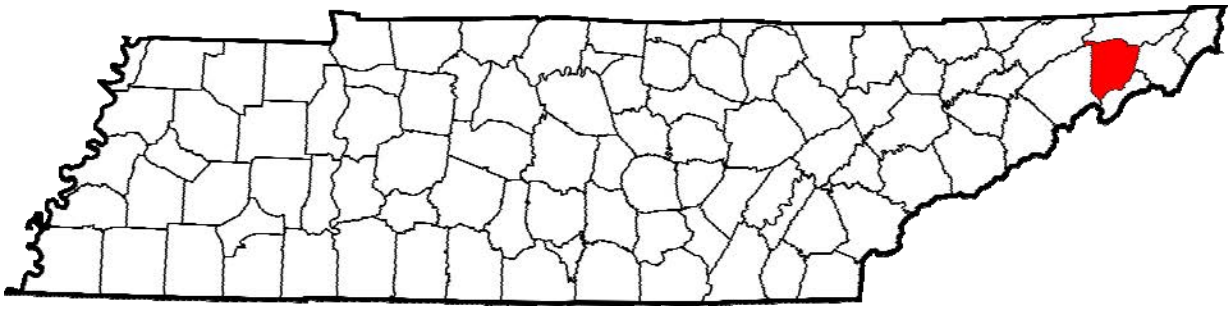
Washington County Multi-Jurisdictional Hazard Mitigation Plan



June 1, 2020

Prepared By:

Washington County Hazard Mitigation Committee
Washington County Emergency Management

Assistance Provided By:

Tennessee Emergency Management Agency
as part of the Tennessee Mitigation Initiative

Executive Summary

Over the past two decades, hazard mitigation has gained increased national attention due to the large number of natural disasters that have occurred throughout the U.S. and the rapid rise in costs associated with those disaster recoveries. It has become apparent that money spent mitigating potential impacts of a disaster event can result in substantial savings of life and property. With these benefit cost ratios being extremely advantageous, the Disaster Mitigation Act of 2000 was developed as U.S. Federal legislation that reinforces the importance of pre-disaster mitigation planning by calling for local governments to develop mitigation plans *(44 CFR 201)*.

The purpose of a local hazard mitigation plan is to identify the community's notable risks and specific vulnerabilities, and then to create/implement corresponding mitigation projects to address those areas of concern. This methodology helps reduce human, environmental, and economical costs from natural and man-made hazards through the creation of long-term mitigation initiatives.

The advantages of developing a local hazard mitigation plan are numerous including improved post-disaster decision making, education on mitigation approaches, an organizational method for prioritizing mitigation projects, etc. It has been noted that communities who successful complete and maintain a mitigation plan receive larger amounts of Federal and State funding to be used on mitigation projects, and receive these funds faster, than communities who do not have a plan. Such funding sources that the plan caters to are Pre-Disaster Mitigation, Flood Mitigation Assistance, and Hazard Mitigation Grant Programs.

The 2020 update of the Washington County Hazard Mitigation Plan was created to act as a well-thought-out guide to be used by, and for, the people of Washington County. For this plan to be successful, the following jurisdictions participated in the drafting and preparation of the plan update. It is important to note that work is currently being done with the Town of Jonesborough in order to include them within this plan. Due to other response efforts occurring at the time of this writing, adding the Town of Jonesborough is delayed. The information within this plan includes the Town of Jonesborough, however, there are no projects or committee participation at this time. The participating jurisdictions include:

- Washington County (unincorporated)
- Johnson City

In reference to federal code title *44 CFR 201*, the plan is required to be submitted to both TEMA (State) and FEMA (Federal) for review to be approved. When the plan is deemed “approval pending adoption” by FEMA *(44 CFR 201.6(c)5)*, each of the participating jurisdictions will adopt the plan through a local resolution.

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Section 1: Planning Process

Planning Process Update

The original Washington County Hazard Mitigation Plan was created and approved by FEMA on June 20, 2011. Per federal requirements stated in *44 CFR 201*, all local hazard mitigation plans are required to go through a FEMA update review every 5 years to remain eligible for hazard mitigation grants. This update methodology was developed to assure that local governments are continuing to re-evaluate their risks and to regularly implement mitigation projects that can reduce community vulnerabilities.

The plan's five-year update process took place at a meeting between Washington County Emergency Management, Washington County Schools, etc. and the Tennessee Emergency Management Agency (TEMA) on February 26, 2020 (***See Appendix 1***). All planning requirements and committee needs were accomplished at this all-day one-time Hazard Mitigation Committee Meeting conference. At this meeting, Washington County Emergency Management stated that they would continue the role of leading staff and interested persons in updating their mitigation plan. The tasks completed prior to this meeting included Washington County Emergency Management consisted of continuing to get agencies and the public involved in the county's mitigation efforts, performing the written plans required 5-year update, and soliciting for new mitigation actions/projects to be added to the plan. TEMA provided requested technical assistance at the beginning of the update process by presenting successful strategies that have been used in updating hazard mitigation plans, facilitating the meeting and guiding the committee on planning requirements; (a service established as part of the Tennessee Mitigation Initiative). Activities during this meeting included reviewing past incidents, disasters and data to gain a complete understanding of the hazards faced by Washington County and all jurisdictions within. The committee proceeded to rate each hazard to evaluate risk. This rating of each hazard is incorporated into the plan under Risk Assessment. The mitigation goals were established and reviewed.

Additional activities undertaken prior to this meeting by Washington County included reorganizing the county-wide hazard mitigation committee. Realizing that a successful mitigation committee includes a number of representatives, specialists, and individuals who can give valuable/unique insights that local emergency management staff may not have considered; invites to be a part of this plan update included open invitation to elected officials, county and city staff, representatives of the jurisdictions, neighboring counties, local businesses, state agencies,

private organizations, academia, non-profits, and other noticeable persons. These invites included email, phone and face to face contact by the Emergency Management staff. The Emergency Manager also provided details via this email to have each committee member think about which projects would be beneficial for the County's Hazard Mitigation program which proved to be beneficial during action/project discussion at the meeting.

Within this plan update, three jurisdictions participated as outlined in the Executive Summary. The Washington County Hazard Mitigation Committee for the plan update consists of the following members:

Member	Representation
Rusty Sells **(Committee Chair)**	Washington County/Johnson City EMA Director
Glenn Barry	Johnson City MTPO
Angie Charles	Washington County Planning Director
Doug Jones	Washington County Highway Department
Evan Clyburn	Washington County/Johnson City EMA, Operations Officer
Greg Wallace	Johnson City Schools Safety Supervisor
Vicki McGulken	COJC WRS Services Training Coordinator
Charles Baines	Washington County Fire Assn. Chair
Allen Kyker	Washington County Sheriff Comm. Spec.
Lesley Musick	911 Mapping Specialist
Brian Rice	Johnson City Police Department, Captain
Eric Doughterty	Johnson City Police Department, Lieutenant

The Washington County Hazard Mitigation Committee continues to be the county's lead in all mitigation efforts and in the development of the county's mitigation plan. The committee member's efforts in the plan update were broken down into five stages: **1)** analysis of the original plan *(the plan as it stood prior to the updates)*, **2)** updating of the plan, **3)** public participation, **4)** review of the final updated plan, and **5)** adoption of the plan.

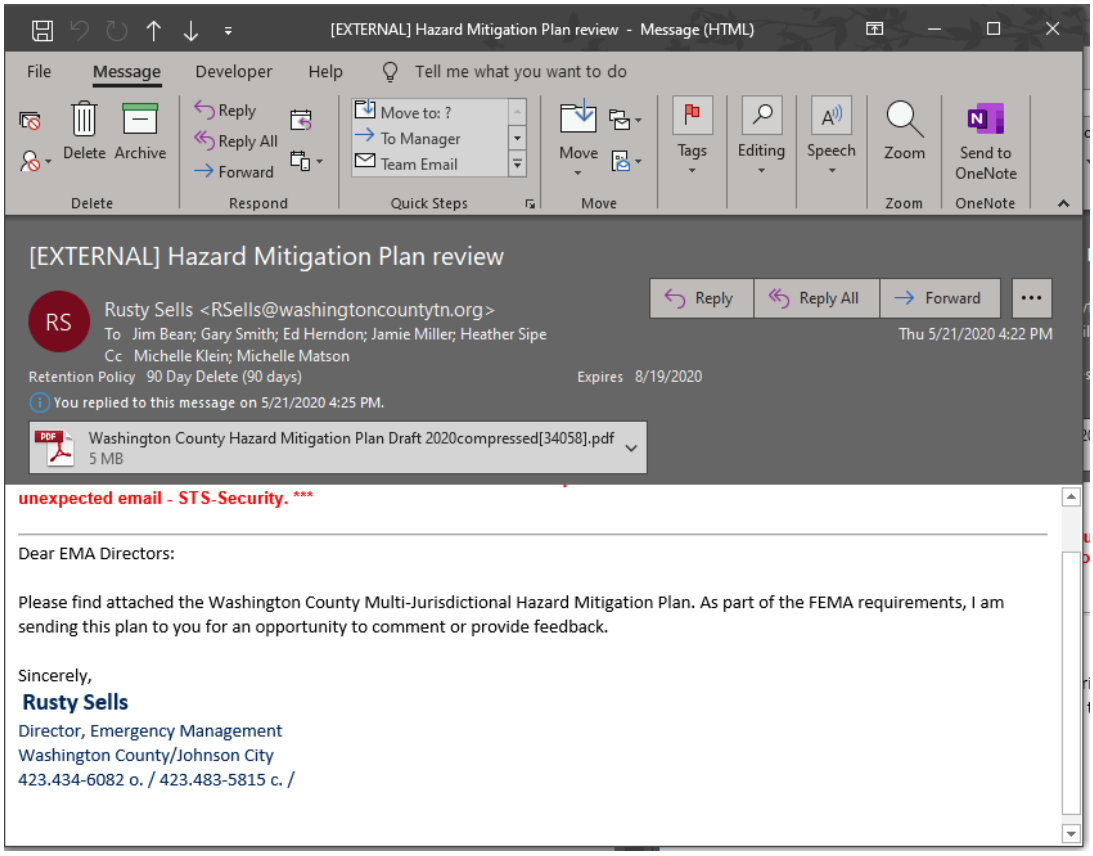
Stage 1: During the analysis of the plan, Washington County Emergency Management, with assistance from TEMA, reviewed the original county plan and made notes on what sections would require the main updates. Washington County Emergency Management suggested that the two core areas for needed updates were in the risk/vulnerability assessment and in the restructuring of the county's listed hazard mitigation projects.

Stage 2: From there, the committee started making the updates to the plan. Tasks included soliciting for new mitigation projects to be added to the plan and examining the status of mitigation projects listed in the original plan.

Stage 3: To encourage public involvement, the Washington County Hazard Mitigation Committee advertised the committee meeting for February 26, 2020 on the Washington County/Johnson City Emergency Management's Facebook and Twitter pages. This notice presents the purpose of the meeting, the time and date of the meeting, the exact location of the meeting, and stated that all are invited to attend. This meeting provided a great opportunity for the public to comment on the plan during the update drafting stage, to contribute in project proposals, and to participate in project reprioritization. ***Appendix 1*** provides a copy of the meeting's attendance sheet and ***Appendix 2*** presents a copy of the public notice for the meeting. No members of the public attended.

Stage 4: Next the committee evaluated the written updates of the plan against FEMA's crosswalk requirements. This also included having the jurisdictions review the drafts that specifically addressed aspects of their jurisdiction before the plan is sent to FEMA for review.

Also, Washington County/Johnson City Emergency Management invited the surrounding jurisdictions to comment on the plan via email. The email was addressed to the surrounding County's Emergency Managers which included Hawkins County, Greene County, Washington County, Carter County and Johnson County. The screenshot of the invite is below.



Stage 5: Upon receiving the "Approval Pending Adoption" designation from FEMA's review, adoption/resolution will be obtained for each participating jurisdiction.

Review of Existing Information

A preliminary review of existing plans, reports, and information was conducted during the initial phase of creating the Washington County Hazard Mitigation Plan. The primary purpose of reviewing this information was to identifying local hazards, recognizing local risks, and understanding different local vulnerabilities. The following list of sources identifies some of the existing studies that were reviewed:

- Washington County Basic Emergency Operations Plan
- East Tennessee State University Hazardous Mitigation Planning
- Washington County Hazard Mitigation Plan (2011)

All of the listed plans, studies, and data sources were incorporated into the Washington County Multi-Jurisdictional Hazard Mitigation Plan. These sources developed the plan's hazard, risk, and vulnerability assessment sections that in return led to the establishment of meaningful mitigation actions.

Updates within the Plan

It is important to note that this countywide plan was entirely reorganized and updated head-to-toe from the original Washington County Hazard Mitigation Plan. Washington County reviewed and analyzed each section of the original plan and made updates in the following ways:

Section 1: Planning Process
Washington County updated the original plan's description of the planning process to include the new or no longer participating committee members, updated the plan's description of the most recent countywide mitigation meeting that took place in 2020, and documented how the public could be involved. Washington County also compiled a new list of existing documents that they reviewed in updating the plan.

Section 2: County Profile
Washington County created a new development trends section in this plan update.

Section 3: Risk Assessment
The committee reviewed their hazards from the 2011 plan and decided to focus more on hazards of prime concern. This shift was

made to allow for more meaningful mitigation actions/projects. These hazards include: Flooding, Severe Storms (Hail, Wind, Tornado), Winter Weather, and Wildfire.

As part of the plan update, Washington County updated their previous occurrence hazard listings going back to 1950 with the exception of Wildfires allowing for re-evaluation of each hazard's extent, probability, and potential impacts. In some hazards, the NOAA National Centers for Environmental Information, Storm Events Database didn't provide data back to 1950 but the committee reviewed all data provided. The county then decided to use a different method for determining vulnerabilities/risks because this new method was considered superior to the older plan's method. Also, the plan now has a HAZUS-flood model study and simplified countywide floodplain maps (as seen in the plan's appendices).

Section 4: Mitigation Strategy

Washington County changed their mitigation goals from the 2016 plan to allow for a broader focus and the likely shift in priorities as the 5 years progress. Additionally, Washington County has utilized a new method for prioritizing mitigation projects, (thought to be superior to the previous method). Washington County also has brainstormed many new mitigation projects that were added to the list, used a new chart method to profile project details, and developed a system to describe where their previous plan's projects are in terms of being implemented.

Section 5: Plan Maintenance

Washington County updated how they would work with the other jurisdictions in monitoring, evaluating, and updating the plan, provided an updated list of mechanisms they could incorporate mitigation within, stated that Washington County Basic Emergency Operations Plan has mitigation concepts incorporated within it, and updated how all the jurisdictions would keep the public involved in updating processes.

Section 2: County Profile

Development Trends

Washington County is the 10th largest county in Tennessee with an estimated 2019 population of 129,375 (2015 population 126,302). The city of Johnson City (Incorporated) is the eighth largest city in the state with an estimated 2018 population of 66,778 (2015 population 66,027). The county seat of Washington County is Jonesborough (Incorporated) with an estimated 2018 population of 5,439 (2015 population of 5,291).

Washington County is located in northeastern Tennessee and is bordered on the north by Sullivan County, Tennessee; on the east by Carter County, Tennessee; on the west by Greene and Hawkins Counties, Tennessee; and on the south by Unicoi County. The major city in the county is Johnson City, which serves as a manufacturing, retail, education and healthcare center in the region. The county covers approximately 330 square miles or 208,640 acres. Washington County is bordered by Boone Lake and the Holston River to the north, and the Nolichucky River and Cherokee National Forest at the county's southern edge. The county's total water area is 3 square miles.

Major transportation corridors include Interstates 26 and 81; U.S. Routes 11, 19, 23, 93 and 321; Primary State Routes 67 and 381; Secondary State Routes 34, 36, 75, 91, 354, 359 and 400 and the CSX and Norfolk Southern Railway.

Washington County has a diverse economic base, and one that is well-suited to the 21st-century economy. Its primary employment sectors include education (not unsurprising with a 15,000-student university in Johnson City), government and health care. The county is also home to a diverse set of industrial employers, is a major player in the call center market, and is the premier retail destination for a large geographic area extending into Southwest Virginia and Western North Carolina. These factors all have helped Washington County consistently boast one of the 10 lowest unemployment rates of Tennessee's 95 counties.

The county's top employers in 2010 were:	
Mountain States Health Alliance:	3,541
East Tennessee State University:	2,330
Citi Commerce Solutions:	1,950
James H. Quillen VA Medical Center:	1,592
Advanced Call Center Technologies:	1,400
Washington County School System:	1,200
American Water Heater Co.:	1,170
City of Johnson City:	853
Johnson City School System:	832
AT&T Mobility:	650

The Johnson City Metro Area (Washington, Carter and Unicoi counties) had the following number of people employed in these non-agricultural employment groups as of early 2010:	
Government:	17,900
Education and Health:	13,400
Transport/Utilities/Trade:	13,300
Wholesale and Retail:	12,100
Goods Production:	11,400
Manufacturing:	8,400
Professional and Business Services:	7,500
Financial Activities:	4,600

Source: http://www.washingtoncountytn.org/work/employers

Future Growth / Growth Trends

The committee was asked to provide feedback and information on future trends. The specific question asked was, “List the areas in your jurisdiction (region, subdivision, etc.) that have experienced growth in the past 10 years or are anticipated to have significant growth in the near future, as well as any potential complications from natural hazards due to the development.”

As per the Northeast Valley Regional Industrial Development Association, Washington County, the fastest growing county east of Knoxville, has a lot going - affordable cost of living, strong cultural heritage, low taxes and a business-friendly environment. Washington County is home to East Tennessee State University, which celebrated its centennial in 2010. With its colleges of medicine, nursing, pharmacy and public health, ETSU has played a major role in developing the top-flight health care services that make Washington County an attractive destination for everyone from retirees to young professionals with families.

Industrial Growth has remained the same over the past 10 years.

Commercial Trends: New retail space has steadily grown. Revitalization of the Downtown area of Johnson City has sparked an interest to move retail and restaurants to that area of the City. Several financial institutions and medical facilities have been established along a major traffic corridor on the north side of town. MedTec Parkway has been built in conjunction with the new Franklin Woods Hospital.

Residential Growth: Many new housing developments are popping up all over the county. As farming decreases in this area, many of the farms are being sold and developed into residential subdivisions.

Resource Capabilities

	YES	NO
Does your jurisdiction enforce building code ordnances?	**X**	
Does your jurisdiction enforce zoning code ordnances?	**X**	
Is your jurisdiction a member of the National Flood Insurance Program?	**X**	
Does your jurisdiction have the following resources in place?		
Law enforcement	**X**	
Full-time fire services	**X**	
Grant writer		**X**
Public information officer	**X**	

Expanding & Improving Mitigation Programs

Mitigation actions has accomplished in the past 5 years, to include with both local (building/zoning codes, incorporating mitigation into existing planning) and external (grants such as mitigation, CDBG, USDA, etc.) funding are: Building codes include planning and inspection for storm water runoff when excavation of existing land such as roads and structures is warranted. We are currently in the process of applying for a USDA grant to mitigate a section of Dry Creek to prevent future flooding issues.

Expansion or enhanced mitigation program opportunities are: We are working with USDA and TDEC to start working toward a solution to flood prone areas of the county. We would like an opportunity to work with the Army Corps of Engineers to design and build a berm and shore up several creek banks that have eroded due to recent flooding events.

Challenges faced in being able to implement and/or expand mitigation are: Our biggest challenge will be getting through all of the red tape associated with working on private property to lessen the flood risk for an entire community. There are so many government agencies involved in even the smallest of projects that it can take years from the planning phase through project completion. Securing funding for the required projects will also be a large challenge.

Section 3: Risk Assessment

Hazard Identification

To begin to assess Washington County, and all jurisdictions within, risk to natural hazards and identify the community's areas of highest vulnerability, the mitigation committee had to identify which hazards have or could impact the county. This hazard identification process began with researching previous hazard events that have occurred in Washington County by going through newspaper articles, Washington County Emergency Management records, the 2011 Washington County Hazard Mitigation Plan, and recalling personal experiences. From there Emergency Management staff also analyzed hazard events that could occur in the county by reviewing scientific studies and the State of Tennessee Hazard Mitigation Plan. The following hazards have been identified as hazards of prime concern by the Washington County mitigation committee. There is a change in focus from the 2011 plan to the 2020 plan to allow for balancing of priorities. The 2011 plan risk assessment was too overwhelming to allow for identification of the prime hazards. By focusing on hazards that are a top priority for the committee, it allowed for better committee discussion and awareness. In some cases, sources of data are restricted to the State of Tennessee Hazard Mitigation Plan and state agencies to ensure continuity of reporting into future years. Consideration has been paid to local needs, input and sensitivities to ensure state and federal input doesn't influence the needs or desires, as deemed appropriate by the committee, of this local plan.

