefferson County emergency operations plan.* Kearneysville, WV: Local Government. Jefferson County Homeland Security & Emergency Management. (2013). *Jefferson County multi-jurisdictional hazard mitigation plan.* Kearneysville, WV: Local Government. Live Science .com. (2016). *Flood facts, types of flooding, floods in history.* Online. Retrieved from: http://www.livescience.com/23913-flood-facts.html National Oceanic and Atmospheric Administration. (2016). *Storm events database.* Online. Retrieved from: http://www.ncdc.noaa.gov/stormevents/ United States Bureau of the Census. (2016). *Quickfacts.* Washington, DC: Federal Government.

I. INTRODUCTION

A. PURPOSE

The purpose of this annex is to assist the county in the protection of public health and safety prior to and during flooding events, utilizing training, equipment, experience, and technology.

B. SCOPE

The scope of this document pertains to any flooding and flash flooding incident.

II. SITUATIONS AND ASSUMPTIONS

A. SITUATIONS

1. Floods cause billions in damages each year and are just behind tornadoes as the top natural disaster (www.livescience.com).

2. There have been 33 flood events in Jefferson County since 1996, 20 of which were river floods and 13 that were considered flash flood events.
3. Historically, West Virginia has had a high frequency of flash floods. Narrow valleys, flanked by steep hillsides, produce fast overflows from heavy rain events. The increase in development within these valleys has caused a dramatic upsurge in damage. The lure of these usually peaceful floodplains is likely to continue, and with it, a continued rise in the potential loss of life and property. The increase of impervious road surfaces and development within the county floodplains has increased the risk of damage from floods within the county.
4. Thunderstorms can produce intermittent rainfall with varying intensity; therefore, it is difficult to determine when the highest rates of runoff will occur and when the flood crest might reach an area. There is also the possibility of having two or more crests during a single flash flood event.
5. Stream flows during a flash flood are unpredictable; a blocked bridge or culvert can divert or change water flow both upstream and down.
6. Past experience strongly indicates that all local media outlets in Jefferson County will give priority to the public's need for emergency public information (EPI) over the need for news coverage, particularly during the initial stages of an emergency when EPI can prove quite critical to the public's safety and welfare.
7. The principal means through which EPI may be disseminated in Jefferson County includes radio, television, Internet, Nixle alerts, and newspaper. Please refer to ESF 15 – External Affairs for additional information concerning warnings and public information.

B. ASSUMPTIONS

1. A flood warning system has been developed that will substantially reduce the threat to life and property from intense localized rainstorms with the cooperation of Jefferson County Homeland Security and Emergency Management (JCHSEM), the National Weather Service (NWS), and the West Virginia Division of Homeland Security and Emergency Management (WVDHSEM). This system is known as the Integrated Flood Observation and Warning System (IFLOWS).
2. Meteorology is effective in forecasting heavy rain events over large areas; however, it may not be accurate enough for small stream forecasting.
3. Functional and access needs groups such as the hearing impaired, sight impaired, and/or physically disabled require special attention efforts to ensure that they receive emergency notifications and warning.

4. According to figures from 2015 Census estimates, 6.3% or approximately 3,558 people of the population of Jefferson County speaks a language other than English at home (US Census Bureau, 2016).
5. Most of the public will respond positively to recommendations from public officials, especially when those orders and requests are easily understood and presented in a timely and proper manner.

III. CONCEPT OF OPERATIONS

A. MITIGATION

1. Mitigation is the county's first flood defense. The engineering department is the lead agency in regulating the National Flood Insurance Program (NFIP) guidelines to include regulating home improvements and new construction to property owners within the flood plain and special flood hazard zones.
2. Jefferson County has been designated as a StormReady Community since 2004. StormReady is a program offered through the National Weather Service (NWS). To be designated, a community must participate in activities including communications, NWS information reception, hydro-meteorological monitoring, local warning dissemination, community preparedness, and administration.
3. JCHSEM conducted the following tasks to achieve the designation as a StormReady Community.
   a. The Jefferson County Emergency Communications Center serves as a 24-hour warning point.
   b. Maintained the required number of ways to receive severe weather warnings and forecasts to alert the public.
   c. Created a system that monitors weather conditions locally.
   d. Promoted the importance of public readiness through community seminars.
   e. Developed a hazardous weather program that includes training severe weather watchers.
4. Each year Jefferson County Homeland Security and Emergency Management (JCHSEM) staff visits the NWS offices in Sterling, Virginia, and staff from the NWS tour the Jefferson County Emergency Communications Center (JCECC) and Emergency Operations Center (EOC). Additionally, each year the NWS offers some type of Skywarn Stormspotter training in Jefferson County. Jefferson County also participates annually with the NWS-Sterling at its hydrology partners meeting.
5. Jefferson County has participated in the Community Rating System (CRS) since 2006.The CRS has the following components which must be completed each year in

order to remain in the program, which grants discounts to residents on their flood insurance policies:

a. Maintain a public information program,
b. Development of elevation certificates,
c. Development of updated flood mapping information,
d. Conducting outreach projects,
e. Providing flood protection information and assistance,
f. Supplying updated or additional flood data,
g. Compliance with open space regulations,
h. Maintaining higher regulatory standards,
i. Conducting storm water management,
j. Providing for flood damage reduction,
k. Floodplain management planning,
l. Conducting acquisition and relocation of structures in the floodplain,
m. Drainage system maintenance,
n. Maintaining a flood warning program,
o. Levee safety, and dam safety, and
p. Additional information is also gathered on repetitive loss properties and interest in potential mitigation projects.