Flooding

Flooding events occur when excess water from rivers and other bodies of water overflow onto riverbanks and adjacent floodplains. In addition, lower lying regions can collect water from rainfall and poorly drained land can accumulate rainfall through ponding on the surface. Floods in Washington County are usually caused by rainfall but may also be caused by snowmelt and man-made incidents. The below charts explain common ways flooding occurs and common factors that contribute toward the severity of floods.

Common Ways Flooding Occurs	
Methods	**Description**
Overland Flow (a) Infiltration (b) Saturation	-Excess overland flow occurs when the rain is falling more rapidly than it infiltrates into the soil. -Excess overland flow occurs when soil spaces are so full of water that no more rain can be absorbed.
Throughflow	-Rainwater which has infiltrated into unsaturated soil can move horizontally to the river channel. This process is slower than overland flow but faster than baseflow.
Baseflow	-Rainwater which has percolated to the aquifer can seep into the river channel. This is the slowest process.

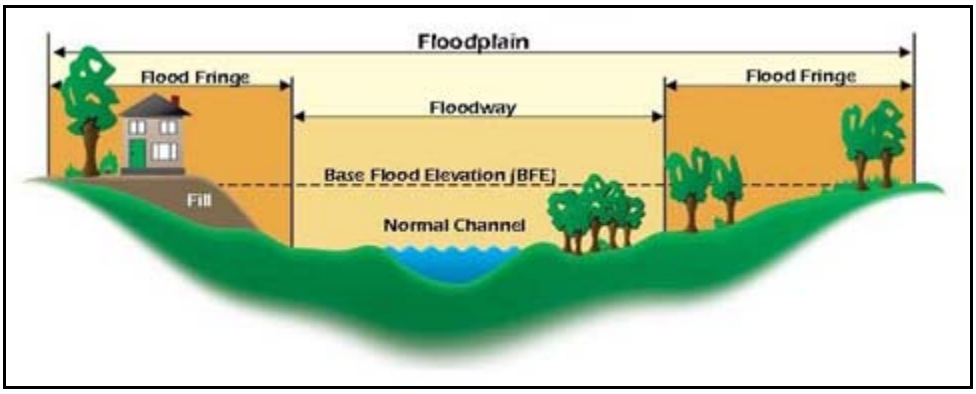
Source: The Field Studies Council

Common Causes of Flooding	
Factor	**Effect on Flooding**
Geology	Impermeable rocks are saturated more quickly than porous and pervious rocks. Saturation-excess overland flow is more common. Sandy soils have larger pore spaces than clay soils. Infiltration is most rapid in sandy soils.
Relief	Water reaches the channel more rapidly in a steeper basin as water is travelling more quickly downhill.
Vegetation	Vegetation intercepts a large proportion of rainfall. Where trees are deciduous, discharge is higher in a forested basin in winter as there is less interception.
Meteorological Factors	Where rain is falling faster than the infiltration rate there is infiltration-excess overland flow. This is common after a summer storm. Snow does not reach the channel but is stored on the ground surface. As snow melts, the meltwater will reach the channel quickly as infiltration is impeded if the ground is still frozen.
Catchment Shape	It takes less time for water to reach the channel in a circular basin as all extremities are roughly equidistant from the channel.
Land Use	Surface runoff is higher in urban areas because there are more urban surfaces (concrete & tarmac) and sewers take water rapidly to rivers. There is less interception and evapotranspiration and more surface runoff in a deforested catchment.
Catchment Size	Water reaches the channel more rapidly in a smaller basin as water has a shorter distance to travel.
Antecedent Conditions	The level of discharge before the storm is called the antecedent discharge. Even a small amount of rain can lead to flooding.

Source: The Field Studies Council

In Washington County some areas are more flood-prone than others. One of the ways of identifying these flood-prone areas is through determining the county's 100- and 500-year floodplains. 100-year floods are calculated to be the level of flood water expected to be equaled or exceeded every 100 years on average, meaning a flood that has a 1% chance of being equaled or exceeded in magnitude in any single year. A 500-year floodplain has a 0.2% chance. A 100-year floodplain would include the areas adjoining a stream, river, or watercourse that would be covered by water in the event of a 100-year flood (see diagram below).

Characteristics of a Floodplain



Source: FEMA

In Washington County, all jurisdictions have 100-year floodplains located within their boundaries and all jurisdictions are susceptible to smaller localized flooding outside of the 100-year floodplains. Areas in the county known to flood more often include:

County:
- Dry Creek Rd.
- Arnold Rd
- Methodist Camp Rd.
- Little Cassi Rd.
- Greenewood Dr.
- Bill Mauk Rd.
- Little Germany Rd.

Johnson City:
- Sinking Creek Rd.
- Todd Dr.
- Portions of West State of Franklin Rd.

*Detailed Flood Insurance Rate Maps (FIRMs) are also included in **Appendix 3**, which shows where FEMA has placed the 100-year and 500-year floodplains for each jurisdiction.*

Washington County historically has had many flood events in the past. Based on NOAA NCDC data, the following charts provide a list of flood events occurring in Washington County from 1950 to 2020 and a list of each flood's description of impacts imposed on the community. No flood was listed for Washington County prior to 1996.

The following information was obtained by accessing the NOAA database. https://www.ncdc.noaa.gov/stormevents/. This information represents all the events and extent of the Flooding hazard experienced by Washington County, including the jurisdictions located within, and is the only source of data accessible. The information provided for Washington County also

applies to the school district due to the geographic distribution of the schools throughout the County.

Flood Events in Washington County: 1950 to 2020

Location	Date	Deaths	Injuries	Property Damage	Extent/Impact Description
Countywide	1/19/1996	0	0	0	Two to over three inches of rain Friday night into Saturday morning combined with melting snow resulted in flooded roads, homes and farmlands. In the Roan Mountain area some residents were evacuated from their homes.
Countywide	5/26/1996	0	0	0	Strong thunderstorms with heavy rains moved across areas where the ground was completely saturated from previous rains. Numerous roads were closed or washed out and mudslides were reported.
Countywide	7/11/1999	0	0	0	Widespread showers and thunderstorms with heavy rain caused flooding problems throughout much of East Tennessee. Numerous incidents of minor flooding were reported around the remainder of the region. Water began to recede across the region by late afternoon/early evening Monday.
Johnson City	6/22/2001	0	0	0	Three quarters to as much as two inches of rain fell from a nearly stationary thunderstorm. A 20x30 foot section of roof at American Water Heater collapsed due to the rain. Many streets were under several inches of water. The creek that flows through Kiwanis Park overflowed its banks and flooded the park. There was an inch of water in Morrell Music Store on West Market Street. Several other buildings on Market Street had water in them also.
Countywide	8/4/2001	0	0	0	Very heavy rain Friday night into Saturday caused widespread flooding and damage as creeks, streams and rivers overflowed. No homes were destroyed in Washington County, but 84 sustained damage. Most of this occurred in the Limestone, Telford, Chuckey, South Central, and Clark's Creek communities.
Countywide	8/30/2001	0	0	0	Numerous roads flooded and several closed. The Fall Branch Fire Department building was flooded and 3 homes were evacuated in Johnson City.
not provided	3/17/2002	0	0	0	Rainfall totals between five and eight inches were reported in 36 hours. Numerous major rivers flooded including the Clinch, Powell, Sequatchie, and Pigeon Rivers. Total damage estimates were calculated to be over 5 million dollars.

Countywide	3/18/2002	0	0	0	Widespread flooding occurred across most of East Tennessee. Rainfall totals between five and eight inches were reported in 36 hours. Total damage estimates were calculated to be over 5 million dollars.
not provided	2/14/2003	0	0	0	Four day rainfall totals of two to eight inches fell across east Tennessee. This rainfall combined with a melting snowpack (reports of up to a foot in the higher elevations) to produce widespread flooding of rivers and streams with numerous mudslides also reported. The Powell, Clinch and Holston rivers measured the most significant rises.
not provided	2/21/2003	0	0	0	With the ground already saturated from the previous week's rainfall, three day rainfall totals of one to three inches created some flooding of streams and rivers as well as several mudslides across east Tennessee. Rivers which rose above their flood stages included the South Chickamauga, Clinch, Powell, Holston, Pigeon, French Broad and Sequatchie rivers.
not provided	4/10/2003	0	0	0	Seven day rainfall totals (4th through the 10th) of three to five inches were reported across central east Tennessee and northeast Tennessee, with one to three inches occurring on the 10th. Several secondary roads across the area were flooded with several rivers experiencing some minor flooding including the Clinch, French Broad, Holston, Pigeon and Powell rivers.
Johnson City	6/11/2003	0	0	0	Numerous main roads closed citywide.
Johnson City	6/30/2003	0	0	0	One to two feet of water in Johnson City. Streets closed.
Johnson City	8/16/2009	0	0	0	A boundary across the area triggered isolated severe thunderstorm during the afternoon and evening hours. Most of the damage reports contained damaging thunderstorm winds. With the slow movement of the storms, isolated flash flooding also occurred. Flash flooding was reported in Johnson City with numerous roads with several inches of water over the roads.
Johnson City	9/26/2009	0	0	0	Areal flooding occurred along a small area along highways 67/321 in Johnson City, Tennessee. Several inches of water was over the road, with a small area briefly impassable due to the flooding.
Johnson City	7/9/2010	0	0	0	Heavy rainfall produced several inches of water over the road, resulting in isolated flash flooding.
Embreeville	8/19/2010	0	0	0	Heavy rainfall resulted in flash flooding with several inches of water over the

Junction					road.
Jonesboro	4/9/2011	0	0	10000	Law enforcement personnel reported heavy rain from thunderstorms produced flooding on Mathews Mill Road and Shanks Road as well as portions of Old State Route 34.
Johnson City	4/5/2012	0	0	1000	Flooding of roads reported in Johnson City, including Hwy 11.
Limestone	4/5/2012	0	0	1000	Oakland Road and Carson Creek Road closed due to flooding.
Johnson City	8/5/2012	0	0	25000	Many roads in Johnson City were impassable. Water rescues necessary in downtown. Maintenance garage flooded, with several buses stranded. Riverview Drive on the Watauga River in Johnson City was impassable. Flooding reported at Silver Creek Apartments. Some downtown businesses were flooded.
Jonesboro	8/5/2012	0	0	5000000	Significant Flash Flooding on Dry Creek. Several houses damaged, one house destroyed. A dozen miniature horses killed on a horse farm. Some automobiles destroyed. A mudslide uphill at the Methodist Camp may have temporarily dammed water whose release contributed to the flash flood. The mudslide carried large rocks and boulders into yards. Water rescues required. No civilian injuries. One water rescue raft flipped, resulting in minor injuries to the rescue team.
Johnson City	1/15/2013	0	0	1000	Several roads closed across the county.
Jonesboro	6/13/2013	0	0	1000	State route 81 was closed between Mt Zion Rd to Tommy Campbell Rd due to flooding.
Johnson City	7/17/2013	0	0	25000	Roads flooded across the northern portion of the county including in Johnson City and the town of Fall Branch. Several vehicles stranded. Up to eleven people rescued from vehicles. Some homes flooded in Fall Branch.
Johnson City	7/5/2015	0	0	0	High water made several roads impassable in Johnson City.
Gray	5/26/2018	1	0	0	Toddler wandered into a swollen creek near the home and drowned.
Johnson City	8/10/2018	0	0	2000	Roads flooded and vehicles have become stalled, requiring police assistance.
Woodlawn	2/23/2019	0	0	0	State Road 353 at Hall Road closed by flooding.
McKinley	2/23/2019	0	0	324000	Carmel Village mobile home park flooded. Car submerged to hood. All told, there was about 324 thousand dollars in individual and public flood damages throughout the county for the overall event, but fortunately very little in the

					way of infrastructure and roads.

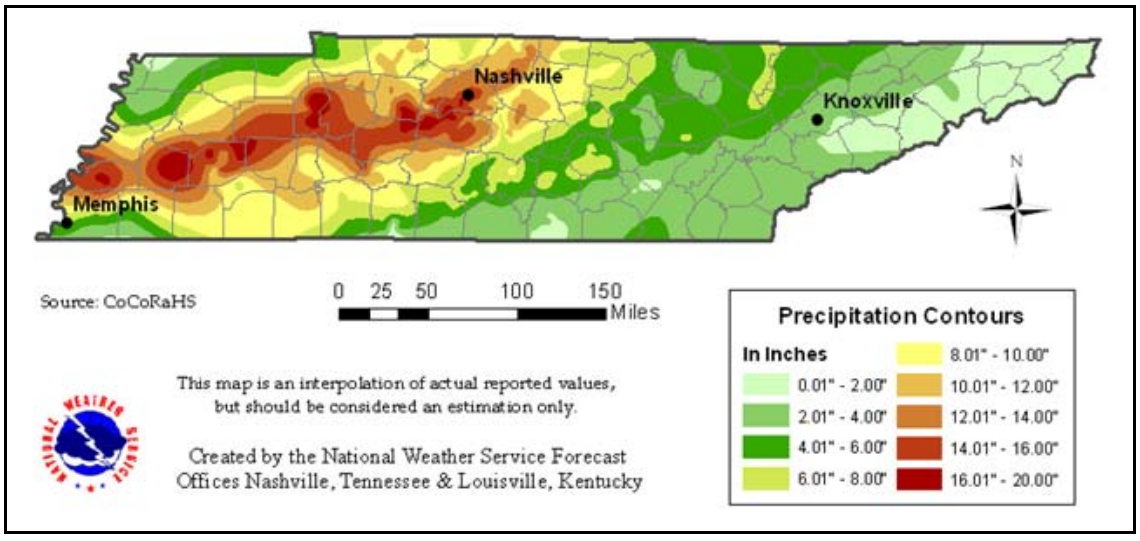
The committee shared their personal experiences of flooding events that have occurred in Washington County, Johnson City, and Town of Jonesborough. The following is transcribed from their thoughts.

- Opened school buildings for shelter.
- Flooding happens regularly where roads are closed. Most residential properties don't report the damage.
- Landslide has occurred along roadways in the past due to excessive rain. Also sinkholes have occurred.
- Carmel Village, Big Valley, Dry Creek – multiple occurrences; getting resources to the scene ASAP
- Flooding in the downtown area has historically been an issue. Current mitigation efforts in Founders Park and Kings Commons have drastically reduced the problem.
- Inside Johnson City limits, as a police officer, no experience with life saving measures. Most experience is traffic control in flooded roadways. Assisted Carter County at Roane Mountain with floods. Loss of life there. We only assist in security to help prevent looting.
- I responded to the flood in Dry Creek area in August 2012. We supplied support for EMS, Fire and Law Enforcement in communications and supplies. We provided spare radios and vehicles for search and rescue.
- Directly involved in numerous flooding events as swiftwater rescue leader. We and Johnson City have significant risk. Several repetitive rescues in same locations every flood event. Johnson City has mitigated much risk and stormwater projects downtown. Flooding concerns are flash flooding and small streams. Nolichucky River poses only a slight risk.
- Various roads throughout the County are consistently closed during heavy rainfall.

Brought forward from the 2011 plan: "In Tennessee, the worst slow rise floods occurred in 1926-1927, 1936-1937, and 1973. The great Tennessee and Cumberland River floods of 1927 gave way to even greater floods in 1937. Moderate to heavy rainfall, ice, and snow in December 1936 continued through January 1937. Soils became saturated, and the Mississippi, Cumberland, and Tennessee Rivers and their tributaries overflowed into some of the most industrialized and populated sections of Tennessee. It was a record flood year for these river systems. Socially and economically, this was the worst single disaster in American history to that date, rivaling the combined effects of the floods of 1926-1927 and the "Dust Bowl" of 1930-1931. The National Weather Service reported that 21.24 inches of rain fell in January alone. January 24th was dubbed "Black Sunday" as rivers overflowed in Tennessee and eleven other states, inundating 12,700 square miles and affecting 75,000 homes. Almost 900 people were seriously injured and 250 died of flood related causes."

Small localized flood events are likely to occur at least once every two years in Washington County. The severity of flooding that may occur in the county is measured by inches of rainfall and by feet of flooding. Based on previous occurrences, in a worst-case scenario it is possible for the extent of a flooding event to exceed 10 inches of rainfall, mudslides and in August 2012, an event caused over $5 million in damages across East Tennessee. As seen with the May 2010 Tennessee Flood Event *(DR-1909)*, it is possible for 20 inches or more of rainfall to amass within two days (see following map).

Tennessee May Flood- Precipitation for May 1st & 2nd 2010

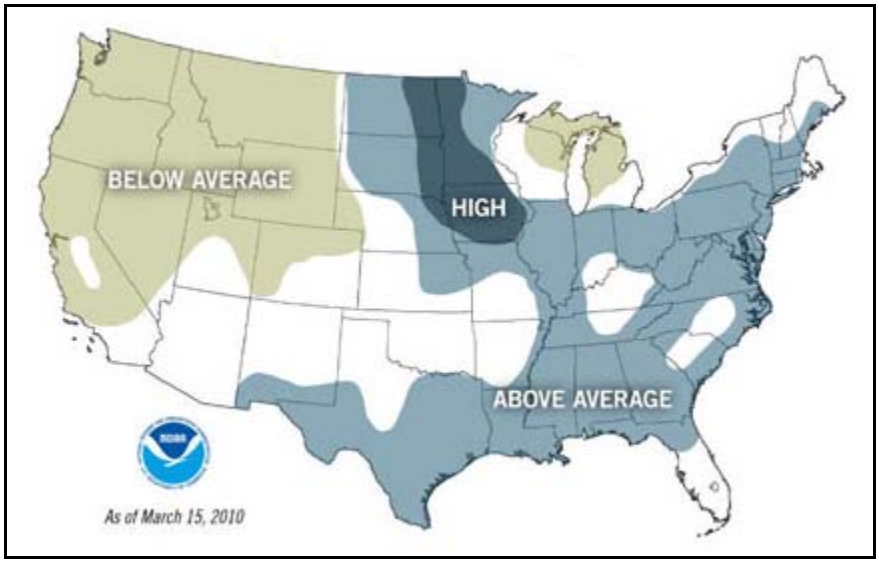


Source: National Weather Service

According to a NOAA Flood Risk Map (see map below), the majority of Tennessee was located in an "above average" risk of flooding zone during

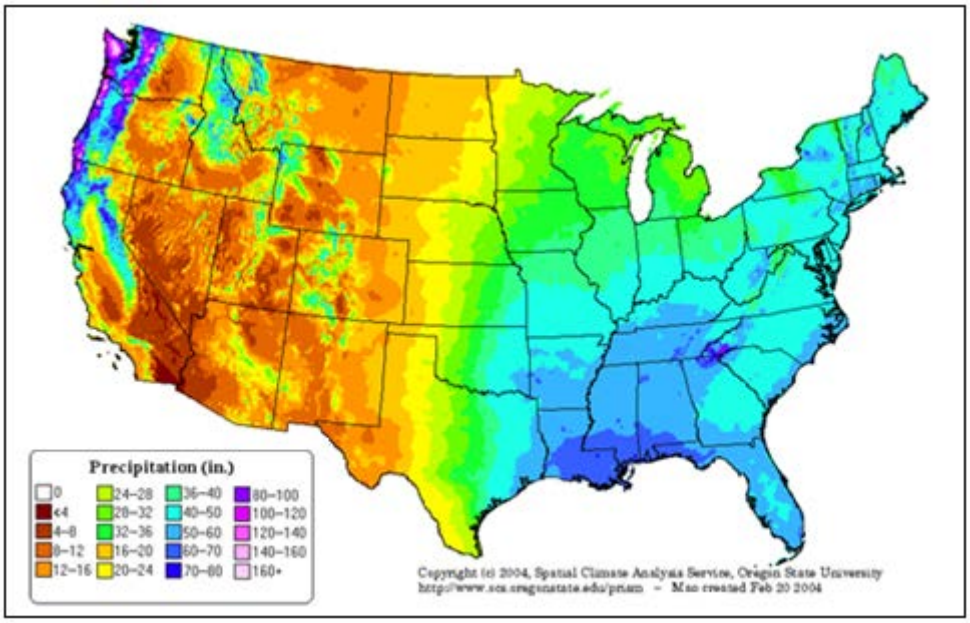
spring 2010. This proposed vulnerability is coupled with the fact that on average Tennessee usually acquires over 50-60 inches of rainfall a year (see following map).

Flood Risk Map



Source: NOAA

Average Annual Precipitation per Year (1971-2000)



Source: Spatial Climate Analysis Service, Oregon State University

Washington County uses a ranking system to determine each jurisdiction's vulnerability to flooding events. This system is based off simple arithmetic which analysis's potential impacts to determine

vulnerabilities and then analysis's the probability of a flood event occurring to calculate a flood risk ranking for each jurisdiction.

Jurisdiction	Impacts			Vulnerability
	Human	Property	Business	H+P+B=#; #/3=V
Washington County Unincorporated	3.25	3.13	1.63	2.67
Johnson City	2.86	3.14	2.14	2.71
Town of Jonesborough	2.75	3.63	2.25	2.88

Jurisdiction	Vulnerability	Probability	Risk V+P=R
Washington County Unincorporated	2.67	3.38	6.04
Johnson City	2.71	2.43	5.14
Town of Jonesborough	2.88	3.00	5.88

Scale	
Low	2-3.6
Moderate	3.7-5.2
Medium	5.3-6.8
High	6.9-8.4
Severe	8.5-10

Human	
Risk of injuries and deaths from the hazard	
1	Death very unlikely, injuries are unlikely
2	Death unlikely, injuries are minimal
3	Death unlikely, injuries may be substantial
4	Death possible, injuries may be substantial
5	Deaths probable, injuries will likely be substantial

Property	
Amount of residetial property damage associated from the hazard	
1	Less than $500 in damages
2	$500-$10,000 in damages
3	$10,000-$500,000 in damages
4	$500,000-$2,000,000 in damages
5	More than $2,000,000 in damages

Business	
Amount of business damage associated from the hazard	
1	Less than 3 businesses closed for only a day
2	More than 3 businesses closed for a week
3	More than 3 businesses closed for a few months
4	More than 3 businesses closed indefinitly or relocated
5	A top-10 local employer closed indefinitly

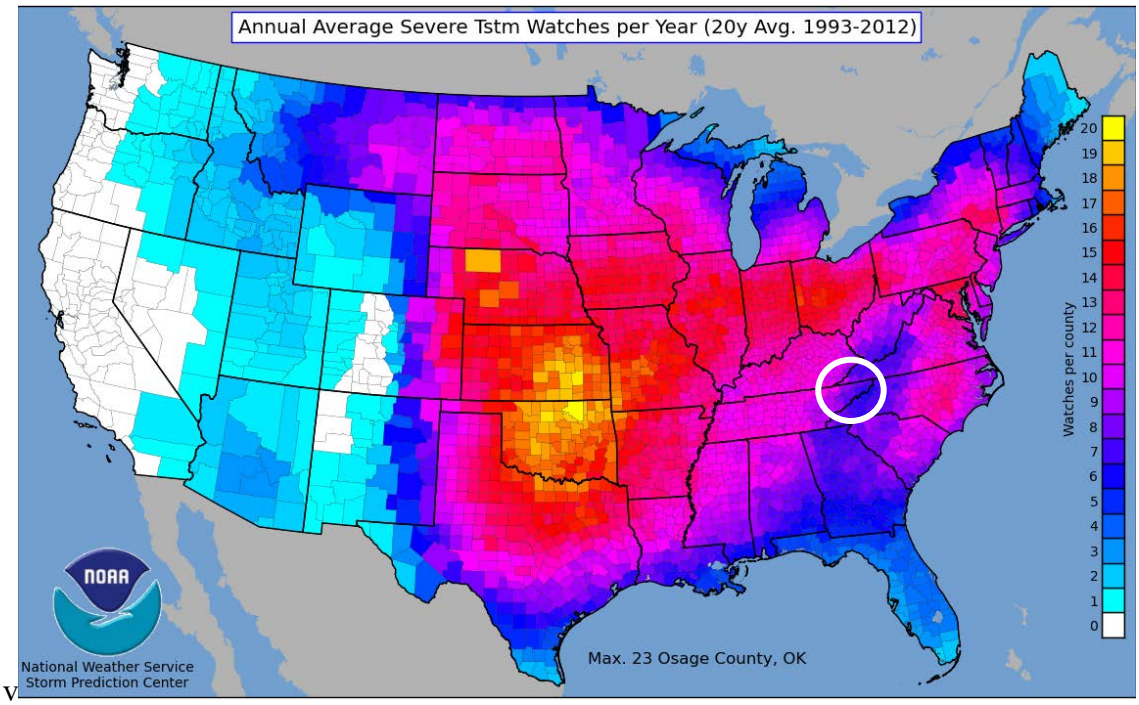
Probability	
Likelihood of the hazard occurring within a given span of years	
1	Less than once every 10 years
2	About once every 5-10 years
3	About once every 2-5 years
4	About once a year
5	More than once a year

For further information about flooding hazards in Washington County, see the HAZUS vulnerability study in ***Appendix 4***.

Tornadoes/Severe Storms

According to the National Weather Service, to consider a storm severe it must encompass one of three traits: produce winds greater than 58 miles per hour (50.4 knots), produce hail ¾ of an inch or greater in diameter, or produce tornadoes. On average, a typical county in Tennessee has about 5 to 10 severe storm watches per year (see map below).

Average Severe Storm Watches Per Year (1993-2012)

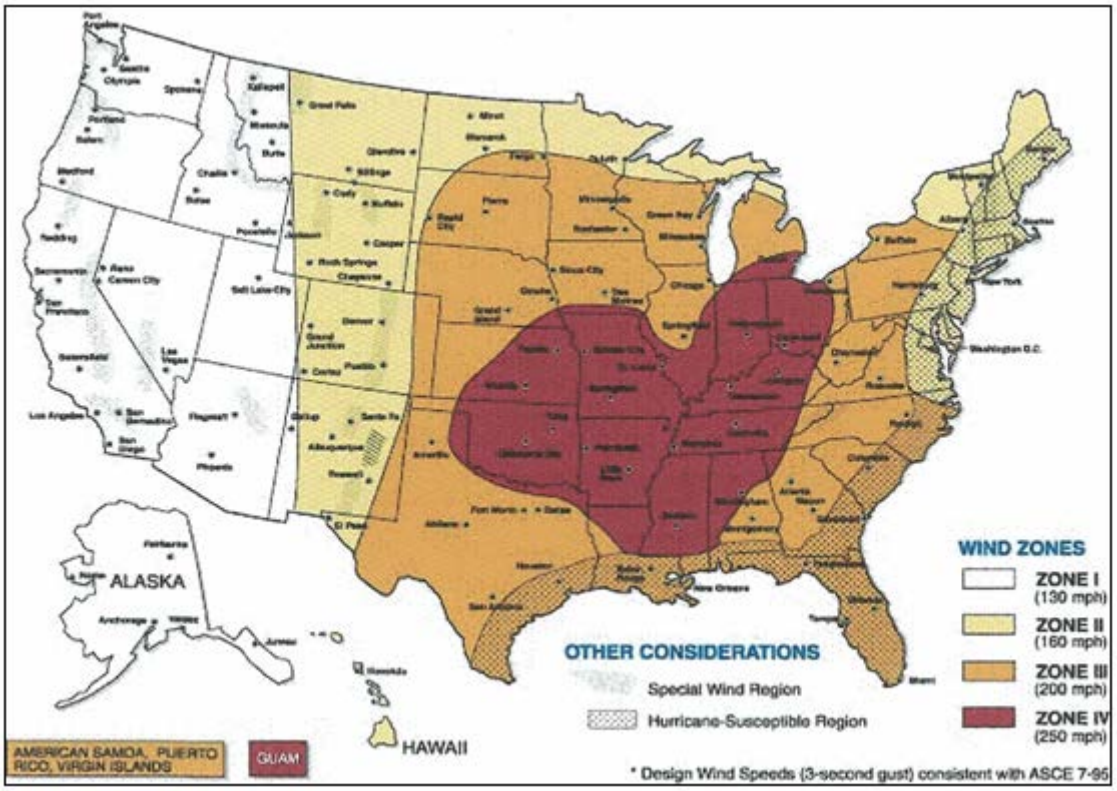


Source: NOAA/NWS Storm Prediction Center

A tornado is a violently rotating column of air that extends from a thunderstorm, etc. down to the ground, and can reach wind speeds of 40 mph to 250 mph and higher. Tornadoes paths, lengths, and widths can

vary greatly. In Washington County, all jurisdictions are vulnerable to tornado threats. The following map places much of Tennessee in the highest wind zone (see following map).

Wind Zones in the United States



Source: FEMA

Washington County historically has had many tornadoes in the past with tornado frequency increasing in the 1990's. Based on NOAA NCDC data, the following charts provide a list of tornado events occurring in Washington County from 1950 to 2020 and a description of recent impacts. The largest tornado experienced is an EF2 which occurred in multiple years. The costliest tornado was April 27, 2011 where many homes were seriously damaged and one individual was killed.

The following information was obtained by accessing the NOAA database. https://www.ncdc.noaa.gov/stormevents/. This information represents all the events and extent of the Tornado hazard experienced by Washington County, including the jurisdictions located within, and is the only source of data accessible. The information provided for Washington County also applies to the school district due to the geographic distribution of the schools throughout the County.

Tornado Events in Washington County: 1950 to 2020

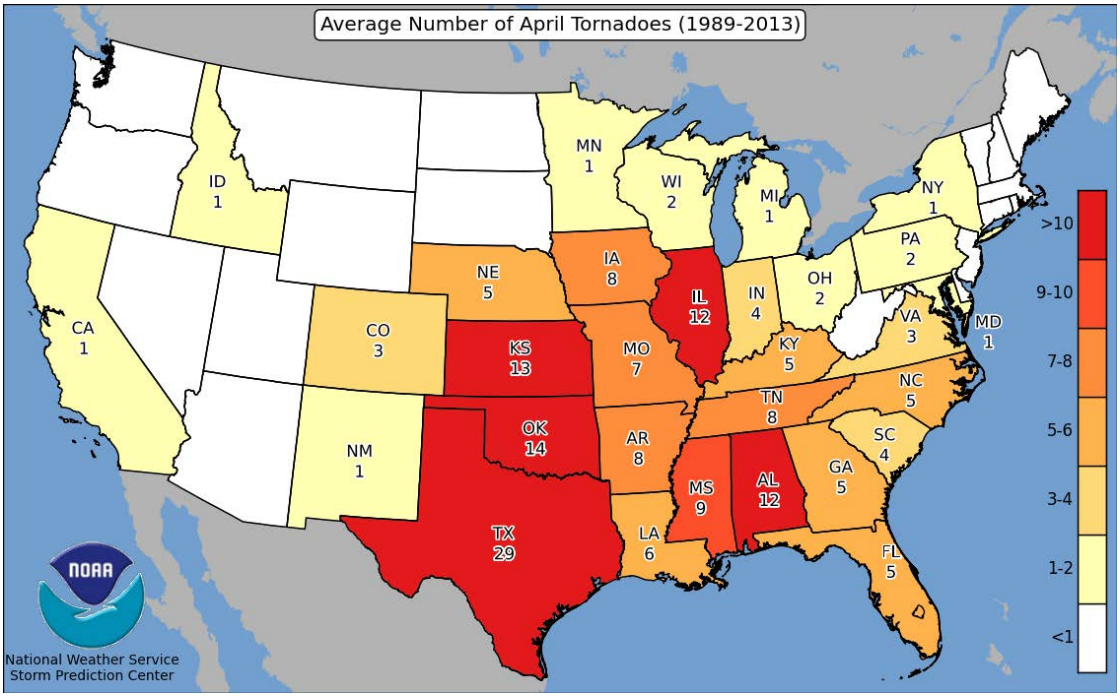
Location	Date	Extent	Deaths	Injuries	Property Damage	EPISODE_NARRATIVE
not provided	4/8/1957	F2	0	0	2500	no information
Limestone	6/13/1997	F1	0	0	500000	A short-lived tornado struck a subdivision at the intersection of Bailey Bridge Road and Lester Snapp Road. The tornado destroyed 3 homes and blew the roofs off 10 others. Around 25000 homes were without power in the county immediately after the storm. Most had power restored by the next day.
Gray	5/8/2009	EF0	0	0	0	Law enforcement confirmed a tornado touchdown.
Mayday	6/16/2009		0	0	0	Law enforcement personnel reported several funnel clouds southwest of Johnson City.
Jonesboro	4/9/2011	EF1	0	0	75000	Emergency management personnel reported an EF-1 tornado touched down 2 miles east of Jonesborough. It had a 3 mile path length and a path width of 150 yards. The maximum wind of 90 mph downed numerous trees and powerlines. Three barns were also damaged by the wind. Six tornadoes touched down across northeast Tennessee and into southwest Virginia. There were also numerous reports of large hail, with a few hailstones as large as a baseball reported.
McKinley	4/9/2011	EF1	0	0	10000	An EF-1 tornado with 90 mph maximum winds touched down and downed several large trees throughout its path.

Milburnton	4/27/2011	EF2	0	0	500000	Ducktown Tornado. A NWS storm survey reported an EF2 tornado touched down in the Ducktown area in Greene County and tracked northeast into Washington County south of Falls Branch. The 120 mph wind ripped off the entire roofs off several homes and downed numerous trees. Across Greene and Washington Counties this tornado had a pathlength of 8.8 miles. The thunderstorms produced more than 50 tornadoes across the east Tennessee area with 32 deaths and more than 200 injured. The tornadoes produced from light to heavy damage to hundreds of homes and businesses. Hail as large as baseballs was also reported.
Liberty	4/27/2011	EF1	0	0	10000	Camp Creek Tornado. By the time this tornado crossed into Washington County it had weakened to an EF1 with winds up to 100 mph. Most of the damage in Washington County for this tornado was to trees. The next tornado a couple of hours later in this same area would do much more damage.||The total length of the tornado was 15.8 miles. Earlier in the evening this same storm spawned the Ringgold/Apison Tornado.
Liberty	4/27/2011	EF2	1	0	3000000	Horse Creek Tornado. A NWS storm survey reported an EF3 tornado that initially touched in the Horse Creek area in Greene county, continued a northeast path into Washington county. The tornado had weakened to an EF2 by the time it was in Washington County with 115 mph winds, but still caused extensive damage. One 47-year-old man was killed in his home.||This tornado had a total path length in the two counties of 13.6 miles.

Rock Springs	7/27/2014	EF0	0	0	0	An EF1 tornado occurred approximately three miles southwest of Colonial Heights with estimated peak winds around 100 mph along a 7.1 mile long path 300 yards in width. There were houses along the path with structural damage while one large barn was heavily damaged. Numerous trees were also downed in this area. Three tornadoes were observed across east Tennessee; one classified as a strong, EF-3 tornado with winds of 140 mph. Additionally, there were several reports of straight-line wind damage and large hail up 2 to 3 inches in diameter! A storm system of this magnitude is highly unusual for this time of year due to the strength of the front and the record cool temperatures it produced in the middle of the Summer season.

Based on previous occurrences, tornado events are likely to occur at least once every 7 to 8 years in Washington County (see the following map for other probability information).

Average Number of Tornadoes Per Year



The severity of tornadoes that may occur in the county is measured using the Enhanced Fujita Scale for tornadoes (see chart below). Based on tornado events in other East Tennessee counties, in a worst-case scenario it is possible for the extent of a tornado to exceed an EF4 ranking.

Fujita Scale / Enhanced Fujita Scale for Tornadoes

Fujita Scale/Enhanced Fujita Scale for Tornadoes				
F-Scale	Fastest Quarter Mile Wind Speed	Typical Impacts	Enhanced Scale: 3 Sec Wind Gust Speed	Enhanced F-Scale
F0	40-72 mph	Some damage to chimney; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.	65-85 mph	EF0
F1	73-112 mph	Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.	86-110 mph	EF1
F2	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.	111-135 mph	EF2
F3	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted.	136-165 mph	EF3
F4	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	166-200 mph	EF4
F5	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.	Over 200 mph	EF5

Source: NOAA National Weather Service; The Tornado Project

Hail is the frozen form of precipitation, falling as small spheres of solid ice. Even though the risk from hail is relatively low, all jurisdictions have the possibility of hail causing some window and roof damage. Historically, hail events occur about once a year in Washington County. The severity of hail is measured by the diameter of the hail itself, commonly using the TORRO Hail Index (see following chart). Washington County's largest hail extent is reported at 1.75 inches (44.45 mm = H5). In the events listed by the NCDC, there was no documentation of damages. However, dollar losses are provided indicating financial impact.

TORRO Hail Index

TORRO Hail Index			
Scale	**Max Diameter**	**Comparisons**	**Typical Impacts**
H0	5-9mm	Pea	No damage.
H1	10-15mm	Mothball	Slight general damage to plants, crops.
H2	16-20mm	Marble	Significant damage to fruit, crops, vegetation.
H3	21-30mm	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored.
H4	31-40mm	Pigeon's Egg	Widespread glass damage, vehicle bodywork damage.
H5	41-50mm	Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries.
H6	51-60mm	Hen's Egg	Bodywork of grounded aircraft dented, brick walls pitted.
H7	61-75mm	Tennis Ball	Severe roof damage, risk of serious injuries.
H8	76-90mm	Soft Ball	Severe damage to aircraft bodywork.
H9	91-100mm	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.

Source: The Tornado & Storm Research Organization

The following chart provides hail event information for Washington County between 1950 to 2020. The following information was obtained by accessing the NOAA database. https://www.ncdc.noaa.gov/stormevents/. This information represents all the events and extent of the Hail hazard experienced by Washington County, including the jurisdictions located within, and is the only source of data accessible. The information provided for Washington County also applies to the school district due to the geographic distribution of the schools throughout the County.

Hail Events in Washington County: 1950 to 2020

Location	Date	Extent in Inches	Deaths	Injuries	Property Damage	Extent/Impact Description
not provided	10/8/1960	3	0	0	0	no information
Johnson City	6/26/1995	0.75	0	0	100	no information
Gray	5/25/1996	1	0	0	0	no information
Johnson City	11/30/1997	0.75	0	0	0	no information
Gray	4/3/1998	1	0	0	0	no information
Gray	5/7/1998	1	0	0	0	no information
Johnson City	5/7/1998	1	0	0	0	no information
Jonesboro	6/5/1998	0.75	0	0	0	3/4 hail also reported in Limestone.
Gray	7/19/1998	1	0	0	0	Tree limbs also reported down in the area.
Garber	5/7/1999	1	0	0	0	Hail near and along Highway 81 near Unicoi County border.
Johnson City	6/10/1999	0.75	0	0	0	no information
Spurgeon	7/28/2000	1.75	0	0	0	no information
Gray	6/11/2003	0.75	0	0	0	Pea to Penny sized hail fell about one and a half miles east of Gray.
Countywide	6/11/2003	0.75	0	0	0	Penny sized hail fell near Boones Station.
Johnson City	8/4/2003	0.75	0	0	0	Penny size hail reported by 911 dispatch.
Gray	4/13/2004	1	0	0	0	no information
Johnson City	4/13/2004	1	0	0	0	no information
Jonesboro	5/14/2005	0.75	0	0	0	Penny sized hail was reported at Jonesboro.
Johnson City	4/3/2006	0.75	0	0	0	Penny-size hail in Johnson City.
Johnson City	4/22/2006	0.88	0	0	0	Nickel-size hail in Johnson City.
Gray	4/25/2006	0.75	0	0	0	Penny-size hail in Gray.
Johnson City	5/18/2006	0.88	0	0	0	Nickel size hail was reported in Johnson City.
Johnson City	5/26/2006	1	0	0	0	Quarter size hail was reported at Johnson City.
Johnson City	5/26/2006	0.75	0	0	0	Penny size hail was reported at Johnson City.