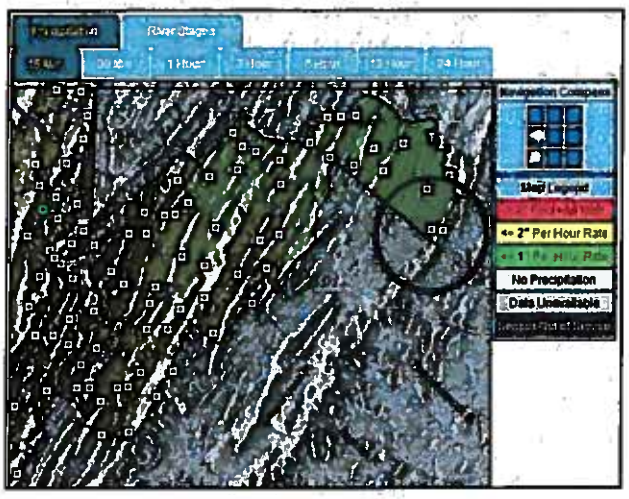
B. WEATHER

1. The National Weather Service (NWS) – Sterling Office will issue flood warnings, watches, statements, and advisories, and has authority to broadcast Emergency Alert System (EAS) messages across area radio and television stations upon request of the Director of Emergency Management.
2. Jefferson County Homeland Security and Emergency Management (JCHSEM) should monitor weather information via internet, cable, Integrated Flood Observation and Warning System (IFLOWS), and National Oceanic and Atmospheric Administration (NOAA) all-hazard radios.

C. DATA COLLECTION & FLOOD THREAT DETECTION

1. **Rain Gauges:** The goals of the IFLOWS program are to reduce the loss of life from flash flood, reduce property damage, and reduce disruption of commerce and human activities.
2. The rain gauge portion of the IFLOWS network is maintained by the West Virginia Division of Homeland Security and Emergency Management (WVDHSEM).

3. There are currently four rainfall gauges located in Jefferson County which are connected to the IFLOWS. There locations are as follows:
   a. Bardane (ID7962),
   b. Shannondale (ID6150),
   c. Shepherdstown (ID7972), and
   d. Summit Point (ID6176).



4. The NWS, in cooperation with the Appalachian Regional Commission, the Tennessee Valley Authority, and the States of Kentucky, Virginia, Pennsylvania, West Virginia, and Tennessee, has implemented IFLOWS. This system combines event reporting sensors, data and voice communications, and minicomputer technology to each county in a 100-county region. Data, forecasts, and warning products are distributed to state and county authorities responsible for the provision of emergency services to people in flood-threatened areas. NWS offices are directly linked to IFLOWS.
5. The sensors trigger the transmission of radio signals that include the station identifiers and values of the monitored parameters. The sensors and transmitters are powered by batteries and are independent of commercial power sources.
6. Radio transmissions from the sensors are line-of-sight to strategically located receivers. Data are then relayed by microwave radio to the dedicated, central processing minicomputer. The counties/communities can receive data, forecasts, and warning products over this same communication system from the minicomputer. IFLOWS operates continuously to monitor local conditions for the counties and for NWS offices in the IFLOWS region.
7. The NWS has access to the following data collection equipment.
   a. Satellite imagery display equipment which enables meteorologists to see approaching weather systems and estimate local arrival times.
   b. Automated weather stations used to forecast flood potentials and predict storm development and movement.
   c. Radar product display equipment enabling meteorologists to evaluate current weather conditions; update heavy precipitation forecasts; estimate rainfall amounts at specific locations; predict storm movement, duration, and areal coverage; refine flood predictions; and anticipate specific flood problems.

D. EVACUATION/SHELTERING/RE-ENTRY

1. Evacuation and re-entry into evacuated areas will be conducted according to Support Annex 6 – Evacuation and Re-Entry of the emergency operations plan.
2. Shelters have been identified across the county and are detailed in ESF 6 – Mass Care, Housing, and Human Services (JCHSEM, 2017).
3. Sudden or unexpected flooding may result in the need to establish an emergency shelter at an established location. The West Virginia Northeastern Region of the American Red Cross (ARC) may decide if the number of evacuees is small, to provide shelter at a pre-identified hotel, motel, or other pre-arranged temporary housing. All mass care will be conducted according to ESF 6 – Mass Care, Housing, and Humans Services of this EOP.
4. The West Virginia Division of Highways (WVDOH) typically coordinates the placement of high water and/or road closed signs. Other agencies, such as JCHSEM, may notice high water areas without signage and notify WVDOH accordingly.
5. During the recovery phase, the engineering department does not perform damage assessments, though it may estimate structures damaged more or less than 50%.

IV. DIRECTION AND CONTROL

A. CENTRAL WARNING POINT

1. The Jefferson County warning point is located in the Jefferson County Emergency Communication Center (JCECC) in Kearneysville, West Virginia. It is staffed 24-hours a day and has sufficient communications and warning equipment available to provide the communications necessary for most emergencies. The JCECC will serve as the facility where all rainfall reports will be initially received.
2. The West Virginia State Police (WVSP) dispatches for state police.
3. Berkeley County Emergency Communications Center serves as a backup ECC for JCECC.

B. EMERGENCY OPERATIONS CENTER

1. The emergency operations center may be activated as per a flood warning with imminent threat.
2. Public schools, hospitals, assisted living facilities, and other populated governmental facilities and institutions should receive notification and flood warnings from the county warning point or, if activated, the county emergency operations center (EOC).

V. INFORMATION COLLECTION, ANALYSIS, AND DISSEMINATION

A. FLOOD WARNINGS WILL BE DISSEMINATED AND FOLLOW-UP INFORMATION FURNISHED BY A COMBINATION OF THE FOLLOWING:

1. NOAA weather radio stations which continuously broadcast weather and river forecasts;
2. Local AM and FM commercial radio stations;
3. Cable, satellite and nearby commercial television stations, as well as Internet websites;
4. Activation of the local Emergency Alert System;
5. Local Nixle alerts by text and email;
6. Siren and PA-equipped emergency vehicles;
7. Social media;
8. Three basic types of flood warnings are disseminated to the public:
   a. **Advisory:** Meaning that nuisance flooding or flooding of a "less serious" nature is either possible or occurring.
   b. **Watch:** Meaning that weather conditions are such that a hazardous flood may occur.
   c. **Warning:** Meaning that a flood which poses a significant threat to life or property is either occurring, is imminent, or has a very high probability of occurrence.

8. **Advance Notice/Warning:** For slow developing situations should be given as soon as it is clear that evacuation may be required, and should address preparedness actions.
9. **Evacuation Warning:** Immediate notification should be made to affected areas using all means available.
10. **Emergency Public Information:** During times of elevated awareness (e.g., forecasted events or season), the PIO will ensure essential information is disseminated to the media on a timely basis.

B. FLOOD WARNINGS FOR FUNCTIONAL AND ACCESS NEEDS GROUPS

1. Flood warnings for the hearing impaired will be by television crawler, originated through local cable television stations.
2. Flood warnings to nursing homes are transmitted over NOAA radios, and/or local radio stations WXVA (98.3 FM) and WLTF (97.5 FM).
3. For campers along rivers as well as homeless persons along the Shenandoah, Sheriff's deputies deploy to conduct face-to-face warning.

C. PUBLIC INFORMATION

1. Dissemination of information may occur through the use of the EAS, public service announcements (PSAs), press releases, public address (PA) systems, and Nixle alerts.
2. Flood warnings are disseminated in the same manner as other warnings, except the warning is restricted to the area to be affected. Information leading to warnings is received from the NWS located in Sterling, Virginia via telephone, Internet, NOAA all-hazard radio, and augmented by IFLOWS.
3. The county public information officer (PIO), working with the EOC staff, should have primary responsibility for informing the public of potential flooding through the utilization of all media communication systems. All information released to the media should be cleared by the JCHSEM.
4. The NWS utilizes the following information for each storm or flood event. All of this information should be considered to develop a flood forecast and should be available in order to provide accurate flood warnings.
   a. Precipitation (i.e., rainfall, snowfall, sleet, etc.) as measured by rain gauges to include total amounts during a storm, intensity or rate of accumulation, snow cover and the rate of melting.
   b. Precipitation runoff.
   c. Stream height as measured at stream gauges.
   d. Time of travel of flood crests.
   e. Time of crest in hours following a heavy rain event.

VI. ORGANIZATION AND ASSIGNMENT OF RESPONSIBILITIES

A. ORGANIZATION

1. The Jefferson County Homeland Security and Emergency Management (JCHSEM) Director coordinates flood warning, along with the Public Information Officer (PIO) and other agencies.
2. The JCHSEM Director will coordinate with the PIO and all participating local media outlets to disseminate flood warnings to the public.

B. ASSIGNMENT OF RESPONSIBILITIES

Primary Agencies

1. **Jefferson County Homeland Security & Emergency Management**
   a. Coordinate with Jefferson County GIS, local floodplain managers, and the NWS, to identify and map the locations of historical flooding, and sites of possible future flooding.
   b. Assist the local first response sector and the County Commissioners and Mayors in the issuance of evacuation orders as necessary.
   c. Request activation of the Emergency Alert System (EAS) as necessary.
   d. Work with the County PIO to distribute necessary flood warning information to the public.
   e. Coordinate with appropriate partners in the release of emergency public information.
   f. Cancel all warning activities when the threat of flooding has subsided.
   g. Disseminate flood warning information to neighboring counties as necessary.

Support Agencies

1. **National Weather Service**
   a. Observe, analyze and forecast weather conditions.
   d. Disseminate weather advisories, statements, watches, and warnings through state warning systems.

2. **Jefferson County Public Information Officer (PIO)**
   a. Serve as lead contact with news media, handle media and public inquiries, emergency public information and warnings, rumor monitoring and response, and media monitoring.
   b. Develop and maintain a public information and education program that includes prepackaged information kits specific for flooding.
   c. Coordinate press releases with the JCHSEM Director.
   d. Collect accurate information regarding the flooding threat and authenticate all sources of information being received and verify for accuracy.
   e. Maintain a chronological record of emergency/disaster related events and the public information corresponding to them.
   f. Arrange for translation services, as needed.

3. **Local Media Organizations**
   a. Disseminate flood warning messages provided by authorized sources to the general public as rapidly as possible in the event of impending or actual flooding, including dissemination to non-English speaking groups.
   b. Train staff to handle emergency announcements (especially designated EAS radio stations).

4. **Jefferson County Sheriff**
   a. Upon notification of potential flooding, conduct stream and road patrols in affected areas and begin evacuation procedures if necessary in accordance with Support Annex 6: Evacuation and Re-Entry when necessary.

5. **Jefferson County Engineering Department**
   a. Coordinate the floodplain permitting and enforcement process.
   b. Support recovery rebuilding efforts following flood incidents.

6. **Jefferson County GIS**
   a. Coordinate the creation of flood maps during pre-emergency conditions.
   b. Create incident-specific maps, as needed.

VII. ADMINISTRATION, FINANCE, AND LOGISTICS

A. ADMINISTRATION
   1. This annex does not replace National Weather Service (NWS) flood warnings for the general area, or for rivers and major tributary waterways; it is intended as a supplement.

B. FINANCE
   1. See Section VI of the Basic Plan.

C. LOGISTICS
   1. See Appendices 2 and 3.

VIII. ANNEX DEVELOPMENT AND MAINTENANCE

A. The planning committee overseeing the maintenance of this annex is comprised of Jefferson County Homeland Security and Emergency Management, the Jefferson County Emergency Communications Center, and the National Weather Service.

B. All organizations, agencies, offices, and volunteers that participate in this annex are responsible for periodically reviewing this annex, or immediately following any flood event, and submitting new or updated information to the Jefferson County Homeland Security and Emergency Management (JCHSEM) Director.

IX. LIST OF APPENDICES

Appendix 1 – Flood Hazard Mapping

Appendix 2 – Flooding Information for the Shenandoah and Potomac Rivers, and Opequon Creek