Jonesboro	6/10/2006	1	0	0	0	Quarter-size hail in Jonesboro
Johnson City	6/12/2007	1.75	0	0	0	The public reported golfball-size hail in Johnson City.
Gray	6/9/2008	0.75	0	0	0	A trained spotter reported penny-size hail in Gray.
Gray	6/9/2008	0.88	0	0	0	A trained spotter reported nickel-size hail in Gray.
Johnson City	7/8/2008	0.75	0	0	0	Penny size hail was reported in Johnson City.
Johnson City	7/22/2008	0.75	0	0	0	Penny sized hail was reported in Johnson City.
Johnson City	8/2/2008	0.75	0	0	0	An amateur radio spotter reported penny-size hail fell in Johnson City.
Woodlawn	9/9/2009	0.88	0	0	0	Nickel size hail was reported on Jim Town Road two miles south of Jonesborough.
Jonesboro	4/9/2011	1	0	0	0	Trained spotter reported quarter-size hail fell from a thunderstorm during the early morning hours.
Telford	4/25/2011	1	0	0	0	A trained spotter reported thunderstorms produced quarter-sized hail in Telford.
Gray	4/27/2011	1.25	0	0	0	Amateur radio personnel reported thunderstorms produced half-dollar-size hail in Gray.
Gray	5/26/2011	1.75	0	0	0	Golf ball size hail was reported.
Dry Creek	4/5/2012	1	0	0	0	Law enforcement personnel reported thunderstorms produced quarter-size hail northwest of Unicoi near Dry Creek.
Fall Branch	7/1/2012	1	0	0	0	Quarter size hail was reported at Fall Branch.
Johnson City	7/24/2012	1	0	0	0	Quarter sized hail was reported in Johnson City.
Limestone	5/13/2014	1	0	0	0	Quarter sized hail was reported at Limestone.
Gray	7/27/2014	1.75	0	0	0	Golf ball sized hail was reported at Gray.
Gray	7/19/2016	1	0	0	0	Quarter size hail was reported.
Jonesboro	7/19/2016	1.75	0	0	0	Golfball size hail was reported at Sulphur Springs.
Y Section	5/18/2019	1	0	0	0	Quarter size hail was reported.

Severe storm winds most commonly occur as straight-line winds; a downburst of wind created by an area of significantly rain-cooled air that spreads out in all directions after hitting the ground. All jurisdictions are vulnerable to receiving damage from these severe storm winds. Historically, severe storm wind events occur about four times a year in Washington County. The severity of severe storm winds is commonly measured by wind speed (knots or mph). It is not unusual for Washington County to experience winds speeds up to 87 knots (100 mph) causing structural damage, power outages and trees down.

The following chart provides severe storm wind event information for Washington County between 1950 and 2020. The following information was obtained by accessing the NOAA database. https://www.ncdc.noaa.gov/stormevents/. This information represents all the events and extent of the Severe Storm Wind hazard experienced by Washington County, including the jurisdictions located within, and is the only source of data accessible. The information provided for Washington County also applies to the school district due to the geographic distribution of the schools throughout the County.

Wind Events in Washington County: 1950 to 2020

NP = not provided

Location	Date	Extent in Knots	Deaths	Injuries	Property Damage	Extent/Impact Description
not provided	10/8/1960	0	0	0	0	no information
not provided	6/7/1963	0	0	0	0	no information
not provided	5/16/1970	0	0	0	0	no information
not provided	4/4/1974	0	0	0	0	no information
not provided	3/18/1977	0	0	0	0	no information
not provided	6/6/1977	0	0	0	0	no information
not provided	7/10/1980	0	0	0	0	no information
not provided	7/3/1982	0	0	0	0	no information
not provided	5/7/1984	0	0	0	0	no information
not provided	9/3/1984	0	0	0	0	no information
not provided	6/3/1985	0	0	0	0	no information
not provided	5/6/1989	0	0	0	0	no information
not provided	6/2/1989	0	0	0	0	no information
not provided	6/22/1990	0	0	1	0	no information
not provided	4/9/1991	0	0	0	0	no information
not provided	7/12/1991	0	0	0	0	no information
not provided	8/4/1991	0	0	0	0	no information
not provided	3/9/1992	0	0	0	0	no information
not provided	9/10/1992	0	0	0	0	no information
Johnson City	8/20/1993	0	0	0	5000	Numerous trees and power lines were knocked down. A roof had its shingles torn and an awning was mangled.
Gray	8/20/1993	0	0	0	500	A few trees were uprooted.
Limestone	6/11/1994	0	0	0	5000	A large tree was uprooted and landed on a house.
Johnson City	6/16/1994	0	0	0	5000	A few trees were blown over. One tree knocked a hole in a roof.

Johnson City	6/19/1994	0	0	0	500	A few trees were knocked down.
Johnson City	6/21/1994	0	0	0	500	A few trees were knocked down.
Limestone	4/11/1995	0	0	0	5000	A deck was blown off of a house.
Johnson City	5/14/1995	0	0	0	5000	Several trees were blown down.
Fall Branch	5/18/1995	0	0	0	5000	A few trees were blown down.
Jonesborough	7/16/1995	0	0	0	2000	A few power lines were blown down and a home garden was damaged.
Johnson City	7/31/1995	0	0	0	2000	Several trees were knocked down.
Countywide	4/13/1996		0	0	0	Numerous trees were blown down countywide
Countywide	5/25/1996	NP	0	0	0	Numerous trees and powerlines were blown down. A few roads were closed as a result.
Countywide	7/2/1996	NP	0	0	10000	Trees and Tree limbs blew down onto powerlines.
Gray	7/14/1996	NP	0	0	10000	Numerous trees and powerlines were downed. Some trees fell onto cars. A few houses were damaged.
Jonesboro	8/17/1996	NP	0	0	15000	A barn and numerous trees were blown down.
Countywide	6/13/1997	NP	0	0	0	A man in the Gray community was trapped in his car from falling trees. Trees blown down between Jonesborough and Johnson City.
Sulphur Springs	7/16/1997	NP	0	0	25000	Strong winds flattened one barn and damaged the roof on another. Winds also moved a trailer home 5 feet off its blocks, knocked down some trees and knocked out two large heavy garage doors.
Countywide	7/21/1997	NP	0	0	15000	Trees and powerlines down throughout the county.
Telford	7/22/1997	NP	0	0	0	Numerous trees down near Telford community.
Fall Branch	2/17/1998	NP	0	0	4000	Tractor trailer blown over on I-81.
Bowmantown	5/26/1998	NP	0	0	0	Several trees reported down in and around the communities of Bowmantown and Telford.
Jonesboro	6/2/1998	NP	0	0	0	Trees down in southwest part of county on Highway 107 near Greene County line.
Jonesboro	6/24/1998	NP	0	0	15000	Powerlines down in western part of county.

Jonesboro	6/24/1998	NP	0	0	0	Trees down in western part of county.
Countywide	7/7/1999	NP	0	0	25000	Trees down.
Taylor Mill	7/28/1999	NP	0	0	1000	Tree down at the intersection of highways 81and 75.
Gray	8/19/1999	NP	0	0	8000	Trees and power lines down. A 50 foot by 100 foot roof was blown off a utility building at the state Department of Transportation, located on North Roan Street in Johnson City. The building was used to store nearly 2000 tons of salt, meant to be used to keep roads clear during the winter. Around 5000 customers lost power during the height of the storm.
Countywide	2/14/2000	NP	0	0	21000	Trees and power lines down.
Jonesboro	2/14/2000	NP	0	0	10000	A large sign blown down.
Garber	5/27/2000	NP	0	0	0	A few trees down on Highway 81.
Limestone	6/3/2000	NP	0	0	0	Trees down.
Limestone	6/14/2000	NP	0	0	0	4 trees down in Limestone.
Limestone	6/15/2000	NP	0	0	0	Trees down.
Limestone	7/14/2000	NP	0	0	0	Trees down on highway 34.
Limestone	7/14/2000	NP	0	0	0	Trees down on highway 107.
Johnson City	7/28/2000	NP	0	0	12000	Trees and power lines down.
Johnson City	8/10/2000	NP	0	0	0	Trees down.
Countywide	11/9/2000	NP	0	0	0	Trees down.
Countywide	11/9/2000	NP	0	0	0	Trees down.
Johnson City	6/29/2001	NP	0	0	0	Several trees down.
Fall Branch	6/29/2001	NP	0	0	20000	Tree fell on a house.
Gray	7/4/2001	NP	0	0	0	Trees down.
Countywide	7/8/2001	NP	0	0	0	Trees down.
Countywide	1/24/2002	NP	0	0	7000	A few trees down.
Johnson City	4/28/2002	NP	0	0	5000	Trees reported down along Highway 107 in the southeastern part of the county.
Countywide	7/3/2002	NP	0	0	20000	Several trees were reported down across the county.
Gray	7/4/2002	NP	0	0	10000	Several trees were reported down in and around Gray.

Johnson City	8/24/2002	NP	0	0	45000	A tree fell on a police cruiser and another fell on a house in Johnson City due to thunderstorm wind gusts.
not provided	2/3/2003	40	0	0	1000	Strong winds (with gusts up to 40 mph) associated with a band of showers caused numerous reports of fallen trees and power outages across east Tennessee.
Countywide	5/2/2003	60	0	0	10000	Numerous trees were reported down across the county.
Johnson City	6/11/2003	55	0	0	10000	A few trees were reported down in Johnson City and across the north half of the county.
Countywide	7/9/2003	60	0	0	0	Numerous trees and power lines reported down by sheriff's office.
Countywide	8/4/2003	60	0	0	0	Numerous trees reported down by 911 dispatch.
Limestone	8/17/2003	60	0	0	0	Several trees reported down by highway department.
Johnson City	8/28/2003	60	0	0	0	Numerous trees and power lines reported down by sheriff's office.
Spurgeon	8/28/2003	60	0	0	0	Power lines reported down by 911 dispatch near Boone Lake.
Gray	5/26/2004	65	0	0	10000	Several signs were blown down and large tree limbs were downed in Gray.
Johnson City	5/26/2004	65	0	0	20000	Numerous trees and power lines were reported down across the county.
Johnson City	5/31/2004	65	0	0	20000	Numerous trees were reported down in Johnson City.
Johnson City	7/5/2004	60	0	0	4000	One tree was reported down in Johnson City and another tree was downed in Grey.
Jonesboro	8/2/2004	50	0	0	2000	Small trees down on houses and power lines on old State Route 34 in Jonesborough.
Liberty	4/22/2005	65	0	0	3000	Several trees down in Liberty.
Johnson City	5/14/2005	60	0	0	15000	Several trees were reported down in Johnson City.
Johnson City	6/7/2005	65	0	0	18000	Numerous trees down countywide.
Jonesboro	6/27/2005	60	0	0	10000	Two trees down near Jonesboro.
Countywide	7/1/2005	60	0	0	30000	Numerous trees were reported down across the county.

Johnson City	7/28/2005	55	0	0	15000	A few trees and power lines were reported down on and in the vicinity of Cherokee Road.
Johnson City	7/28/2005	55	0	0	6000	Two tree were reported down.
Johnson City	7/28/2005	56	0	0	3000	Wind gust estimated at 65 mph.
Jonesboro	7/28/2005	60	0	0	30000	Numerous trees were reported down across the south half of the county.
Countywide	4/2/2006	60	0	0	10000	A few trees down. Reported by Washington County Power.
Fall Branch	4/17/2006	60	0	0	6000	A few trees down near Fall Branch.
Gray	4/25/2006	65	0	0	15000	Numerous trees down in Gray and Fall Branch area.
Jonesboro	5/18/2006	60	0	0	6000	Two trees were reported down near Jonesboro.
Johnson City	5/18/2006	57	0	0	3000	A 65 mph wind gust was measured at Johnson City.
Johnson City	5/20/2006	60	0	0	10000	A large tree and numerous limbs over four inches in diameter were reported down on power lines along highway 107.
Johnson City	5/26/2006	60	0	0	20000	Several trees were reported down across the county.
Jonesboro	5/26/2006	60	0	0	20000	Several trees were reported down across the southern part of the county.
Countywide	6/10/2006	60	0	0	8000	A few trees and limbs down on roads countywide.
Gray	7/4/2006	60	0	0	20000	Numerous trees were reported down in Gray and the surrounding area.
Countywide	8/29/2006	60	0	0	35000	Numerous trees and powerlines down across the northern half of the county. Three homes in Johnson City sustained roof damage. A small storage building was also destroyed.
Johnson City	9/28/2006	60	0	0	9000	Three trees were reported down at Johnson City.
not provided	12/1/2006	60	0	0	20000	Numerous trees down countywide.
Johnson City	4/3/2007	50	0	0	15000	Several trees and large limbs were reported down in the western part of Johnson City.
Johnson City	7/30/2007	60	0	0	0	One tree was reported down in Johnson City at the intersection of Mckinley and North streets. Several trees down across the west half of the county. This was reported by the sheriff's office.

Johnson City	3/4/2008	50	0	0	0	Three power poles were snapped and downed by strong thunderstorm winds.
Gray	6/9/2008	65	0	0	15000	Dispatch reported numerous trees downed by thunderstorm winds in Gray, Johnson City and the northern portion of the county.
Sulphur Springs	7/9/2008	55	0	0	0	A few trees were reported down five miles northwest of Jonesborough.
Johnson City	6/11/2009	60	0	0	20000	Law enforcement officials reported numerous trees and powerlines downed by thunderstorm winds from south of Jonesboro to Johnson City.
McKinley	6/16/2009	60	0	0	20000	Law enforcement personnel reported numerous trees downed by thunderstorm winds in the southeast half of the county.
Jonesboro	6/17/2009	60	0	0	20000	Law enforcement officials reported numerous trees downed by thunderstorm winds countywide.
Johnson City	6/18/2009	60	0	0	15000	Law enforcement personnel reported several trees and powerlines downed by thunderstorm winds countywide.
Little Cherokee	6/18/2009	55	0	0	8000	Law enforcement personnel reported several trees downed by thunderstorm winds in the Jonesborough area.
Little Cherokee	6/20/2009	55	0	0	8000	Law enforcement personnel reported several trees downed by thunderstorm winds southeast of Jonesboro.
Gladstone	7/9/2009	50	0	0	0	Several trees were reported down six miles west of Embreeville.
Crouch Crossroad	7/12/2009	50	0	0	0	A few trees were reported down.
Johnson City	8/16/2009	60	0	0	20000	Law enforcement personnel reported numerous trees downed by thunderstorm winds |in Johnson City.
not provided	12/2/2009	65	0	0	20000	Law enforcement officials reported numerous trees and a few powerlines downed by non-thunderstorm winds across the southern portions of the county.

not provided	12/9/2009	60	0	0	15000	Law enforcement personnel reported several trees downed by non-thunderstorm winds countywide.
not provided	12/9/2009	60	0	0	5000	Utility company personnel reported two trees downed by non-thunderstorm winds near Whitetop Mountain.
not provided	12/9/2009	60	0	0	25000	The Johnson City Press newspaper reported numerous trees and powerlines downed by non-thunderstorm winds countywide. Several homes and building were damaged.
not provided	12/25/2009	60	0	0	8000	Law enforcement officials reported several trees downed by non thunderstorm winds near Embreeville.
New Victory	5/15/2010	55	0	0	0	Two trees were reported down on Mayberry Road.
Washington College	5/16/2010	61	0	0	0	Weather spotter/Ham radio operator estimated thunderstorm winds between 50 and 55 mph with gusts between 65 and 70 mph six miles southwest of Jonesborough at Teleford.
LIMESTONE	5/16/2010	50	0	0	0	Several trees were reported down in Limestone and the surrounding area.
Fairview	5/16/2010	50	0	0	0	One tree was reported down on Yankee Camp Road.
Johnson City	5/28/2010	55	0	0	8000	A few trees and power lines were blown down by thunderstorm winds.
Johnson City	6/21/2010	60	0	0	12000	Law enforcement personnel reported numerous trees downed by thunderstorm winds countywide.
Bowmantown	7/28/2010	50	0	0	0	One tree was reported down across the road at the intersection of Harmony Road and Wheelock Road.
Fairview	8/12/2010	55	0	0	10000	Law enforcement personnel reported numerous trees downed by thunderstorm winds across the northern half of the county.
Johnson City	10/25/2010	60	0	0	100000	Johnson City Power Board reported that 19 utility poles and numerous power lines and trees were downed due to thunderstorm winds.
Johnson City	10/25/2010	60	0	0	10000	Coop observer reported numerous trees downed by thunderstorm winds in the Johnson City County Club area.

Johnson City	10/25/2010	60	0	0	50000	The Johnson City Press newspaper reported numerous trees downed by thunderstorm winds in Johnson City and across the remainder of the county. Many homes...buildings and businesses were also damaged by the wind.
not provided	2/1/2011	60	0	0	15000	Highway department personnel reported several trees downed by non-thunderstorm winds along the Nolichucky River in the foothills of the mountains.
not provided	2/25/2011	55	0	0	5000	Law enforcement personnel reported a few trees downed by non-thunderstorm wind in Johnson City.
not provided	2/25/2011	55	0	0	5000	Law enforcement personnel reported a few trees downed by non-thunderstorm wind in Jonesborough.
Jonesboro	4/9/2011	60	0	0	25000	Emergency manager personnel reported numerous large trees downed by thunderstorm wind along Head Town and John Frances Roads near Jonesborough. A roof of a barn was also blown off by the wind.
Johnson City	4/9/2011	60	0	0	15000	Amateur radio personnel reported trees and powerlines downed by thunderstorm wind near the Johnson City Medical Center.
Johnson City	4/25/2011	55	0	0	10000	Law enforcement personnel reported a few trees and powerlines downed by thunderstorm wind near Johnson City.
Johnson City	5/10/2011	55	0	0	0	Numerous trees and power lines were reported down.
Johnson City	5/26/2011	50	0	0	0	A few trees were reported down.
Jonesboro	6/5/2011	50	0	0	10000	Law enforcement personnel reported several trees downed by thunderstorm wind in Jonesborough.
Johnson City	6/5/2011	55	0	0	10000	Law enforcement personnel reported a tree downed on a car by thunderstorm wind in Johnson City.
Johnson City	6/5/2011	55	0	0	8000	Law enforcement personnel reported several trees and powerlines downed by thunderstorm wind in Johnson City.
Gray	6/21/2011	60	0	0	20000	Law enforcement personnel reported numerous trees downed by thunderstorm wind in Gray.

Johnson City	8/8/2011	50	0	0	2000	Law enforcement personnel reported a tree downed by thunderstorm wind in Johnson City.
Jonesboro	2/22/2012	52	0	0	8000	High department personnel reported several trees downed by thunderstorm wind near Jonesborough.
LIMESTONE	4/5/2012	52	0	0	8000	Law enforcement personnel reported several trees downed by thunderstorm wind on Conklin Road southeast of Limestone near Gladstone.
Johnson City	4/26/2012	50	0	0	5000	Law enforcement personnel reported a few trees downed by thunderstorm wind in Johnson City.
Johnson City	7/5/2012	60	0	0	0	Two large trees were reported down. The first occurred on Holston Avenue and was six feet in diameter and the second was on Unaka Road and was four feet in diameter.
Johnson City	7/5/2012	60	0	0	0	Numerous trees and power lines were reported down in Johnson City.
Johnson City	7/24/2012	50	0	0	0	One tree was reported down in Johnson City.
Fall Branch	7/31/2012	50	0	0	0	One tree was reported down in Fall Branch.
not provided	12/20/2012	60	0	0	25000	Dispatch personnel reported many trees downed by high wind countywide but mainly south toward Route 107 and around West View. A portable carport along Route 107 was also blown over by the wind.
not provided	12/26/2012	50	0	0	8000	Dispatch personnel reported 4 trees downed by high wind near Jonesborough.
not provided	2/10/2013	53	0	0	3000	The highway department reported a couple of trees downed by high wind in the county.
not provided	2/26/2013	55	0	0	3000	Dispatch personnel reported high wind downed a couple of trees around the foothills 2 miles north of Embreeville.
Jonesboro	5/21/2013	50	0	0	0	Many trees were reported down across the county.
Fall Branch	6/13/2013	50	0	0	8000	Law enforcement personnel reported several trees downed by thunderstorm wind in Falls Branch.

Johnson City	6/13/2013	56	0	0	2000	Amateur radio personnel reported an estimated thunderstorm wind gust of 65 mph (56 knots) in Johnson City.
Johnson City	6/13/2013	52	0	0	15000	Law enforcement personnel reported several trees downed on homes by thunderstorm wind in Johnson City. Trees also downed county wide.
not provided	4/7/2014	55	0	0	2000	Law enforcement personnel reported one large tree was downed by high wind 3 miles south of Johnson City near Dry Creek Road and Harvey Lane.
Leesburg	6/4/2014	50	0	0	5000	Dispatch reported a few trees downed by thunderstorm wind in Leesburg.
Jonesboro	6/10/2014	52	0	0	8000	Law enforcement personnel reported several trees downed by thunderstorms wind in Jonesborough.
Johnson City	6/19/2014	52	0	0	10000	Law enforcement personnel reported several trees downed by thunderstorm wind in Johnson City and elsewhere across the northern third of the county.
Boones Creek	7/8/2014	50	0	0	0	Trees were reported down near Boones Creek.
Johnson City	7/8/2014	50	0	0	0	A few trees were reported down in Johnson City.
Austin Springs	7/27/2014	87	0	0	0	A woman was seriously injured when her car was blown across four lanes of Bristol Highway as she tried to drive to work. Her car ended up in a ditch along the highway.
Fall Branch	7/13/2015	50	0	0	0	A privacy fence was blown over in a convective gust.
Johnson City	7/13/2015	50	0	0	0	Numerous trees were reported down across the entire county. Several county highways were blocked due to fallen trees.
Johnson City	8/5/2015	50	0	0	0	Several trees were downed and a railroad arm was also blown down. WJHL measured a wind gust of 56 mph during the event.
not provided	2/24/2016	60	0	0	0	A few trees were reported down in Gray. One of the trees fell onto a home.
Gray	7/8/2016	55	0	0	0	Several trees were downed along Crystal Springs Road in Gray.