Appendix 3 – Rainfall and Stream Gauge Information

Appendix 4 – Overview of the Flood Risk

APPENDIX 1 TO INCIDENT SPECIFIC ANNEX 5

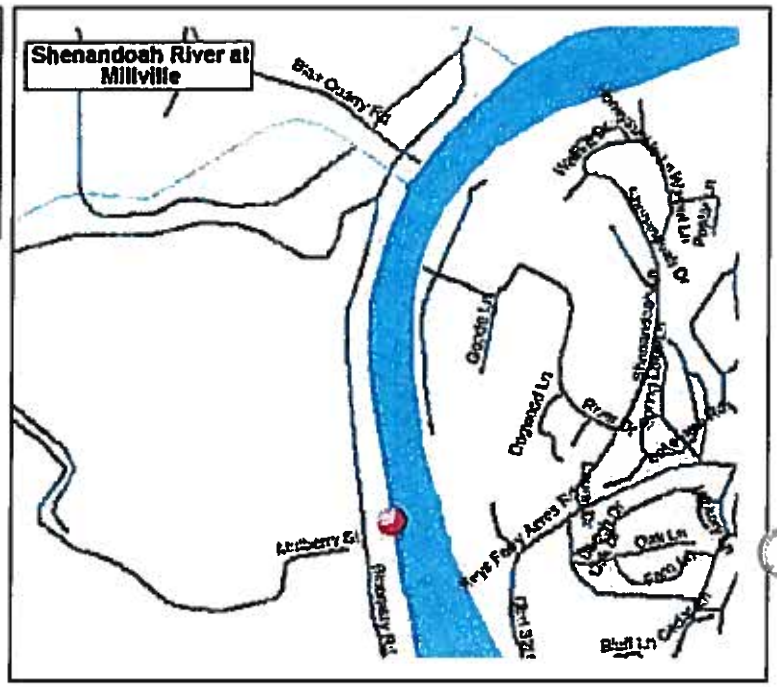
FLOOD HAZARD MAPPING

This appendix contains copies of current flood hazard mapping.

APPENDIX 2 TO INCIDENT SPECIFIC ANNEX 5
FLOODING INFORMATION FOR THE SHENANDOAH RIVER, POTOMAC RIVER & OPEQUON CREEK

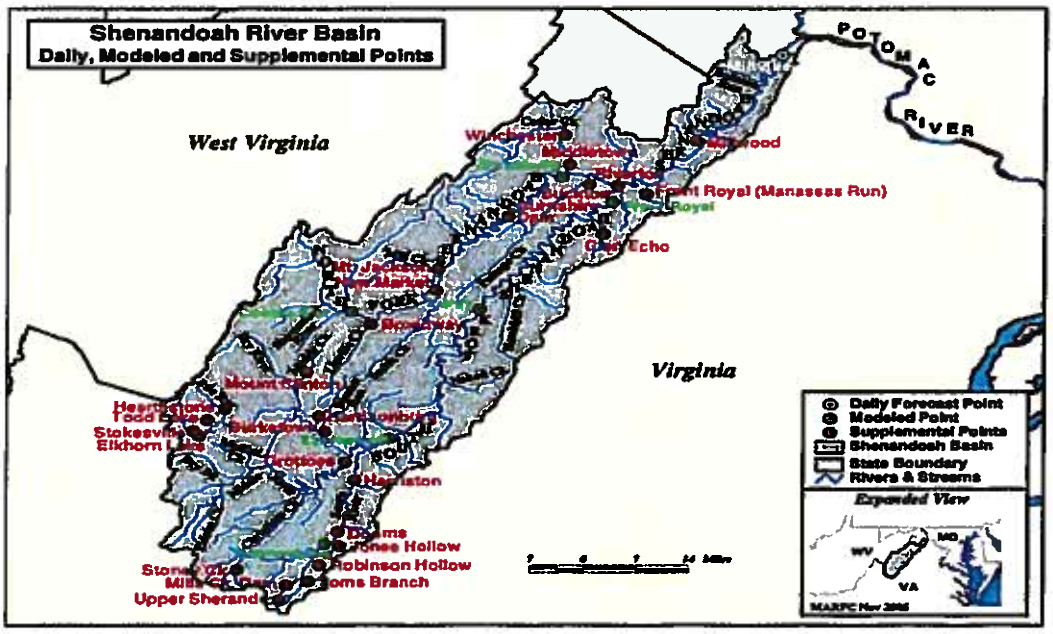
SHENANDOAH RIVER AT MILLVILLE

TOP 5 HISTORICAL CRESTS	
Date of Flood	Crest
October 16th, 1942	32.40 feet
September 8th, 1996	26.84 feet
October 1st, 1870	26.40 feet
March 18th, 1936	26.36 feet
November 6th, 1985	25.60 feet



IMPACTS

- 42.0 feet – Water overflows the old Molar Steel Mill dike
- 28.0 feet – Some homes along river in Avon Bend flooded
- 25.0 feet – Water covers Route 115 Bridge over Shenandoah River
- 19.0 feet – Water approaches lower Portion of power substation near dam
- 17.0 feet – Water reaches railroad tracks at Millville.
- 8.0 feet – Water will begin to Inundate parts of Bloomery Road near Bloomery, WV.

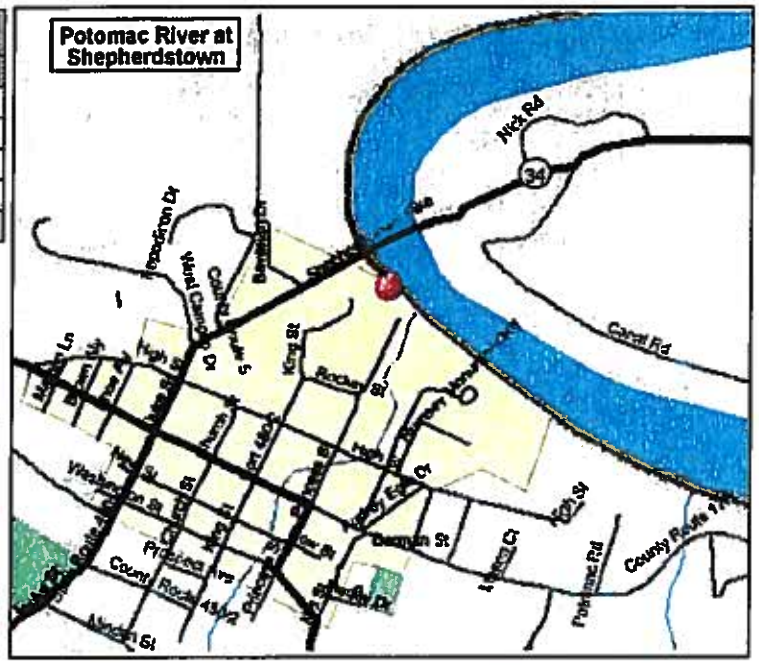


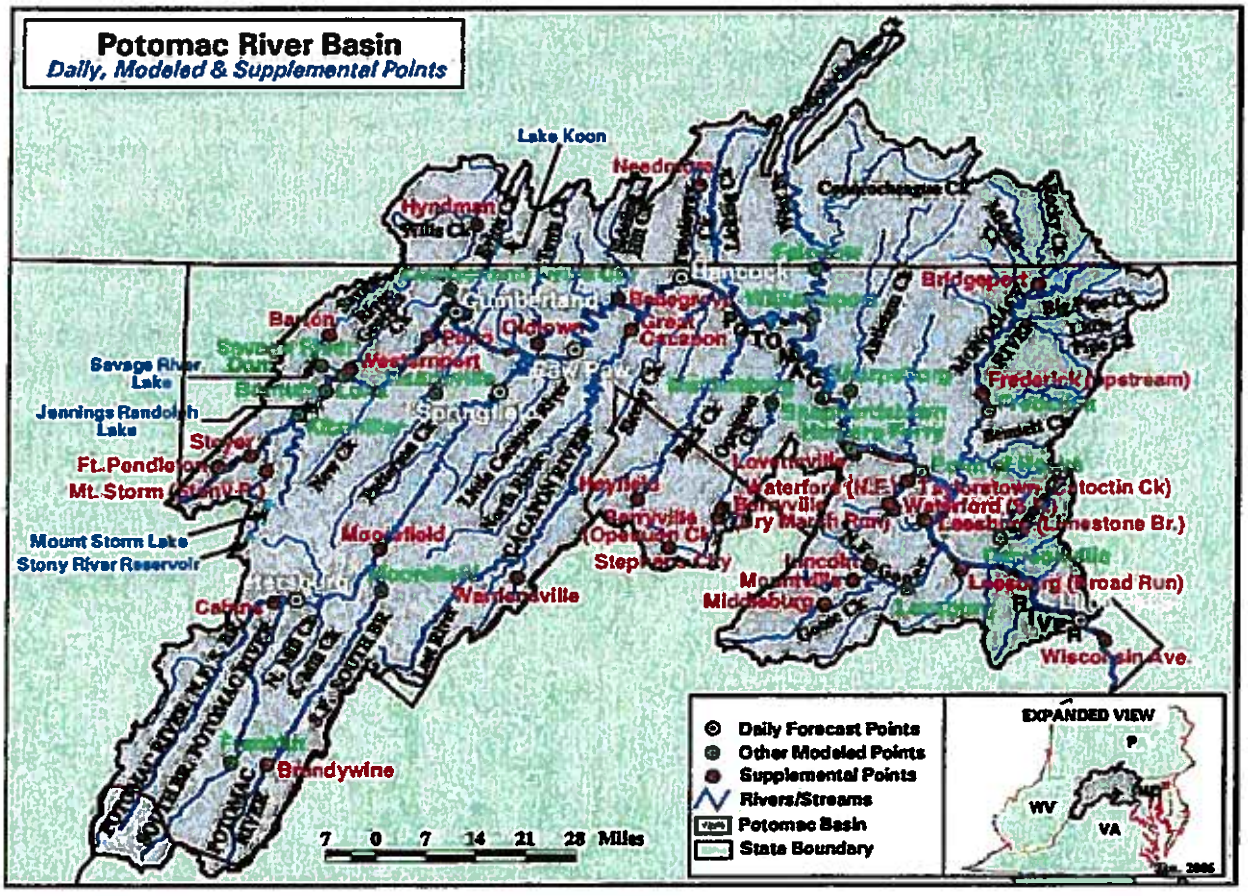
POTOMAC RIVER AT SHEPHERDSTOWN

TOP 5 HISTORICAL CRESTS	
Date of Flood	**Crest**
March 19th, 1936	42.07 feet
June 1st, 1889	39.20 feet
April 27th, 1937	33.20 feet
October 16th, 1942	32.68 feet
January 21th, 1996	32.50 feet

IMPACTS

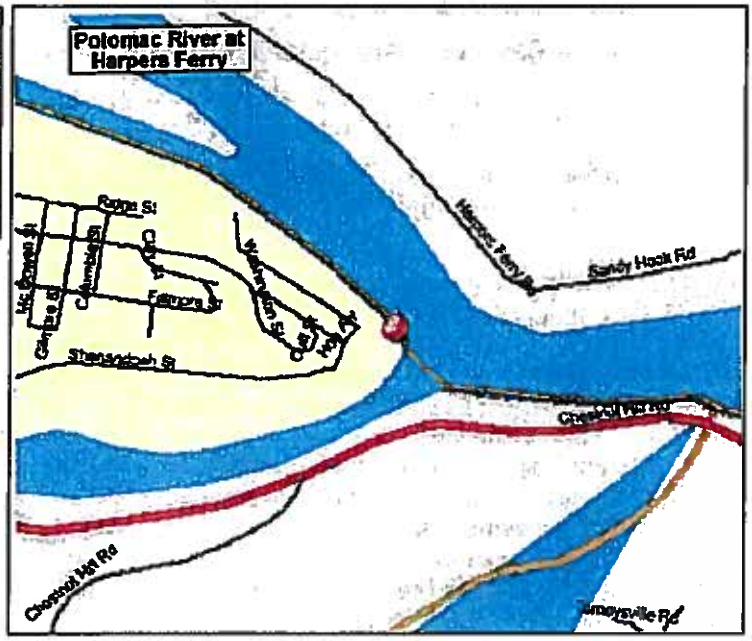
- 18 feet – Water approaches the C&O Canal Towpath.
- 15 feet – River overflow low lying areas just downstream from Shepherdstown.
- 11 feet – Water begins to overflow low lying areas and the adjacent road just upstream from the Shepherdstown water plant.
- 5.1 feet – The river is at hazardous level for recreational use.