Johnson City	7/8/2016	61	0	0	0	A roof was partially removed from a home at Camelot Circle in Johnson City.
Fall Branch	8/15/2016	50	0	0	0	A few trees were reported down.
Gray	8/15/2016	50	0	0	0	A roof was blown off a barn on Hog Hollow Road.
Limestone	8/16/2016	50	0	0	0	Four to five trees were blown down in Limestone.
Telford	8/16/2016	50	0	0	0	Trees and power lines were reported down in Telford.
Boones Creek	5/24/2017	50	0	0	0	Significant damage was reported at the Poplar Ridge apartments along highway 36. Several trees and power lines were reported down along with roof and fence damage.
not provided	10/23/2017	50	0	0	0	Several trees were reported down across the western part of the county.
Carnegie	3/17/2018	52	0	0	0	Wind gust was estimated at 60 mph three miles east southeast of Johnson City at King Springs and Dave Buck Roads.
Gray	3/17/2018	50	0	0	0	A few trees were reported down near Gray.
Fall Branch	9/9/2018	50	0	0	0	A few trees were down near Fall Branch.
Jonesboro	11/6/2018	50	0	0	0	Several trees were reported down in Jonesboro and Embreeville.
Y Section	5/18/2019	50	0	0	0	A tree and a power line was reported down near Buffalo Mountain State Park.
Embreeville Junction	5/18/2019	50	0	0	0	A tree and power line was reported down on College Heights Road.
Oakland	5/18/2019	50	0	0	0	A tree was reported down on a mobile home along Oakland Road.
Telford	6/20/2019	55	0	0	0	Several trees were reported down across the county.

The committee shared their personal experiences of severe storm events that have occurred in Washington County and Johnson City. The following is transcribed from their thoughts.

- Limbs, trees, etc. will fall on roads and most of the time, they come from private property. By law, County employees are not allowed on private property. And, there are no laws in place to allow the County to force property owners to take care of the problem.
- April 2011 – Tornado occurred in South Central community. During this event, there was one death and several injuries of which 2 to 3 were substantial injuries. Death may be recorded as the Horse Creek on the slide [NCDC data].
- I responded to the tornado in 2011 with command trailer and equipment to search for people. I saw areas we needed to improve equipment and transport.
- Opened school buildings for shelter.
- There has been more damage by winds then noted. During wind events, there has been several trees that damage homes that are not noted.

Washington County uses a ranking system to determine each jurisdiction's vulnerability to severe storm events (with a focus on tornadoes). This system is based off simple arithmetic which analysis's potential impacts to determine vulnerabilities and then analyzes the probability of a severe storm event occurring to calculate a risk ranking for each jurisdiction.

Jurisdiction	Impacts			Vulnerability
	Human	Property	Business	H+P+B=#; #/3=V
Washington County Unincorporated	3.11	3.89	1.89	2.96
Town of Jonesborough	3.00	3.38	2.00	2.79
Johnson City	2.89	3.44	1.89	2.74

Jurisdiction	Vulnerability	Probability	Risk V+P=R
Washington County Unincorporated	2.96	3.11	6.07
Town of Jonesborough	2.79	2.50	5.29
Johnson City	2.74	2.56	5.30

Scale	
Low	2-3.6
Moderate	3.7-5.2
Medium	5.3-6.8
High	6.9-8.4
Severe	8.5-10

Human	
Risk of injuries and deaths from the hazard	
1	Death very unlikely, injuries are unlikely
2	Death unlikely, injuries are minimal
3	Death unlikely, injuries may be substantial
4	Death possible, injuries may be substantial
5	Deaths probable, injuries will likely be substantial

Property	
Amount of residetial property damage associated from the hazard	
1	Less than $500 in damages
2	$500-$10,000 in damages
3	$10,000-$500,000 in damages
4	$500,000-$2,000,000 in damages
5	More than $2,000,000 in damages

Business	
Amount of business damage associated from the hazard	
1	Less than 3 businesses closed for only a day
2	More than 3 businesses closed for a week
3	More than 3 businesses closed for a few months
4	More than 3 businesses closed indefinitly or relocated
5	A top-10 local employer closed indefinitly

Probability	
Likelihood of the hazard occurring within a given span of years	
1	Less than once every 10 years
2	About once every 5-10 years
3	About once every 2-5 years
4	About once a year
5	More than once a year

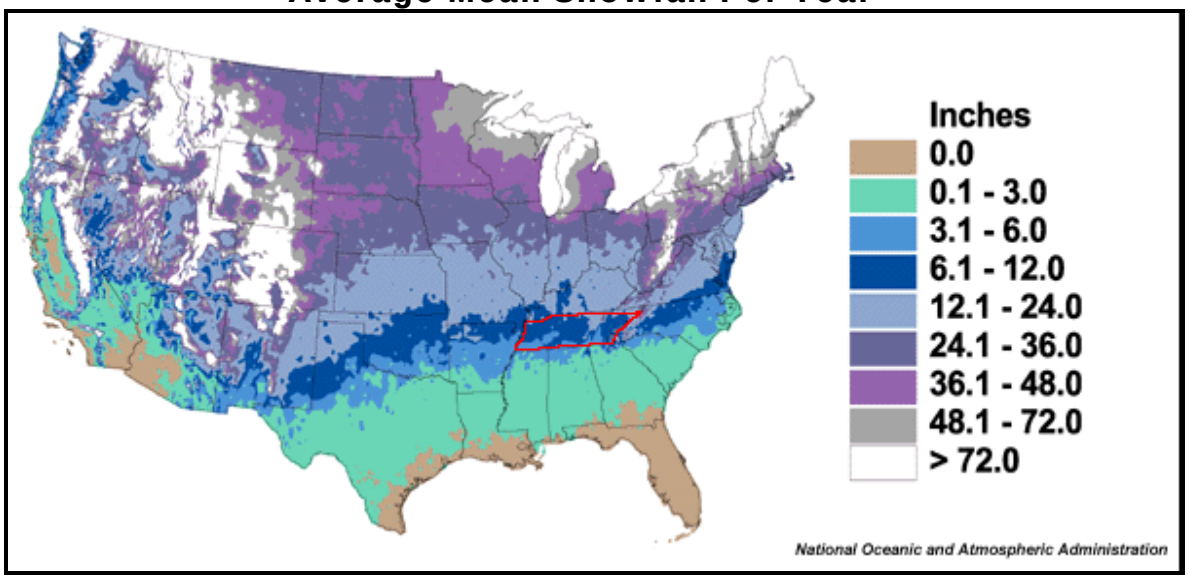
Freezes/Winter Storms

A freeze occurs when temperatures are below 32 degrees Fahrenheit for a period of time. These temperatures can damage agricultural crops, burst water pipes, and create layers of "black ice." Winter storms are events that can range from a few hours of moderate snow to blizzard-like circumstances that can affect driving conditions and impact communications, electricity, and other services. In Washington County, all jurisdictions are vulnerable to freezes and moderate winter storms, but not to the severity level seen in much of the northern U.S.

Based on previous occurrences, Washington County can experience multiple winter weather events in one year.

The severity of winter storms is commonly measured by inches of snowfall. It is possible for snowfall to accumulate up to 12 inches in Washington County and/or ice accumulations to cause for hazardous conditions. The average mean snowfall per year in Washington County is between 6 to 12 inches (as seen on the map below).

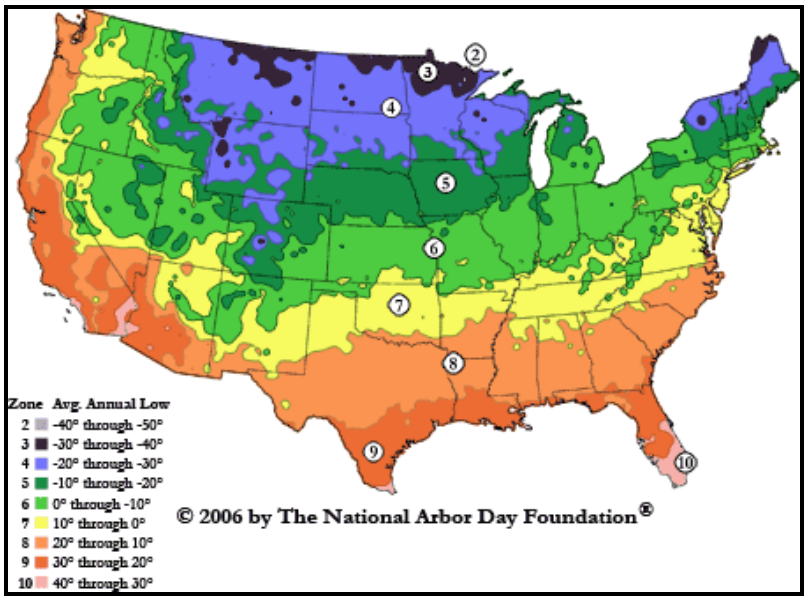
Average Mean Snowfall Per Year



Source: NOAA

Washington County can experience temperatures between 15 to 5 degrees Fahrenheit, thus causing multiple freeze conditions during the winter months (see the following map for other average lows).

Average Annual Low Temperatures



Source: NOAA

The following chart provides winter storm event information for Washington County between 1950 and 2020. The following information was obtained by accessing the NOAA database. https://www.ncdc.noaa.gov/stormevents/. This information represents all the events and extent of the Winter Weather hazard experienced by Washington County, including the jurisdictions located within, and is the only source of data accessible. The information provided for Washington County also applies to the school district due to the geographic distribution of the schools throughout the County.

Winter Storm Impacts in Washington County: 1950 - 2020

Date	Deaths	Injuries	Property Damage	Extent/Impact Description
1/6/1996	0	0	0	A strong low pressure system from the Gulf Coast region brought up to one foot of snow to parts of East Tennessee. Numerous trees and power lines fell. Many roads became impassable shutting down schools and businesses across the area. There were also isolated incidents of collapsed roofs.
1/11/1996	0	0	0	Heavy snow accumulations of 4 to 8 inches caused numerous power outages and car accidents. Numerous trees fell as well. Schools and businesses were closed.
2/2/1996	0	0	0	Washington 10-12 inches of snow.
12/18/1996	0	0	0	A strong upper level disturbance brought heavy snow showers to the area resulting in widespread icy roads and hazardous driving conditions. Across northeast Tennessee, amounts were generally between 1 and 2 1/2".
1/10/1997	0	0	0	3-5 inches in northeast Tennessee.
12/30/1997	0	0	0	A series of fast-moving upper level disturbances caused heavy snow shower activity across East Tennessee. Amounts were generally 2 to 5"
1/27/1998	0	0	1000000	Heavy snow fell throughout most of northeast Tennessee. Most snowfall totals ranged from 5 to 10 inches. The heavy wet snow resulted in numerous power outages in northeast Tennessee, with as many as 100,000 people with out power at one point.
12/22/1998	0	0	0	The ice storm left minor accumulations of ice in valley locations due to warm ground temperatures. Most of the ice was on trees and bridges. Most roads were only wet. In higher elevations, the ice was much heavier.
1/6/1999	0	0	0	Generally less than 2 inches of snow fell across East Tennessee, resulting in numerous school closings and traffic accidents.
3/13/1999	0	0	0	Heavy rain began early Saturday morning, changed to heavy snow in some places during the day Saturday, back to rain Saturday night, then finally to snow Sunday night. There were also isolated reports of freezing rain. The snow was confined to northeast Tennessee, generally northeast of Knoxville. Rainfall amounts across much of East Tennessee was 1-2 inches. Snowfall amounts in northeast Tennessee averaged 1-3 inches.

1/22/2000	0	0	0	Generally 2-4 inches of snow fell across central and northeast portions of East Tennessee.
12/2/2000	0	0	0	In northeast Tennessee, snowfall amounts averaged 1 to 3 inches, with a few spots in the mountains reporting 2 to 4 inches.
12/18/2000	0	0	0	Widespread light snow fell across East Tennessee. Amounts in counties in the valley generally ranged from 1 to 2 inches. In the higher mountain elevations, amounts were a bit higher, averaging 2 to 4 inches.
1/1/2001	0	0	0	Amounts were generally 1/2 inch to 2 inches. There were a few isolated reports of 3 inches, mainly near the mountains.
1/20/2001	0	0	0	1 to 3 inches fell in the higher elevations of the mountain counties from Johnson County in the northeast to Monroe County in the southeast. A few spots received around 4 inches. Across the remainder of East Tennessee, amounts were under 1 inch.
1/5/2002	0	0	0	Across northeast Tennessee, amounts average between a dusting and a half inch.
1/5/2003	0	0	0	Widespread snows over northern East Tennessee...and all of the mountain regions brought 4 to 6 inches of snow between 4 A.M. and noon.
1/16/2003	0	0	0	Snowfall amounts ranging from 2 to 8 inches across eastern Tennessee. The higher accumulations were concentrated across extreme northeast sections of the state.
1/22/2003	0	0	0	Snowfall amounts ranged from 2 to 5 inches in the lower elevations while higher elevations across the region picked up totals ranging from 5 to 8 inches.
1/25/2004	0	0	0	1/10-1/4 inch ice accumulation
2/15/2004	0	0	0	4-8 inches of snow was reported...mainly across the higher elevations. 1-3 inches fell across the lower elevations of the Tennessee Valley.
2/26/2004	0	0	0	no information
1/29/2005	0	0	0	Mixture of freezing rain and sleet across the lower elevations and a mixture of sleet and snow across the higher terrain. Much of the region ended up with ice accumulation around one quarter inch with some locations measuring as much as one half inch of ice. Trees and power lines were downed across parts of the region due to ice accumulation.
2/11/2006	0	0	0	4 to 6 inch snowfall amounts across much of the area.
12/18/2009	0	0	0	Law enforcement personnel reported 4 to 6 inches of snow fell across the county.

1/29/2010	0	0	0	Six to eight inches of snow was reported across the county.
12/16/2010	0	0	20000	Law enforcement personnel reported freezing rain produced 0.50 inches of ice on the roads in Johnson City along with 1 to 2 inches of snow.
12/26/2010	0	0	0	Mesonet reported 6 inches of snow fell near Jonesborough.
1/17/2013	0	0	0	Snowfall of 4.1 inches was reported two miles south southwest of Jonesborough.
1/17/2013	0	0	0	Snowfall of 4.2 inches was reported one mile east of Gray.
1/17/2013	0	0	0	Four inches of snow was reported at Johnson City.
3/5/2013	0	0	0	One to two inches of snow was reported across the county.
2/12/2014	0	0	0	The public reported 5 inches of snow fell 5 miles east-northeast of Limestone in Telford.
2/12/2014	0	0	0	The public reported 5 inches of snow fell in Johnson City.
2/12/2014	0	0	0	A CoCoRaHS site reported 5.5 inches of snow fell 2 miles south-southwest of Jonesborough.
2/13/2014	0	0	0	CoCoRaHS observation reported 11.5 inches of snow fell 3 miles south-southwest of Jonesborough.
11/1/2014	0	0	0	Two miles south southwest of Jonesborough at an elevation of 1700 feet snowfall depth was estimated at 3.7 inches.
11/1/2014	0	0	0	Three miles northeast of Johnson City snowfall depth was estimated at 3.5 inches.
2/16/2015	0	0	0	A trained spotter reported 6 inches of snow fell in Jonesborough.
2/16/2015	0	0	0	Dispatch personnel reported 1 inch of sleet fell in Johnson City.
2/17/2015	0	0	0	Emergency manager personnel reported 5 inches of snow fell in Gray.
2/17/2015	0	0	0	Emergency manager personnel reported freezing rain produced 0.50 inches of ice accretion in Gray.
2/26/2015	0	0	0	A trained spotter recorded 4 inches of snow in Gray.
2/26/2015	0	0	0	A trained spotter recorded 5.5 inches of snow in Gray.
2/26/2015	0	0	0	The public recorded 5 inches of snow in Jonesborough.
1/20/2016	0	0	0	Four inches of snow was reported at Gray.
1/20/2016	0	0	0	Five inches of snow was reported five miles north of Johnson City.
1/20/2016	0	0	0	A snowfall total of 5 inches was reported three miles east southeast of Gray.
1/22/2016	0	0	0	A snowfall total of 8 inches was reported at Fall Branch.
1/22/2016	0	0	0	A snowfall total of 7 inches was reported at Leesburg.

1/22/2016	0	0	0	A snowfall total of 5 inches was reported at Jonesborough.
2/14/2016	0	0	0	Snow depth was measured at 3.2 inches six miles northwest of Johnson City.
1/6/2017	0	0	0	A snowfall total of 6.5 inches was measured at Johnson City.
1/6/2017	0	0	0	A snowfall total of 6.5 inches was measured at Jonesborough.
3/12/2018	0	0	0	Four inches of snow was reported at Jonesborough.
3/12/2018	0	0	0	Six inches of snow was reported across the northern part of the county.
12/9/2018	0	0	0	Eight inches of snow was reported 4 miles east southeast of Gray.
12/9/2018	0	0	0	Four and a half inches of snow was reported 2 miles east of Gray.
12/9/2018	0	0	0	Three inches of snow was reported at Gray.
12/9/2018	0	0	0	Three inches of snow was reported at Gray.
12/9/2018	0	0	0	Four inches of snow was reported 3 miles east southeast of Johnson City.
12/9/2018	0	0	0	Six and a half inches of snow was reported at Fall Branch.
12/9/2018	0	0	0	Eleven inches of snow was reported one mile north northeast of Gray.
12/9/2018	0	0	0	Four inches of snow was reported one mile east southeast of Johnson City.
12/9/2018	0	0	0	Eleven inches of snow was reported one mile north northeast southeast of Gray.

The following past event information was brought forward from the 2011 plan, “The landmark winters of the nineteenth century were in 1835 and 1898. February 5, 1835 was called “Cold Friday” because so many cattle and hogs froze to death that day. The most arduous blizzard seasons of the twentieth century were those of 1945, 1951, and 1993. In March of 1993 the “Storm of the Century” struck the eastern half of the state, killing 18 people and causing $18 million in damage.”

The committee shared their personal experiences of winter weather events that have occurred in Washington County and Johnson City. The following is transcribed from their thoughts.

- The biggest issue with winter weather has been associated with I-26. I have personally been stuck forever working 8 hours on crashes. The main issue seems to be west of the Gray area.
- Winter storm 12/24 – I-26 [interstate] standstill
- I-26 is extremely hazardous with snow that sticks to the roadway. Snow does not occur often but it can be bad for travelers when it does.
- Transmission lines down – loss of power for 22 hours (1990s). Ice and cold temperatures in 1990s made transportation and deliveries of essentials and fuel from outside the area difficult.
- Most damage occurs when trees are down.

Washington County uses a ranking system to determine each jurisdiction’s vulnerability to freezes/winter storm events. This system is based off simple arithmetic which analysis’s potential impacts to determine vulnerabilities and then analysis’s the probability of a freeze/winter storm event occurring to calculate a risk ranking for each jurisdiction.