POTOMAC RIVER AT HARPERS FERRY

TOP 5 HISTORICAL CRESTS	
Date of Flood	**Crest**
March 19th, 1936	36.50 feet
June 1st, 1889	34.80 feet
October 16th, 1942	33.80 feet
October 1st, 1896	33.00 feet
November 6th, 1985	30.10 feet

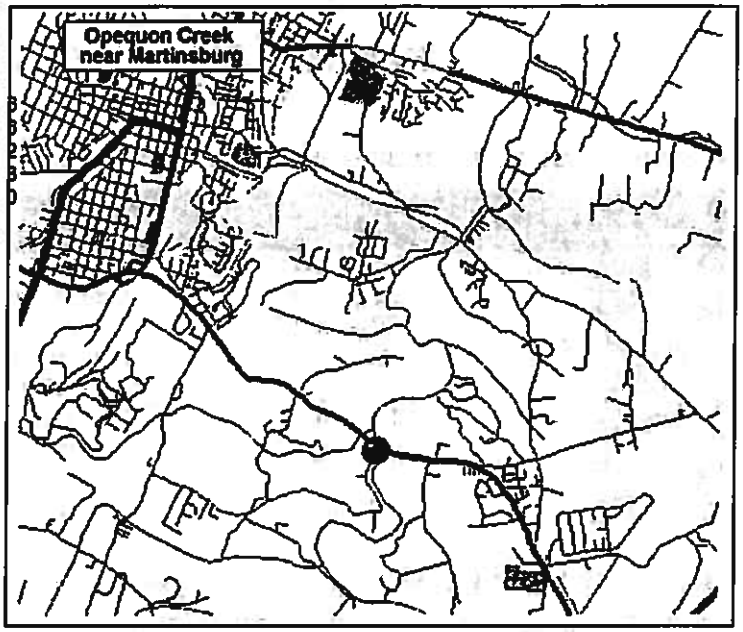


IMPACTS

- 43.5 feet – Water approaches the lowest point on Potomac Avenue downriver in Brunswick Maryland.
- 40.0 feet – Water inundates the depot of the MARC and Amtrak station at Harpers Ferry.
- 33.5 feet – Water reaches the railroad yards downriver in Brunswick Maryland.
- 33.0 feet – Water reaches the second floor of buildings in historic Harpers Ferry along Shenandoah St.
- 32.0 feet – Water reaches several private buildings on lower edge of Harpers Ferry.
- 28.0 feet – All buildings facing Shenandoah Street are flooded in Historic Harpers Ferry.
- 25.5 feet – Flood waters reach the general store and the lower-most portion of the John Brown Story building.
- 24.5 feet – Flood waters reach the Industry Museum in Historic Harpers Ferry.
- 23.5 feet – Water approaches John Brown's Fort in Harpers Ferry; water surrounds the book shop and A Place in Time Museum; water surrounds the blacksmith's shop; Potomac Street begins to flood at the intersection with Shenandoah.
- 22.5 feet – Water covers Shenandoah Street to the edge of the business district and standing water in low sections of the roads adjacent to the intersections between Potomac and Shenandoah Streets.
- 19.5 feet – Water approaches old federal armory site in Historic Harpers Ferry.
- 18.0 feet – Water begins to inundate low lying service roads on the Shenandoah River side of Historic Harpers Ferry, due to backwater effects.
- 16.0 feet – The river begins to overflow onto the C&O Canal Towpath on the Maryland side of the river across from Harpers Ferry, WV.

OPEQUON CREEK NEAR MARTINSBURG

TOP 5 HISTORICAL CRESTS	
Date of Flood	**Crest**
January 20th, 1996	18.76 feet
March 18th, 1936	17.50 feet
June 22nd, 1972	17.45 feet
May 19th, 1988	16.29 feet
November 13th, 1970	15.81 feet



IMPACTS

- 10.0 feet – Water begins to overflow low lying areas.
- 12.5 feet – The creek is well out of its banks.
- 15.0 feet – Water reaches homes on Douglas Grove Road.
- 20.0 feet – A significant flood is occurring. Numerous homes flooded east of Martinsburg. The worst flooding is south of the railroad bridge.

APPENDIX 3 TO INCIDENT SPECIFIC ANNEX 5

RAIN AND STREAM GAUGE INFORMATION

IFLOWS RAIN GAUGES IN JEFFERSON COUNTY, WEST VIRGINIA

Gauge Number	Type of Station	Point of Contact / Phone Number	Address	Latitude/Longitude	Elevation
ID 7962	MET	WV DOH County Supervisor 304.725.5821	1301 Old Lee Town Pike Kearneysville, WV	39 20.185 77 54.938	541.6 ft.
ID 6159	Rain		836 Eagles Nest Lane Harpers Ferry, WV	39 11.864 77 49.012	1488 ft.
ID 7972	MET		4960 Engle Moler Road Shepherdstown, WV	39 24.049 77 46.267	436.3 ft.

STREAM GAUGES IN JEFFERSON COUNTY, WEST VIRGINIA

USGS Shenandoah River at Millville, WV 01636500

Location	Lat 39°16'55", Long 77°47'22", NAD 27 – Jefferson County, Hydrologic Unit 02070007 on left bank 0.4 miles downstream from Cattail Run, 1.0 miles upstream from Millville, 5.0 miles upstream from Harpers Ferry, and at mile 4.7.
Drainage Area	3,041 square miles.
Period of Record	April 1895 to March 1909 August 1928 to September 2001 Measurements = Daily Mean Discharge and Annual Maximums.
	October 2001 to September 2004 Measurements = Daily Mean Discharge, Annual Maximums, Discharges at 1 hour or less)
	October 2004 to current year Measurements = Daily Mean Discharges, Annual Maximums, Gage Heights, Discharges at 1 hour or less)
Revised Records	WSP 951: 1936 (M). WSP 1432: 1895-99, 1901-02, 1905, 1907-08. 1932 (M) 1935 (M)
Gage	Water-stage recorder with satellite telemeter. Datum of gage is 293 feet above NGVD 29. April 15, 1895 to March 31, 1909, non-recording gage at site 0.8 miles downstream at datum 0.32 feet higher.
Remarks	Some regulation by upstream hydroelectric plants, including that of Potomac Light and Power Company, 0.5 miles upstream from station.
Extremes Outside Period of Record	Flood of 1870 reached practically same stage as flood of March 18, 1936, 26.36 feet, with discharge of 151,000 Cubic feet per second (ft^3/s).

This gauging station is maintained in cooperation with Allegheny Energy Supply Company. The website for this gauge station is: http://waterdata.usgs.gov/usa/nwis/uv?site_no=01636500.

USGS Bullskin Run below Kabletown, WV 01636464

Location	Lat 39°12'41.7", Long 77°50'05.5", NAD 83
Drainage Area	21.8 square miles.
Period of Record	April 2008 to 2016 Measurements = Daily Mean Discharge and Annual Maximums.

This gauging station is managed in cooperation with the Jefferson County Commission. It is managed by the Leetown Field Office. The website for this gauge is: http://waterdata.usgs.gov/wv/nwis/uv/?site_no=01636464&PARAmeter_cd=00065,00060,62614

APPENDIX 4 TO INCIDENT SPECIFIC ANNEX 5
OVERVIEW OF THE FLOOD RISK

FLOOD HISTORY

- According to records from the NOAA Event Record database (NOAA, 2016), the months when the most flooding occurs are March, with five reported floods from 1950 to present, September, with four reported floods and January and February both with three reported floods. There have been 29 flood events in Jefferson County since 1993, 18 of which were river floods, and 11 that were considered flash flood events.
- The worst hazard events experienced in Jefferson County were incidences of flooding resulting from heavy rains and snow melt. The earliest flood on record occurred in 1870 when the Shenandoah River was recorded at 12.9 feet above flood stage in the community of Millville. The most damaging floods in Jefferson County have all occurred within the last decade. The following are brief descriptions of historical floods that have occurred in Jefferson County.
  - October 1962 – Flooding of the Shenandoah River at Millville resulted in estimated damages to over 40 homes and mobile homes. The river crested at 32.45 feet.
  - April 22, 1992 – Both the Shenandoah and the Potomac Rivers crested above flood stage after 4.5 inches of rainfall. A car and a mobile home were destroyed by the high waters.
  - March 25-28, 1993 – Flash flooding occurred after snow melted throughout the county. Several people were evacuated and approximately $5,000 in damages to public facilities was reported.
  - January 19-21, 1996 – A three-day period of flooding resulted from snow melting after the Blizzard of 1996. Several roads were closed and many structures were affected or damaged by high water. This flooding resulted in approximately $593,000 in damages to public and private facilities.
  - September 6, 1996 – Heavy rain and flooding was experienced as a result of Hurricane Fran. Damage was sustained by many residential structures throughout the county. Harpers Ferry was especially hard hit with the flooding of park exhibition buildings and clean-up costs of over $2.8 million. Transportation was also impacted with roadways closed and washed out, as well as severe damage to some CSX railroad tracks.
  - November 7-10, 1997 – Flooding on the Potomac River, Opequon Creek, and the Shenandoah River resulted in the inundation of roadways and other minor damages.
  - January 8-10, 1998 – Roadways flooded with minor damages reported. The

Opequon Creek crested .75 inches above flood stage; Potomac River crested 1/2 foot under flood stage; and the Shenandoah River crested 1.8 feet over flood stage at Millville.

- January 28-29, 1998 – Flooding occurred along the banks of the Shenandoah and Potomac Rivers and Opequon Creek during a Winter Storm Warning issued by the NWS.
- May 26, 2002 – Scattered thunderstorms with large hail and very heavy downpours moved through the Eastern Panhandle between 3 and 7 PM. Basements and yards were flooded. Water collected on Route 480 near Shepherdstown.
- January 2, 2003 – Heavy rainfall on the 1st caused minor flooding on rivers and creeks in Berkeley and Jefferson counties. In Shepherdstown, the Potomac River reached a stage of 16.57 feet. Flood stage is 15 feet. The road to a housing development was flooded and several other low lying areas along the river were inundated by water.
- February 23, 2003 – A combination of 1.5 to 3 inches of rain that fell between the evening of the 21st and the morning of the 23rd, and snow melt from the massive snowstorm of the 14-18 of February led to widespread flooding. In Jefferson County, drivers had to be rescued when their vehicles stalled in high water on Bloomery Road. Avon Bend Road was flooded by the Shenandoah River and a motorist had to be rescued when his car became stalled in flood waters.
- May 16, 2003 – A large area of showers and thunderstorms containing heavy downpours moved through the region between the afternoon of the 15th and the morning of the 16th. The system dropped between 1.5 and 3 inches of rain across the extreme northeast portion of the Eastern Panhandle, resulting in minor flooding. In Jefferson County, Route 230 was closed by high water. Roads were also flooded in the Ranson and Millville areas. In addition, flooding was reported along Route 340 near the confluence of the Shenandoah and Potomac Rivers near Harpers Ferry.
- September 18-20, 2003 – Heavy rain and flooding was experienced as a result of Hurricane Isabel. At Shepherdstown, there was moderate flooding with the river cresting at 19.83 feet on September 20. Flood stage is 15 feet. The Opequon Creek at Martinsburg had minor flooding. Millville on the Shenandoah River had moderate flooding reaching a crest of 17.31 feet at 8 pm on September 20. Flood stage is 13.5 feet. Harpers Ferry at the confluence of the two rivers saw minor flooding.
- September 28, 2004: The remnants of Hurricane Jeanne brought widespread flooding to Eastern West Virginia on the 28th. The flooding lasted from mid morning at some sites through late evening. Many secondary and primary roads, including US Routes 51 and 11, were under water.