Jurisdiction	Impacts			Vulnerability
	Human	Property	Business	H+P+B=#; #/3=V
Washington County Unincorporated	2.00	2.43	1.29	1.90
Town of Jonesborough	1.67	2.50	1.17	1.78
Johnson City	1.57	2.43	1.43	1.81

Jurisdiction	Vulnerability	Probability	Risk V+P=R
Washington County Unincorporated	1.90	3.57	5.48
Town of Jonesborough	1.78	3.33	5.11
Johnson City	1.81	3.43	5.24

Scale	
Low	2-3.6

Moderate	3.7-5.2
Medium	5.3-6.8
High	6.9-8.4
Severe	8.5-10

Human	
Risk of injuries and deaths from the hazard	
1	Death very unlikely, injuries are unlikely
2	Death unlikely, injuries are minimal
3	Death unlikely, injuries may be substantial
4	Death possible, injuries may be substantial
5	Deaths probable, injuries will likely be substantial

Property	
Amount of residetial property damage associated from the hazard	
1	Less than $500 in damages
2	$500-$10,000 in damages
3	$10,000-$500,000 in damages
4	$500,000-$2,000,000 in damages
5	More than $2,000,000 in damages

Business	
Amount of business damage associated from the hazard	
1	Less than 3 businesses closed for only a day
2	More than 3 businesses closed for a week
3	More than 3 businesses closed for a few months
4	More than 3 businesses closed indefinitly or relocated
5	A top-10 local employer closed indefinitly

Probability	
Likelihood of the hazard occurring within a given span of years	
1	Less than once every 10 years
2	About once every 5-10 years
3	About once every 2-5 years
4	About once a year
5	More than once a year

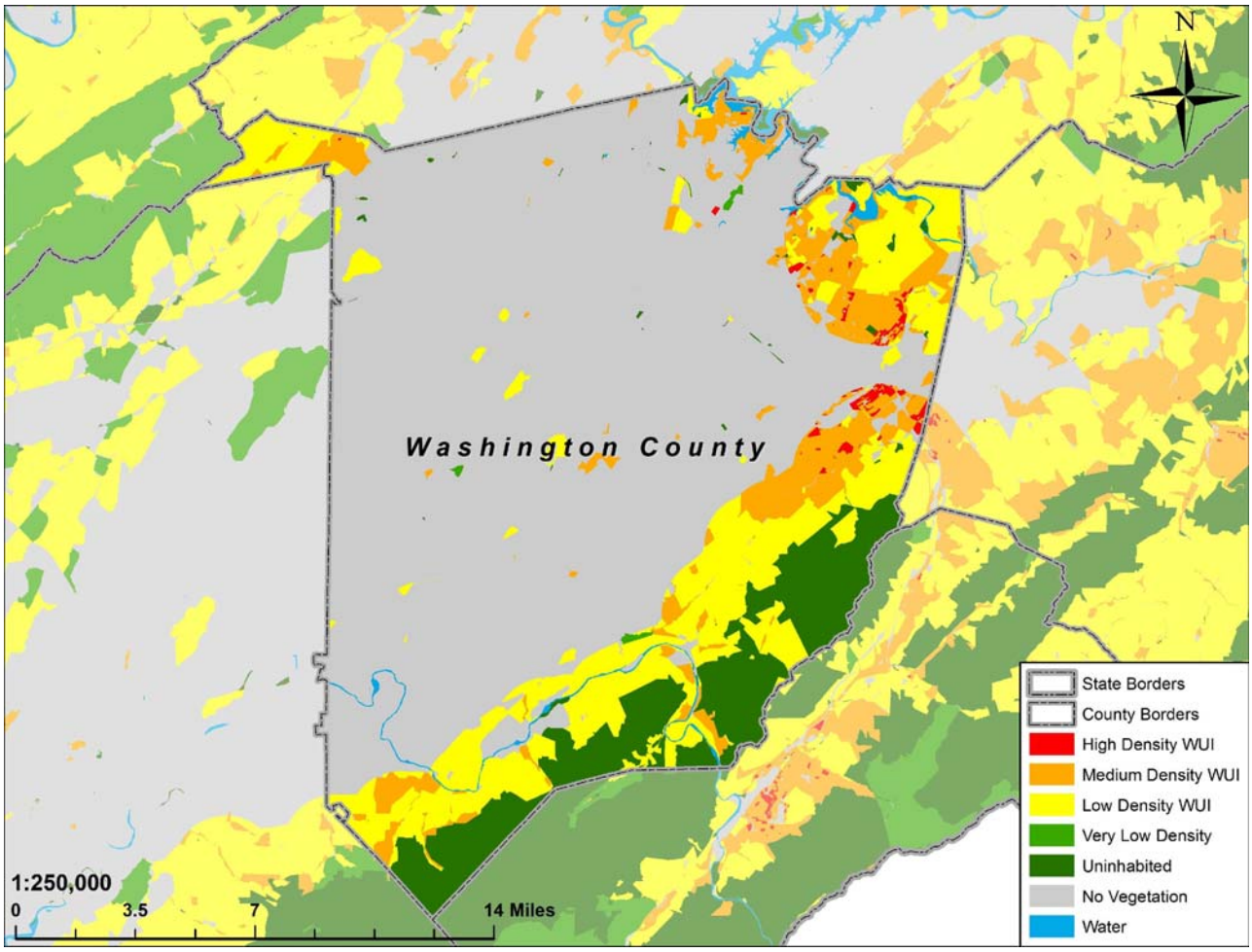
Wildfire

There are very few news reports of Wildfires occurring in Washington County. As reported by wjlh.com on April 13, 2018, an out of control 3 acre brush fire destroyed cars, outbuildings, grass and trees as a result of dry conditions. One man was displaced from his home.

As reported by johnsoncitypress.com on November 14, 2016, there were numerous fires across East Tennessee causing heavy smoke conditions in the Tri Cities area causing for health concerns. There were multiple brush fires in Washington County. All these incidents were made worse by drought conditions.

In the eastern portion of Washington County, there are portions that are uninhabited or very low density with a lot of vegetation. The remaining parts of the County mostly no vegetation.

Many fires occur in grassland areas such as yards and pastures. When the conditions are right, all these areas become vulnerable to devastating wildfires. Below is the Wildland Urban Interface for Washington County.



According to the TN Division of Forestry, debris burning and arson are the two main causes of wildfires. Generally, there are three major factors that sustain wildfires and allow for predictions of a given area's potential to burn. These factors include:

- Fuel;
- Topography; and
- Weather.

Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree needles, twigs, and

branches to dead standing trees, live trees, brush, and cured grasses. Man-made structures and other associated combustibles are also to be considered as a fuel source. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for spreading wildfires.

An area's topography (terrain and land slopes) affects its susceptibility to wildfire spread. Fire intensities and rates of spread increase as slope increases due to the tendency of heat from a fire to rise via convection and radiation. The natural arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes

Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out the fuels that feed the wildfire creating a situation where fuel will more readily ignite and burn more intensely. Wind is the most treacherous weather factor. The issue of drought conditions contributes to concerns about wildfire vulnerability.

East Tennessee typically has two fire seasons. The spring fire season, prompted by warming weather, begins about February 15 and ends near May 15th, when the forest has "greened up". Fall fire season begins around October 15, when the leaves begin to fall and usually ends December 15th due to shorter, cooler, wetter days. Still, wildland fires occur year round. A burning permit is required for outdoor burning between October 15th and May 15th.

The committee did not provide any feedback in reference to personal experiences.

Washington County is located in the East TN District of the TN Division of Forestry. The TN Division of Forestry provides statistics for each region summarizing wildfire events. Due to outside data sources including federal and state land, causing confusion in wildfire data, the TN Division of Forestry will always remain the only source for Counties within the

State of Tennessee for information. It is not the responsibility of Washington County to mitigate federal or state land. Hopefully, in the future, a more defined dataset can be provided. At this time, this is the only information Washington County is able to obtain that is consistent and confirmed. Below are the statistics for Washington County from 2007 to 2016. These statistics also provide extent of the Wildfire Hazard. For Area, the total number of acres for the East TN District is 6,245,119.29. The percentage is calculated by taking the percentage and calculating the total area by percentage within the entire district. Size is calculated by total number of acres divided by total number of fires.

Year	# of Fires Forested	# of Fires Non-Forested	Total	# of Acres Forested	# of Acres Non-Forested	Total	Size	Area
2016	1	1	2	0.5	0.1	0.6	0.3	0.000
2015	2	2	4	0.1	1.2	1.3	0.3	0.000
2014	12	4	16	378.4	55.8	434.2	27.1	0.002
2013	0	2	2	0.0	5.0	5.0	2.5	0.000
2012	2	1	3	5.1	1.3	6.4	2.1	0.000
2011	2	0	2	40.4		40.4	20.2	0.000
2010	1	0	1	15.0		15.0	15.0	0.000
2009	4	0	4	4.9		4.9	1.2	0.000
2008	6	0	6	81.5	0.0	81.5	13.6	0.000
2007	7	1	8	613.0	0.3	613.3	76.7	0.002

Brought forward from the 2011 plan: ” Buffalo Mountain Park is a 725-acre natural resource area obtained in a land swap with the U.S. Forest Service in 1994. The park is located on the North Slope of Buffalo Mountain and consists of steep topography and densely forested land. The park functions as a nature preserve primarily for hiking, picnicking, and nature programs. In May 2008, during the drought that we experience in this area for about two years, a wildfire erupted on the top of Buffalo Mountain. The fire involved about 100 acres on top of Buffalo Mountain. The fire started in the National Forest and spread quickly to the park area run by the City of Johnson City. The fire lasted for days and was finally extinguish by the U.S. Forestry Service along with mutual aid agencies. The City of Johnson City’s public safety communications towers are located on top of Buffalo Mountain and were also in danger of being damaged by the fire.”

The committee provided input on the Wildfire hazard for the County and Johnson City. The following are their thoughts.

- Johnson City – not an issue.
- City of Johnson City can be impacted by wildfires outside the cooperate limits due to water supply.

Washington County uses a ranking system to determine each jurisdiction's vulnerability to wildfire events. This system is based off simple arithmetic which analyzes potential impacts to determine vulnerabilities and then analyzes the probability of a wildfire event occurring to calculate a risk ranking for each jurisdiction.

Jurisdiction	Impacts			Vulnerability
	Human	Property	Business	H+P+B=#; #/3=V
Washington County Unincorporated	2.50	3.25	1.38	2.38
Town of Jonesborough	1.57	1.86	1.00	1.48
Johnson City	1.56	2.00	1.11	1.56

Jurisdiction	Vulnerability	Probability	Risk V+P=R
Washington County Unincorporated	2.38	2.13	4.50
Town of Jonesborough	1.48	2.14	3.62
Johnson City	1.56	2.11	3.67

Scale	
Low	2-3.6
Moderate	3.7-5.2
Medium	5.3-6.8
High	6.9-8.4
Severe	8.5-10

Presidential Disaster Declarations

The source of this information came from https://www.fema.gov/disasters. All disasters included in the table below that were provided on this website.

FEMA DR	Date	Hazard				PA	IA
1974	5/1/2011	Severe Storms	Tornadoes	Straight Line Winds	Flooding	yes	yes
3095	3/14/1993	Winter Storm				yes	no
3217	9/5/2005	Hurricane Katrina				yes	no
366	5/15/1972	Heavy Rains	Flooding			yes	Yes
544	11/12/1977	Severe Storms	Flooding			yes	Yes
1387	8/15/2001	Severe Storms	Flooding			yes	Yes
1197	1/13/1998	Severe Storms	Flooding			yes	Yes

Section 4: Mitigation Strategy

Mitigation Goals

The purpose for developing a set of Goals is to clearly state the community's overall vision for hazard mitigation and to provide a path towards building a safer, more resilient community. The Washington County Hazard Mitigation Committee identified the following goals to be the forefront in the overall development of this plan. All actions/projects recommended as mitigation efforts for the Hazard Mitigation Plan must first meet or further at least one of these goals**.** The goals are provided in a ranked order where the first goal is paramount.

Goal 1: Protect the lives and health of citizens from the effects of natural hazards.

Goal 2: Emphasize mitigation planning to decrease vulnerability of existing and new structures.

Goal 3: Encourage public support and commitment to hazard mitigation, by communicating mitigation benefits.

Identification and Prioritization of Mitigation Projects

Washington County has developed a comprehensive range of mitigation projects. These projects were solicited and identified by the different entities whom make up the Washington County Hazard Mitigation Committee. Once the proposed projects attained a sponsoring agency and the details of the projects were discussed by the committee, the committee then proceeded to prioritize the mitigation projects.

The prioritization process was important since most mitigation projects represent a large investment of financial and personal resources. By evaluating each project's degree of feasibility and the level of costs versus benefits, Washington County was able to determine when and which projects should be implemented based on available funding and time.

The Washington County Hazard Mitigation Committee used the SAFE-T method to prioritize these projects. This approach was adopted from the successful methodology used by other counties in FEMA Region 4. This rating system uses five variables to evaluate the overall feasibility and appropriateness: Societal, Administrative, Financial, Environmental, and Technical. A focus on this methodology emphasizes the use of a cost-benefit review to maximize benefits.

Project Prioritization Method: SAFE-T			
	Variable	Value	Description
S	**Societal**: The public must support the overall implementation strategy and specified mitigation actions. The projects will be evaluated in terms of community acceptance and societal benefits.	1	Low community priority, few societal benefits
		2	Moderate community acceptance/priority
		3	High community acceptance/priority
A	**Administrative**: The projects will be evaluated for anticipated staffing and maintenance requirements to determine if the jurisdiction has the personnel and administrative capabilities necessary to implement the project or whether outside help will be needed.	1	High staffing, outside needed
		2	Some staffing, help may be needed
		3	Low staffing, no outside help needed
F	**Financial**: The projects will be evaluated on their general cost-effectiveness and whether additional outside funding will be required.	1	Somewhat cost-effective
		2	Moderately cost-effective
		3	Very cost-effective
E	**Environmental**: The projects will be evaluated for any immediate or long-term environmental impacts caused by their construction or operation.	1	Many environ. impacts, possibly long-term
		2	Some environ. Impacts, some possibly long-term
		3	Few, if any, environ. impacts
T	**Technical**: The projects will be evaluated on their ability to reduce losses in the long-term, whether there are secondary impacts, and whether the proposed project solves the associated problem or if additional components are necessary.	1	Other actions are needed or short-term fix
		2	Other actions may be needed for long-term fix
		3	Other actions not needed, long-term fix

Committee members ranked the projects as a group by determining the value for each variable and then by adding the variables rates up for a project sum value. All the project rankings can be seen on the Washington County Hazard Mitigation Project List. Also, the committee tally for the rating of each project is in the following table.

Action No.	Action Title	Hazard Rated Priority		Social	Administrative	Financial	Environmental	Technical	Total
1	Public Education and Awareness Program	5		2.6	2.3	2.5	2.7	2.3	2.5
2	Improving Codes/Policies to increase long term resilience	8		2.3	2.2	2.4	2.3	2.2	2.3
3	Bury above ground power lines	12		2.1	1.3	1.6	1.6	2.1	1.7
4	Conduct watershed studies to determine which watersheds and/or subwatershed areas may need additional storm water detention requirements or where regional flood control facilities would be effective. Amend the development of regulations as	11		2.1	1.8	2.3	2.0	1.8	2.0
5	Conduct watershed studies for each municipality's watersheds and update mappings of existing storm water systems.	10		2.1	1.9	2.1	1.9	1.9	2.0
6	Floodwater and rain gauges	3		2.0	2.2	2.2	2.7	2.1	2.3
7	Buy-out flood prone properties	9		2.1	1.9	2.1	1.9	2.2	2.0
8	Water/sewer facility flood proofing	6		2.2	2.2	2.2	2.0	2.2	2.2
9	Generators for utilities	2		2.4	2.5	2.6	2.5	2.5	2.5
10	Generators for critical facilities and infrastructure	1		2.4	2.4	2.6	2.6	2.5	2.5
11	911 Window reinforcement	4		2.1	2.3	2.2	2.7	2.4	2.4
12	Study flood prone areas	7		1.8	2.1	2.3	2.3	2.0	2.1

Washington County Project List

The following Project List provides an overview of all the Washington County Hazard Mitigation Committee projects. This includes potential funding sources, implementation timeframes, the project's responsible agency, and other information. This list is to remain active and updated.

Washington County and Johnson City Project List

Hazard Mitigated	Project #	Washington County (Unincorporated) Action/Project Name	Priority Rank	Addresses New or Existing Buildings/Infra?	Responsible Agency	Possible Funding Source(s)	Timeframe
Flooding	7	Buy out flood prone properties	9	Existing	County Commission	HMGP, PDM	1-5 years
	12	Study of Flood Prone Areas	7	Existing	EMA	HMGP, PDM	1-5 years
	8	Water/Sewer facility flood proofing	6	Existing	Water/Sewer	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long-term resilience	8	Existing/New	County Commission	HMGP, PDM	1-5 years
	4	Conduct watershed studies to determine which watersheds and/or sub-watershed areas may need additional storm water detention requirements or where regional flood facilities would be effective. Amend the development regulations as necessary.	11	Existing/New	Water/Sewer	HMGP, PDM	1-5 years
	5	Conduct watershed studies for each municipality's watersheds and update mappings of existing storm water systems.	10	Existing/New	TVA	HMGP, PDM	1-5 years
	6	Floodwater and rain gauges	3	New	EMA	HMGP, PDM	1-5 years
	1	Public Education and Awareness Program	5	existing	EMA	HMGP, PDM	1-5 years
Tornado/Severe Storms (Hail, Wind)	9	Generator for utilities	2	Existing	Department Heads	HMGP, PDM	1-5 years
	10	Generators for critical facilities	1	Existing	County Commission	HMGP, PDM	1-5 years

	11	911 Window reinforcement	4	Existing	911 Board/911 Director	HMGP, PDM	1-5 years
	3	Bury above ground power lines	12	existing	Brightridge	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long term resilience	8	existing	County Commission	HMGP, PDM	1-5 years
	1	Public Education and Awareness Program	5	Existing	EMA	HMGP, PDM	1-5 years
Winter Weather	9	Generator for utilities	2	Existing	Department Heads	HMGP, PDM	1-5 years
	10	Generators for critical facilities	1	Existing	County Commission	HMGP, PDM	1-5 years
	11	911 Window reinforcement	4	Existing	911 Board/911 Director	HMGP, PDM	1-5 years
	3	Bury above ground power lines	12	Existing	Brightridge	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long term resilience	8	existing	County Commission	HMGP, PDM	1-5 years
	1	Public Education and Awareness Program	5	Existing	EMA	HMGP, PDM	1-5 years
Wildfires	1	Public Education and Awareness Program	5	existing	Fire Departments	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long term resilience	8	existing	Fire Departments	HMGP, PDM	1-5 years

Hazard Mitigated	Project #	Johnson City (Unincorporated) Action/Project Name	Priority Rank	Addresses New or Existing Buildings/Infra?	Responsible Agency	Possible Funding Source(s)	Timeframe
Flooding	7	Buy out flood prone properties	9	Existing	City Commission	HMGP, PDM	1-5 years
	12	Study of Flood Prone Areas	7	Existing	EMA	HMGP, PDM	1-5 years
	8	Water/Sewer facility flood proofing	6	Existing	Water/Sewer	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long-term resilience	8	Existing/New	City Commission	HMGP, PDM	1-5 years
	4	Conduct watershed studies to determine which watersheds and/or sub-watershed areas may need additional storm water detention requirements or where regional flood facilities would be effective. Amend the development regulations as necessary.	11	Existing/New	Public Works	HMGP, PDM	1-5 years
	5	Conduct watershed studies for each municipality's watersheds and update mappings of existing storm water systems.	10	Existing/New	Public Works	HMGP, PDM	1-5 years
	6	Floodwater and rain gauges	3	New	Public Works	HMGP, PDM	1-5 years
	1	Public Education and Awareness Program	5	existing	EMA	HMGP, PDM	1-5 years
Tornado/Severe Storms (Hail, Wind)	9	Generator for utilities	2	Existing	City Commission	HMGP, PDM	1-5 years
	10	Generators for critical facilities	1	Existing	City Commission	HMGP, PDM	1-5 years
	3	Bury above ground power lines	12	existing	Brightridge	HMGP, PDM	1-5 years

	2	Improving Codes/Policies to increase long term resilience	8	existing	City Commission	HMGP, PDM	1-5 years
	1	Public Education and Awareness Program	5	Existing	EMA	HMGP, PDM	1-5 years
tWinter Weather	9	Generator for utilities	2	Existing	City Commission	HMGP, PDM	1-5 years
	10	Generators for critical facilities	1	Existing	City Commission	HMGP, PDM	1-5 years
	3	Bury above ground power lines	12	Existing	Brightridge	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long term resilience	8	existing	City Commission	HMGP, PDM	1-5 years
	1	Public Education and Awareness Program	5	Existing	EMA	HMGP, PDM	1-5 years
Wildfires	1	Public Education and Awareness Program	5	existing	Fire Department	HMGP, PDM	1-5 years
	2	Improving Codes/Policies to increase long term resilience	8	existing	Fire Department		

Notes:

The Code of Federal Regulations in reference to plan development requires 2 projects per hazard per jurisdiction. This may be helpful because projects may repeat across hazards.

The timeframe was determined based on the required revision schedule of this plan which gives the committee the full 5 years to focus on these efforts.