- November 29, 2005 – Vehicles were flooded out in water across the county. A large low pressure system moved from the Ohio Valley into the Middle Appalachians on November 29. Southerly winds brought moisture into the region. Prolonged heavy rainfall occurred in the Eastern Panhandle of West Virginia. These heavy rainfalls lead to flooding in some areas. On the evening of the 29th, some thunderstorms produced flash flooding in Jefferson and Berkeley counties.
- June 26, 2006 – Scattered areas of flash flooding began late on June 27 and continued into June 28. High water caused a vehicle accident on Highway 230 near Covenant Baptist Church, Spruce Street was flooded, water went into the Bolivar-Harpers Ferry Public Library, basement flooding occurred in homes in Bolivar, and numerous road closures and several water rescues were reported across the Eastern Panhandle of West Virginia.
- March 2, 2007 – On Saturday, March 3rd, two people became stranded in the flood waters when they drove past the "Road Closed" and "High Water" signs on River Road. The South Branch of the Potomac River at Shepherdstown crested at 15 feet after midnight on March 2nd. Total property damage reported was $15,000.
- March 13, 2010 – A low moving low pressure system moved up the Mid-Atlantic coast producing widespread heavy rainfall. The two to four inches of rain combined with nearly saturated antecedent conditions to produce flooding over eastern West Virginia. Several roads across the county were closed due to high water, including John Rissler Road, Bloomery Road, and River Road. Flooding was reported on River Road at Packhorse Ford Drive, River Road at Potomac View Land, and Rattlesnake Run.
- April 16, 2011 – A strong and closed low pressure system over the Ohio Valley remained nearly stationary through the 16th, bringing copious moisture northward up the eastern seaboard. Rainfall amounts over the eastern panhandle exceeded three inches in spots. Chestnut Hill Road was closed due to water cascading down the road toward US 340. A mudslide and flooded basements were reported near the top of the mountain near the Virginia border.
- May 16, 2014 – A deep upper level trough tapped into Gulf and Atlantic moisture, which led to heavy rain across the Mid Atlantic. Tropical-like conditions resulted in showers and thunderstorms to persist before a cold front moved through later in the day. Paynes Ford Road and Bowers Road were flooded from Opequon Creek.
- February 4, 2016 – The stream gauge on the Shenandoah River at Millville reached flood stage. The gauge peaked at 10.90 feet at 00:30 EST. Parts of Bloomery Road and John Rissler Road were flooded. Moulton Park and the Millville boat launch also flooded.

EVALUATION OF THE FLOOD THREAT

- Flood threat recognition for the Jefferson County area depends on the issuance of warnings by the NWS as well as monitoring IFLOWS. Appendix 2 describes the locations of the field equipment.
- Jefferson County GIS has developed accurate, detailed mapping of identified flood-prone areas in Jefferson County, as well as the number and types of structures, and the number of people that are located in these areas. This mapping was developed utilizing FEMA Digital Flood Insurance Rate Maps (D-FIRMs).
- Flood hazard mapping is contained in the *Jefferson County Multi-Jurisdictional Mitigation Plan* (JCHSEM, 2013).
- There are 20 "repetitive loss" properties in Jefferson County according to representatives with the FEMA Natural Hazards Program. The following table indicates the type of structure, the number of losses suffered, and the approximate location of the property. This information is legally privileged and confidential. Its use is protected under the privacy act of 1974, 5 U.S.C. Section 552(a). Use of this information should be restricted to applicable routine use.

JEFFERSON COUNTY REPETITIVE LOSS DETAILS			
Type of Structure	# of Losses	Location	Mitigated
Residential – Single Family	2	Shepherdstown	Yes
Residential – Single Family	2	Shepherdstown	Yes
Residential – Single Family	5	Harpers Ferry	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	3	Charles Town	No
Residential – Single Family	3	Charles Town	No
Residential – Single Family	3	Harpers Ferry	No
Residential – Single Family	3	Harpers Ferry	No
Residential – Single Family	3	Shepherdstown	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Charles Town	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Charles Town	No
Residential – Single Family	2	Shepherdstown	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Charles Town	No
Residential – Single Family	2	Shepherdstown	No
Residential – Single Family	2	Harpers Ferry	No

HAZARD IMPACT

- Flooding continues to be a frequent and damaging natural disaster as a result of the Potomac and Shenandoah Rivers and their many tributaries. Flooding is the most costly natural hazard in Jefferson County and has resulted in approximately $21 million in property damage over the past 57 years.
- Flooding impacts to the community include injuries to citizens and public safety officials, damage to property, lost revenue and economic damages, and increased demand on public safety and infrastructure-related services. Response activities include unanticipated overtime for EOC activations, evacuations, sheltering of displaced people, rerouting traffic destined for impassible roads, bridge and road damage repairs, and rescue or medical missions related to motorists and isolated families. Private property damages to homes and vehicles as well as land erosion, river channel changes, agricultural damages and livestock losses resulting in significant rural economic impacts to local residents.
- The table below summarizes the asset inventory for properties in the floodplain across Jefferson County.

Use Type	Charles Town	Ranson	Harpers Ferry	Shepherdstown	County	Total
Commercial	2	0	0	22	3	27
Residential	12	61	0	25	237	335
Other	1	0	3	7	9	20
Total	15	61	3	54	249	382

- Shepherdstown has 126 addressable structures in flood hazard areas (JCHSEM, 2013). These are properties that are alongside Town Run, a creek that runs through the center of the town from north to south. High Street to the north, New Street to the south, Church Street to the west, and Mill Street to the east bound the area most impacted by this flood plain. Shepherdstown has a mix of both residential and commercial properties at risk from flooding as well as other buildings such as properties belonging to the town and Shepherd University.
- Ranson has 88 addressable structures located in flood hazard areas (JCHSEM, 2013). Most are located in the southwest portion of the municipality, primarily to the west of George Street, all fall within the identified flood hazard areas.
- Charles Town has the third highest amount of addressable structures in flood hazard areas at 19 (JCHSEM, 2013). These structures are primarily located along Evitts Run, a creek that crosses through the southwestern portion of the town, and the majority is in the area surrounding the Evitts Run Park. Charles Town is also the only municipality within

Jefferson County to have a critical facility located within the floodplain (the Charles Town Waste Water Treatment Plant).

- According to information collected by the National Park Service, the lower town of Harpers Ferry has reached, or surpassed the flood stage of 18.5 feet over 36 times. The highest river crest of record for the Harpers Ferry area was 36.5 feet on March 19, 1936. Based on the procedures detailed in the emergency response plan for Harpers Ferry National Historical Park, a variety of park and town facilities are at risk when the river crests above flood stage:
  - 16-18 feet – Pedestrian Bridge over Potomac River.
  - 18.5-20 feet – Shenandoah Street and Harpers Ferry/Bolivar Public Service District.
  - 20-27 feet – Lower town.

- Approximately 29 miles of transportation infrastructure and utilities are located in flood hazard areas. The table below illustrates the number of miles of transportation infrastructure and utilities that are located in flood hazard areas.

Type	Number of Miles
Roads	4.47
Utilities	3.38
Railroads	21.39
Total	29.24