Acronym definition – HMGP (Hazard Mitigation Grant Program), FMA – Flood Mitigation Assistance, PDM (Pre-Disaster Mitigation), EMA (Emergency Management Agency), TVA (Tennessee Valley Authority)

Project List Update

The Washington County Hazard Mitigation Planning Committee reviewed the actions/projects in the 2010 plan. The following are the committee's decisions surrounding the 2010 projects.

The initial review decided the following projects were preparedness, therefore, removed.

- Continue to participate in awareness campaigns such as Severe Weather Awareness Week and Earthquake Awareness Week (Countywide).
- Routine trimming of branches/vegetation near power lines and structures (Countywide).
- Work with National Weather Service and the Community to see that the community receives winter weather advisories (Countywide).
- Work with the community and promote the purchase and installation of S.A.M.E. compliant weather radios within the homes of the citizens of Washington County (Countywide).
- Pursue additional fire training (Countywide).
- Pursue additional wildland fire fighting training (Countywide).
- Washington County Volunteer Fire Departments work in cooperation with government agencies overseeing wildland fire protection strategies (Countywide).
- Incident Command Training for all public safety entities within Washington County (Countywide).
- Train Washington County, City of Johnson City, and the Town of Jonesborough technical staff to use the GIS in conjunction with the HAZUS-MH system.
- Train personnel from the municipalities with information needed to include them in the HAZUS-MH system.
- Through the proposed storm water fee, municipalities shall employ a Storm Water Manager and maintenance crew to perform routine inspections of the storm water systems and make necessary repairs to ensure the system is clear of debris and flowing properly.

The following actions/projects were determined to be required hazard mitigation planning elements and not projects, therefore, removed.

- Record all structures within existing floodplains, as well as areas of repetitive losses due to flooding.

All projects listed under Hazardous Materials were removed because it's not a natural hazard.

All projects under the hazard Earthquake were removed because this is no longer a hazard of prime concern.

The following action/project was brought forward to the 2020 plan but generalized and will be considered for the Public Education and Awareness Program (a project listed in this plan update).

- Continue to public articles in the local newspapers to increase public awareness of the risks associate with natural hazards that are prevalent to Washington County and all incorporated areas within.
- Encourage businesses and private property owners to adopt appropriate mitigation actions to existing and new construction.
- Educate property owners on affordable, individual mitigation and preparedness measures that can be performed on existing as well as new construction.
- Provide information on tools, partnership opportunities, and funding sources to assist in implanting mitigation activities.
- Continue School Education programs
- Community awareness in fire prevention procedures related to urban wildland fire interfaces.
- Ensure Washington County and all municipalities understand they must remain in good standing with NFIP to be eligible for any mitigation funding and for residents to be able to obtain flood insurance.
- Ensure local citizens are aware that flood insurance is available to all residents of Washington County through their local insurance agency.

The committee has reviewed the following 2010 projects and will consider them as part of the overall improvement of codes/polices to increase long-term resilience program (a project listed in this plan update).

- Work with local governments to see that they have adequate warning technologies in place to warn them of impending severe weather.
- Adopt and promote low impact development regulations to help reduce downstream flooding due to development and improve water quality at the same time.
- Prohibit development within flood hazard areas.
- Adopt a storm water utility fee to provide funding source to help fund future storm water projects.
- Review/Revise local building codes
- Institute/review open burning policies.
- Continue to participate in NFIP and not issue any new building permits within the 100 year flood plain unless they meet the requirements of the flood plain regulations.

The 2010 project, “Work with utility companies to implement underground power lines when and where feasible” was brought forward to the 2020 plan but re-worded to read, “Bury above ground power lines.”

The following 2010 projects were brought forward to the 2020 plan:

- Conduct watershed studies to determine which watersheds and/or sub-watershed areas may need additional storm water detention requirements or where regional flood control facilities would be effective. Amend the development regulations as necessary.
- Conduct watershed studies for each municipality's watersheds and update mappings of existing storm water systems.
- Floodwater and rain gauges

The following project for Johnson City was removed due to other priorities, "Buy property upstream of the flooding areas in Downtown Johnson City to construct a regional detention pond and/or remove buildings over the existing creeks to restore a natural floodplain to reduce the potential for flooding of buildings and streets in the downtown area of Johnson City."

National Flood Insurance Program Compliance

The National Flood Insurance Program (NFIP) is a pre-disaster flood hazard mitigation and insurance protection program which has reduced the increasing cost of disasters. The intent of the program is to: require new and substantially improved structures be designed and constructed to minimize or eliminate future flood damage; provide floodplain residents and business owners with financial insurance assistance in the form of insurance after floods; and it transfers most of the cost of private property flood losses from the taxpayers to floodplain property owners through flood insurance premiums. Participation in the NFIP is based on an agreement between communities and FEMA.

Currently, Washington County unincorporated, the Town of Jonesborough and Johnson City are NFIP participants. FEMA has listed these three jurisdictions to have a current effective map date as of 9/29/2006.

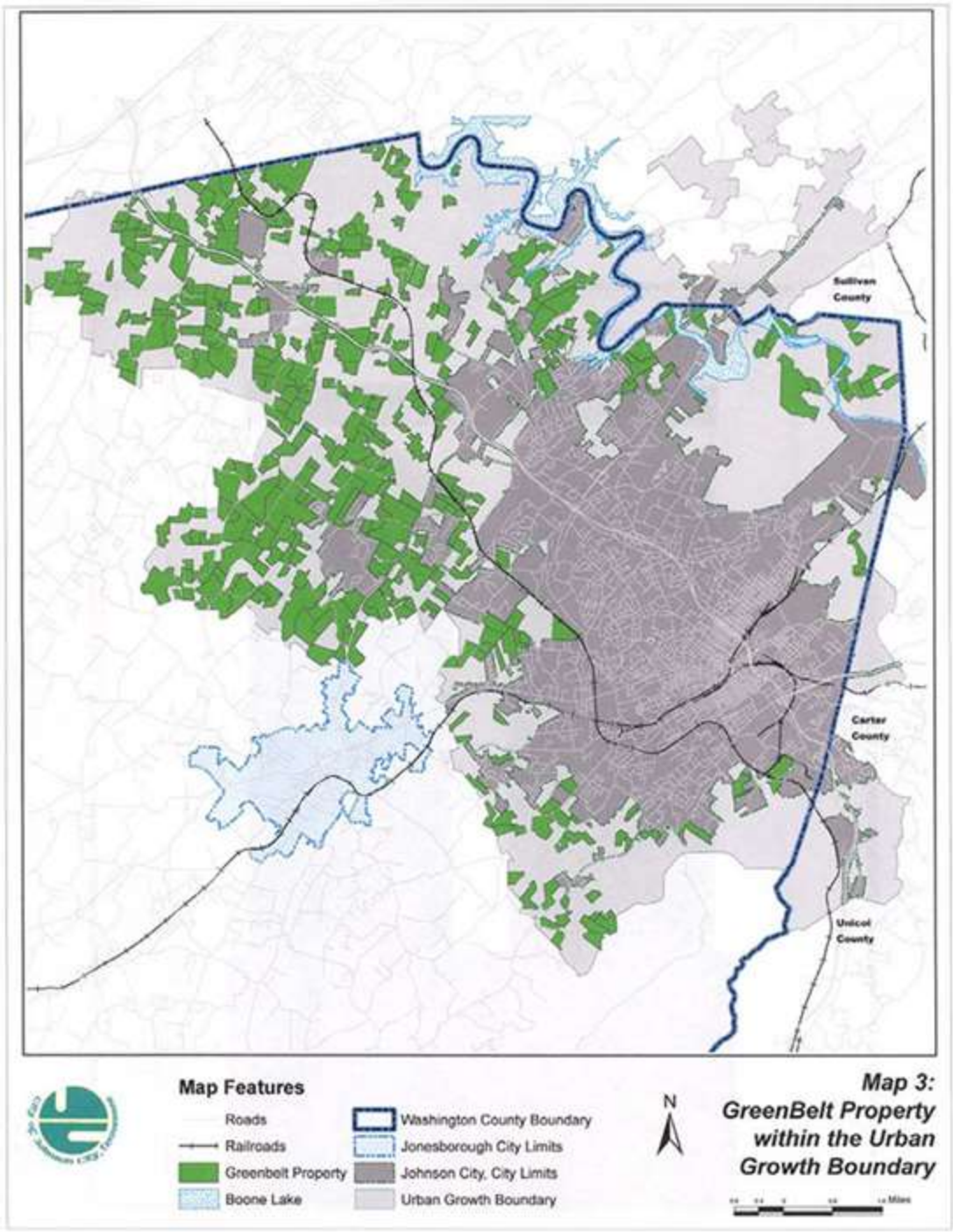
Unfortunately, there are several issues with the NFIP as it pertains to Johnson City. The below outlines these issues and a lengthy attempt was made in 2018/2019 to resolve with no resolution. This information is presented here in case future issues appear surrounding this issue.

Johnson City is located in Washington, Carter and Sullivan Counties. However, the NFIP Policy information has all of Johnson City located in Carter County as illustrated below.

Policy Statistics
Tennessee
AS OF 06/30/2018

County Name	Community Name	Policies In-force	Insurance In-force whole $	Written Premium In-force
VAN BUREN COUNTY	VAN BUREN COUNTY *	21	4,300,200	18,718
WARREN COUNTY	MCMINNVILLE, CITY OF	19	3,907,300	20,315
	VIOLA, TOWN OF	1	105,000	362
	WARREN COUNTY*	30	4,856,700	25,226
WASHINGTON COUNTY	JONESBOROUGH, TOWN OF	13	2,166,900	13,418
	WASHINGTON COUNTY *	73	15,570,500	45,303
WAYNE COUNTY	CLIFTON, CITY OF	12	1,832,800	9,427
	WAYNE COUNTY *	47	6,502,900	40,483
	STEWART COUNTY *	47	9,873,400	30,417
SULLIVAN COUNTY	BLUFF CITY, TOWN OF	1	16,500	290
	BRISTOL, CITY OF	60	14,090,300	100,494
	SULLIVAN COUNTY *	139	27,648,500	125,269
SUMNER COUNTY	GALLATIN, CITY OF	239	71,179,300	184,182
	HENDERSONVILLE, CITY OF	397	113,948,800	258,006
	HUNTINGDON, TOWN OF	26	4,269,200	31,333
	MCKENZIE, TOWN OF	5	1,011,500	5,818
CARTER COUNTY	CARTER COUNTY *	263	34,064,700	282,710
	ELIZABETHTON, CITY OF	102	18,367,700	119,470
	JOHNSON CITY, CITY OF	200	48,816,800	275,710
	WATAUGA, CITY OF	1	500,000	9,245
CHEATHAM COUNTY	ASHLAND CITY, TOWN OF	174	48,922,400	180,408

The following image shows Johnson City, which is a part of the Washington County Hazard Mitigation Plan, boundary map. Johnson City is located in Washington, Carter, and Sullivan Counties.



The following page provides details about policies within Washington County and all jurisdictions within. The below is a description of each column.

Adjuster Expense	The total amount paid to adjusters for all claims within the community and/or county. It includes all special expenses, allocated loss adjusted expense, and allocated ICC expense.

Building Coverage	Building coverage for a policy or claim (whole dollars)
Building Payments	The total amount paid for all losses for building,
Community Name	The official NFIP name of the community in which the claim or policy exists.
Community Number	The 6 character community ID in which the claim or policy exists.
Contents Coverage	Contents coverage for a policy or claim (whole dollars)
Contents Payments	The total amount paid for all losses for contents
County Name	The official FIPS county name for the claim or policy. It is determined by geocoding of the policy or claim address, rather than the historical method of using the community to look up the county.
Data as of Date	The date of the most recent validated data upon which the report is based.
ICC Coverage	ICC coverage for a policy or claim (whole dollars)
ICC Payments	The total amount paid for all losses for ICC
Number of Losses	The number of losses (claims) reported within that community and/or county.
State	The state in which the policy or claim exists. The value is determined by the geocoded data first, and in the absence of geocoding, by the community state.
Total Policy Count	The total number of policies reported within the community and/or county in force as of the given date. All condo units are counted for each condo master policy.
Total Premium and Policy Fee	The policy premium and associated policy fee for the policies.
WYO or Direct	An indicator of whether the policy or claim is administered by NFIP Direct ("Direct") or a Write-Your-Own Company ("WYO")

Because of the issues presented above, the following NFIP information includes Washington and Carter Counties.

Community Name (Number)	County	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
CARTER COUNTY * (470024)	CARTER COUNTY	$ 46,676	$ 198,740	$ 245,416	65	176	241	$ 8,628	$ 23,230	$ 31,858	50	89	139	$ 389,065	$ 806,012	$ 1,195,077	$ 82,117
ELIZABETHTON, CITY OF (475425)	CARTER COUNTY	$ 17,173	$ 96,598	$ 113,771	18	76	94	$ 3,042	$ 13,346	$ 16,388	31	25	56	$ 91,252	$ 120,748	$ 211,999	$ 25,169
CARTER COUNTY * (470024)	WASHINGTON COUNTY	$ -	$ 1,764	$ 1,764	-	1	1	$ -	$ 143	$ 143	-	3	3	$ -	$ 4,200	$ 4,200	$ 750
ERWIN, CITY OF (470094)	WASHINGTON COUNTY	$ -	$ -	$ -	-	-	-	$ -	$ -	$ -	1	-	1	$ -	$ -	$ -	$ 150
JOHNSON CITY, CITY OF (475432)	WASHINGTON COUNTY	$ 45,985	$ 243,061	$ 289,046	19	169	188	$ 4,190	$ 43,774	$ 47,964	36	55	91	$ 395,810	$ 2,834,726	$ 3,230,536	$ 109,682
JONESBOROUGH, TOWN OF	WASHINGTON COUNTY	$ 7,496	$ 8,699	$ 16,195	5	9	14	$ 867	$ 1,613	$ 2,480	6	2	8	$ 7,626	$ 3,234	$ 10,860	$ 1,858

(470198)																	
WASHINGTON COUNTY * (470265)	WASHINGTON COUNTY	$ 6,293	$ 45,137	$ 51,430	16	65	81	$ 3,086	$ 14,065	$ 17,151	3	23	26	$ 44,086	$ 250,146	$ 294,231	$ 24,733

Community Name (Number)	County	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
JOHNSON CITY, CITY OF (475432)	UNKNOWN	$ -	$ -	$ -	-	-	-	$ -	$ -	$ -	1	-	1	$ -	$ -	$ -	$ 63
JOHNSON CITY, CITY OF (475432)	WASHINGTON COUNTY	$ 45,985	$ 243,061	$ 289,046	19	169	188	$ 4,190	$ 43,774	$ 47,964	36	55	91	$ 395,810	$ 2,834,726	$ 3,230,536	$ 109,682
JONESBOROUGH, TOWN OF (470198)	WASHINGTON COUNTY	$ 7,496	$ 8,699	$ 16,195	5	9	14	$ 867	$ 1,613	$ 2,480	6	2	8	$ 7,626	$ 3,234	$ 10,860	$ 1,858
WASHINGTON COUNTY * (470265)	WASHINGTON COUNTY	$ 6,293	$ 45,137	$ 51,430	16	65	81	$ 3,086	$ 14,065	$ 17,151	3	23	26	$ 44,086	$ 250,146	$ 294,231	$ 24,733

According to the National Flood Insurance Program, repetitive flood loss is defined as a facility or structure that has experienced two or more insurance claims of at least $1,000 in any given 10 year period since 1978. Within the NFIP, repetitive flood loss properties are usually considered the most vital structures to mitigate. According to FEMA databases, Washington County has multiple repetitive and several repetitive loss properties. It's important to note the following information may be in reference to another County. However, because of the confusion within NFIP, it was decided to go ahead and place this information here.

- Washington County has 3 residential (single family) repetitive loss or severe repetitive loss properties.
- Johnson City has 7 other/nonresidential and 5 (2 to 4 family, single family, or condo) residential repetitive loss or severe repetitive loss properties. It is important to note NFIP lists these properties as all being in Carter County but in fact are located in Washington County.
- Town of Jonesborough has 1 residential (single family) repetitive loss or severe repetitive loss property.

To continue compliance with the NFIP, the jurisdictions have identified, analyzed, and prioritized three mitigation strategies to stay active with the program.

1. Continue to evaluate improved standards that are proven to reduce flood damage.
2. Maintaining supplies of FEMA/NFIP materials to help homeowners evaluate measures to reduce damage.
3. Maintaining a map of areas that flood frequently and prioritizing those areas for inspection immediately following heavy rains or flooding event.

Section 5: Plan Maintenance

Monitoring, Evaluating, and Updating

The Washington County Hazard Mitigation Committee is designated to monitor and evaluate the mitigation plan. This committee is chaired by Washington County Emergency Management who leads the monitoring, evaluating, and updating process.

Monitoring activities will involve Washington County Emergency Management setting up a committee meeting to be held on an annual basis. Washington County Emergency Management will prepare a brief annual report of the meeting's findings by addressing mitigation progress and shortfalls within the county.

The plan is to be evaluated annually and after any significant disaster causing human, infrastructure, and property losses. Following each annual informal evaluation of the plan by emergency management staff, any proposed revisions or recommendations will be brought before the Mitigation Committee to be incorporated into the plan. Potential updates to the plan will address changes to the hazard assessment, the critical facilities list, the repetitive loss list, the committee membership list, and the project priority list.

The plan will be formally updated every five years in accordance to 44 CFR 201.6(d)3, which states that the plan shall be reviewed, revised, and resubmitted for approval within five years to continue eligibility for HMGP grant funding. For the five-year update, Washington County Emergency Management will notify the jurisdictional governments and the Washington County Hazard Mitigation Committee approximately one year prior to the plan's expiration date. The review of the plan will include updating the planning process, the hazard profiles, the risk assessment, the vulnerability assessment, the mitigation strategies, and the plan maintenance descriptions.

The five-year plan update will also include soliciting other interested persons/agencies to join the Mitigation Committee and a review of what has been accomplished in the past 5 years. The Washington County Hazard Mitigation Committee's goal is to have at least 5 meetings within this time span; dates, public notices, and objectives for these meetings will be determined by Washington County Emergency Management.

Five months prior to the plan's expiration date, Washington County Emergency Management will submit the revised plan to the Tennessee Emergency Management Agency for preliminary review. Upon approval by the state, TEMA will submit the updated plan to FEMA for review.

Once Washington County has attained the designation of the plan's approval pending adoption, each jurisdiction will adopt the plan through a resolution within a year.

Incorporation into Planning Mechanisms

By incorporating the Washington County Hazard Mitigation Plan into other planning documents and mechanisms, information contained in the mitigation plan can help fill-in missing gaps in existing documents, can contribute to already existing mitigation-based projects, and can create a strengthen stance of mitigation implementation and awareness within the county and its jurisdictions.

Some of the mechanisms that the Washington County Hazard Mitigation Plan could be incorporated into include:

- Washington County Basic Emergency Operations Plan
- East Tennessee State University Hazardous Mitigation Planning
- Washington County Floodplain Planning
- City of Johnson City Floodplain Planning
- Town of Jonesborough Floodplain Planning
- Washington County Zoning Planning and Review
- Town of Jonesborough Zoning, Planning and Review
- City of Johnson City Zoning, Planning and Review

The process of incorporating the hazard mitigation plan into other plans will begin during the other plan's update cycles. Washington County Emergency Management will first review the plans side-by-side, and where deemed necessary, Emergency Management will make notes on how mitigation concepts and actions can be incorporated into the other plans. These recommendations will be submitted to the lead agencies of the other planning mechanisms for them to place relevant information within the documents.

Continued Public Participation

The Washington County Mitigation Committee will strive to involve the public in future mitigation activities. This will be accomplished by continuing to post Mitigation Committee Meeting dates in the local newspaper, by attempting to have a public mitigation meeting once a year, by providing public access to copies of the Washington County Hazard Mitigation Plan in the local emergency management office, and by soliciting other interested persons to participate in the mitigation planning process. By implementing these methods, the public will have an opportunity to comment on the plan during the update drafting stage and prior to plan approval.

Appendix 1

Attendance Sheets

Hazard Mitigation Planning Meeting

26 FEB 2020

Name	Organization	Email	Contact Number
Vicki S. McGuchen	COJC W-S Services	VMcGuchen@johnsoncitytn.org	97526
Charles A. Baines	Washington County Fire	cbaines@washingtoncountytn.org	423-833-7149
Allen Kyker	Washington Co Sheriff	AKyker@wcso.net	423-753-1414
Michelle Klein	TEMA	michelle.c.klein@tn.gov	865-594-5652
Trip Voss	TEMA	john.voss@tn.gov	615-815-8116
Lesley Musick	911	lesley.musick@wc911.org	423 979 1508
Brian Rice	J.C.P.D	brice@johnsoncitytn.org	423-483-5878
Eric Dougherty	J.C.P.D	edougherty@johnsoncitytn.org	423-483-5580
EA Herndon	Unicoi Co.	[illegible]	423 743-4912

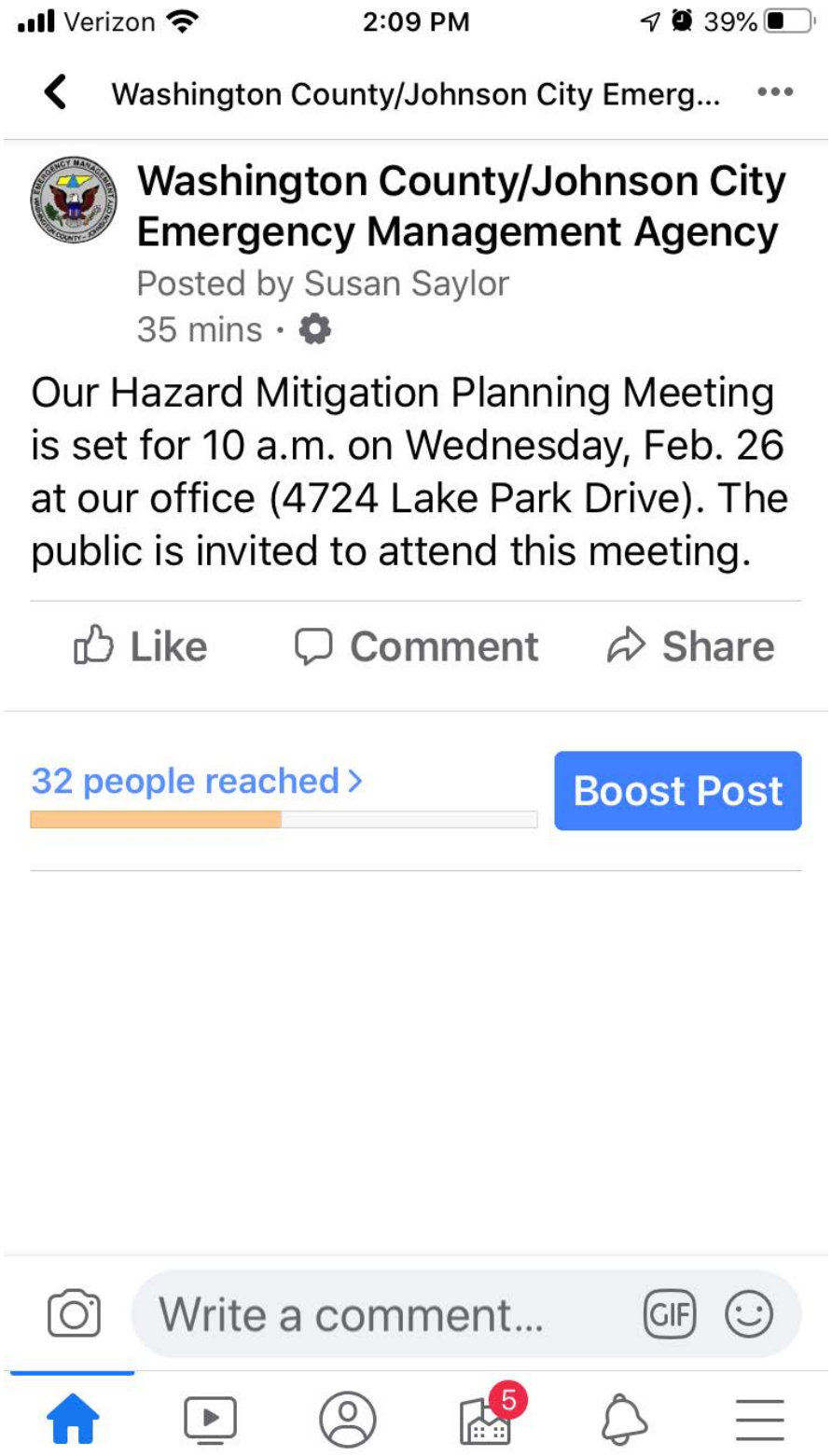
Hazard Mitigation Planning Meeting

26 FEB 2020

Name	Organization	Email	Contact Number
Phillip Patrick	Washington County Dept. of Ed.	ppatrick@washcoed.org	423-926-1100
Glenn K Berry	Johnson City MPO	glenn.berry@jcmpo.org	434-6272
Angie Charles	Wash Co	acharles@washingtoncountytn.org	753-1852
Doug Jones	W.C.H.D.	djones@washingtoncountytn.org	753-1714
Evan Clay Burn	WC/JC EMA	EClayBurn@washingtoncountytn.org	491-7293
Green Wallace	JC Schools	WallaceG@JCSchools.org	423.741-4371
Rusty Sells	WC/JC EMA	rsells@washingtoncountytn.org	423-434-6082

Appendix 2


Verizon
2:10 PM
38%
Tweet
WCJCEMA
@WCJC_EMA
Our Hazard Mitigation Planning Meeting is set for 10 a.m. on Wednesday, Feb. 26 at our office (4724 Lake Park Drive). The public is invited to attend this meeting.
1:54 PM · 1/31/20 · Twitter Web App
Tweet your reply
20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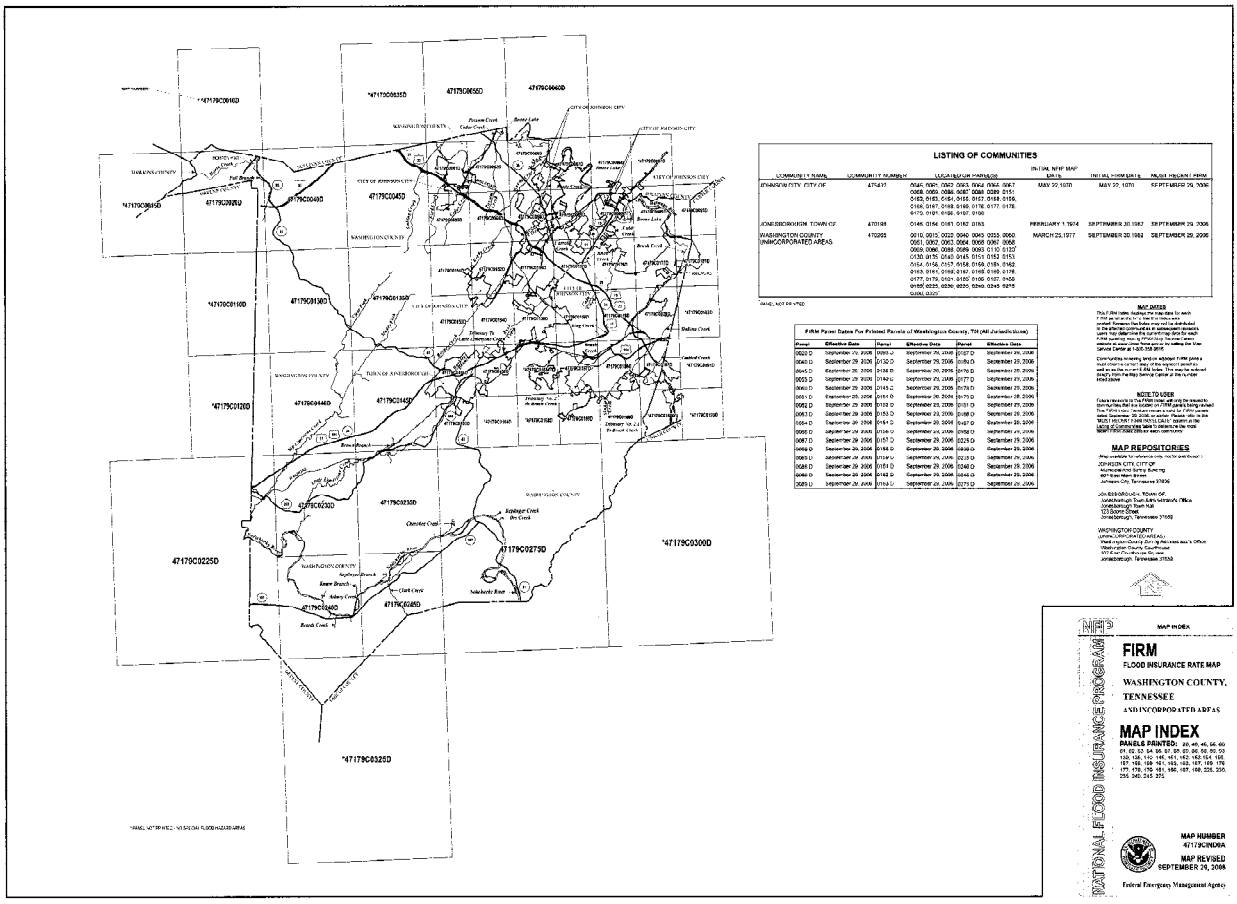
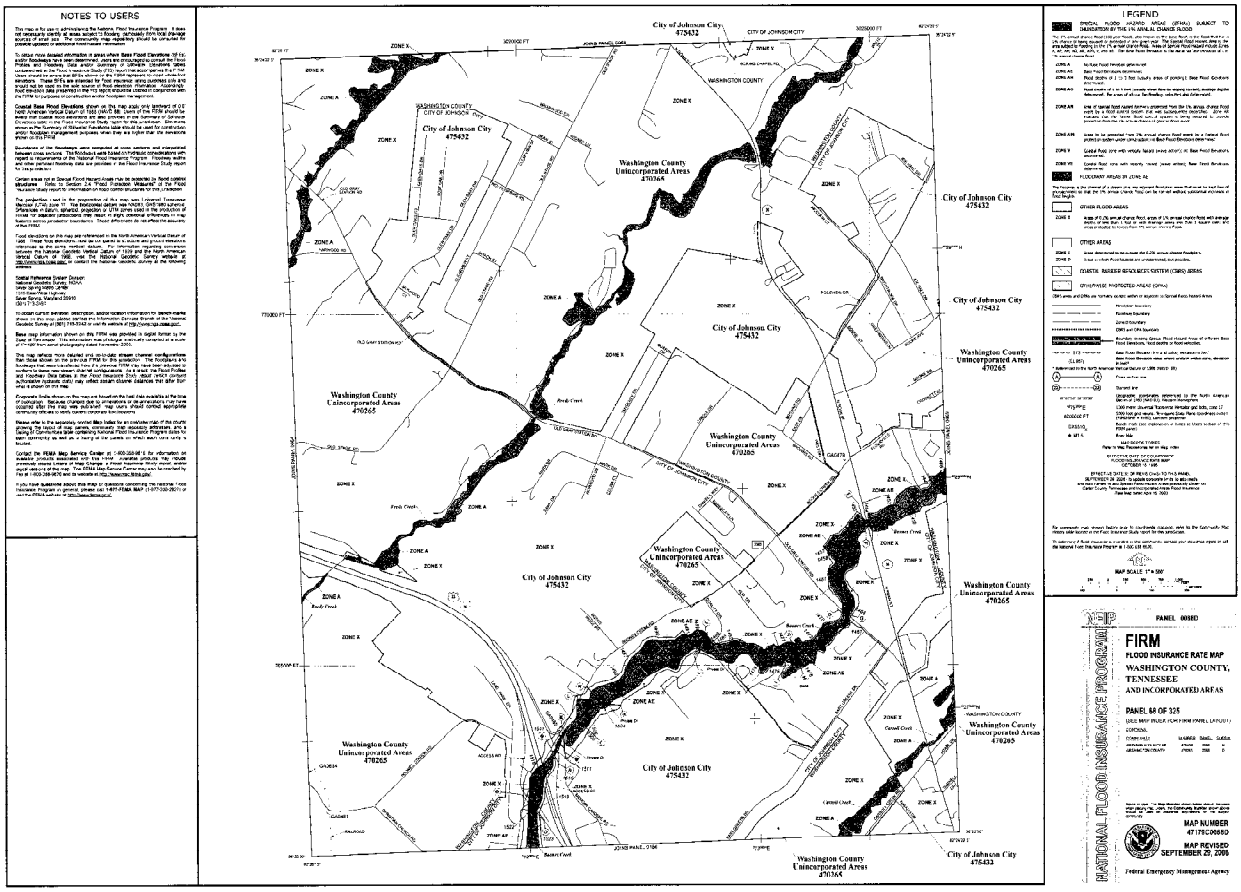
2:09 PM
39%
Washington County/Johnson City Emerg...
Washington County/Johnson City Emergency Management Agency
Posted by Susan Saylor
35 mins
Our Hazard Mitigation Planning Meeting is set for 10 a.m. on Wednesday, Feb. 26 at our office (4724 Lake Park Drive). The public is invited to attend this meeting.
Like
Comment
Share
32 people reached
Boost Post
Write a comment...
GIF
5

Appendix 3

Flood Insurance Rate Maps for Washington County

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475432
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Unincorporated Areas
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NATIONAL FLOOD INSURANCE PROGRAM
FIRM
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WASHINGTON COUNTY,
TENNESSEE
AND INCORPORATED AREAS
PANEL 68 OF 325
MAP NUMBER
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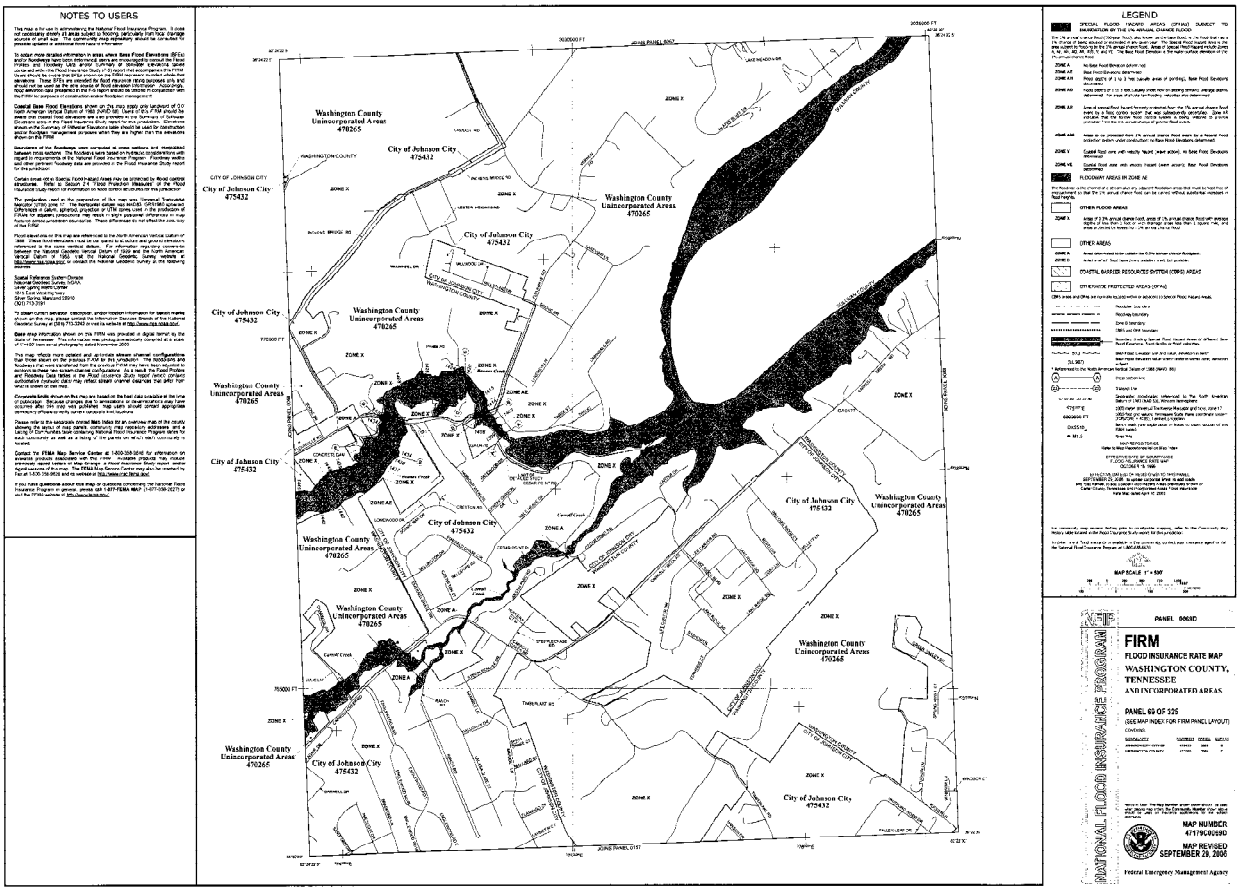
MAP REVISED
SEPTEMBER 29, 2006
Federal Emergency Management Agency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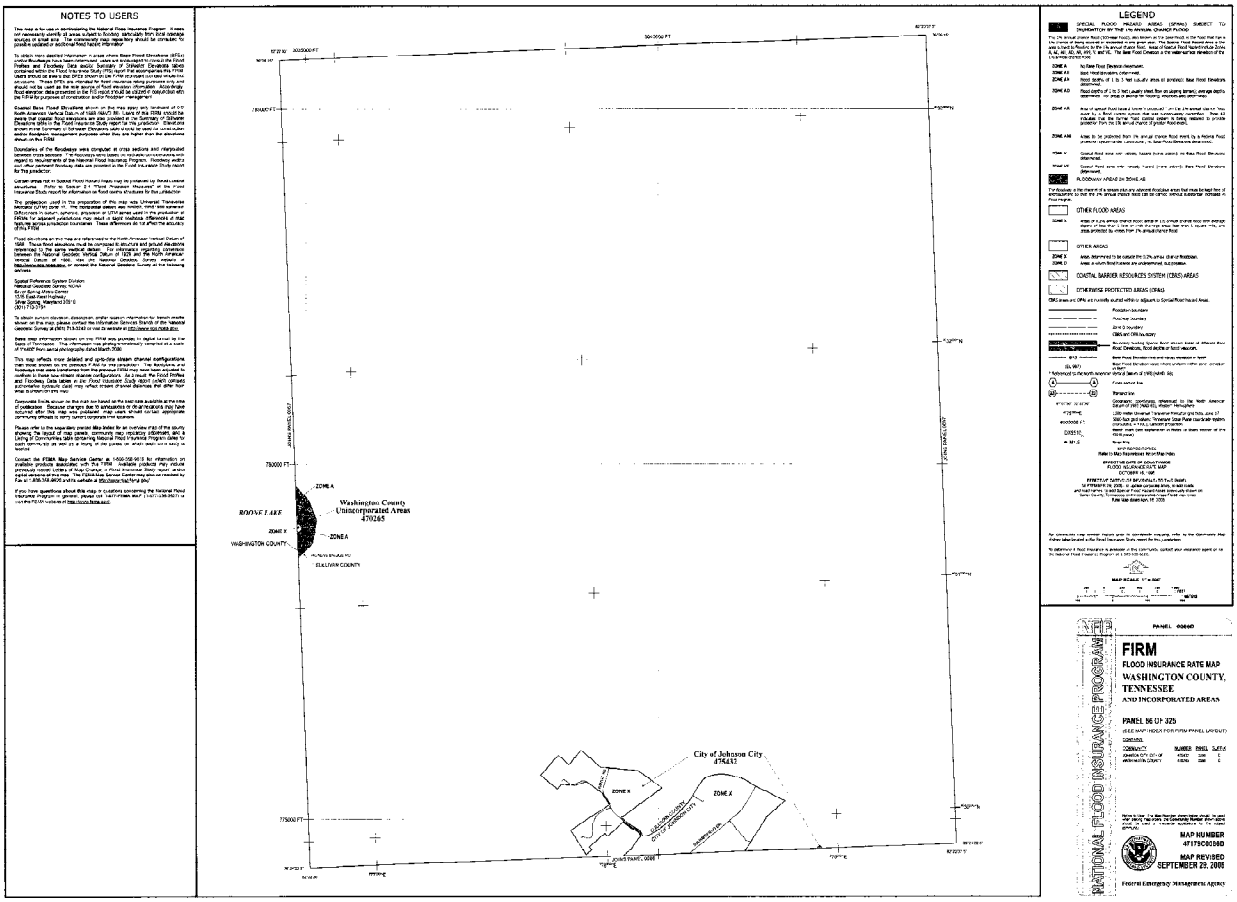
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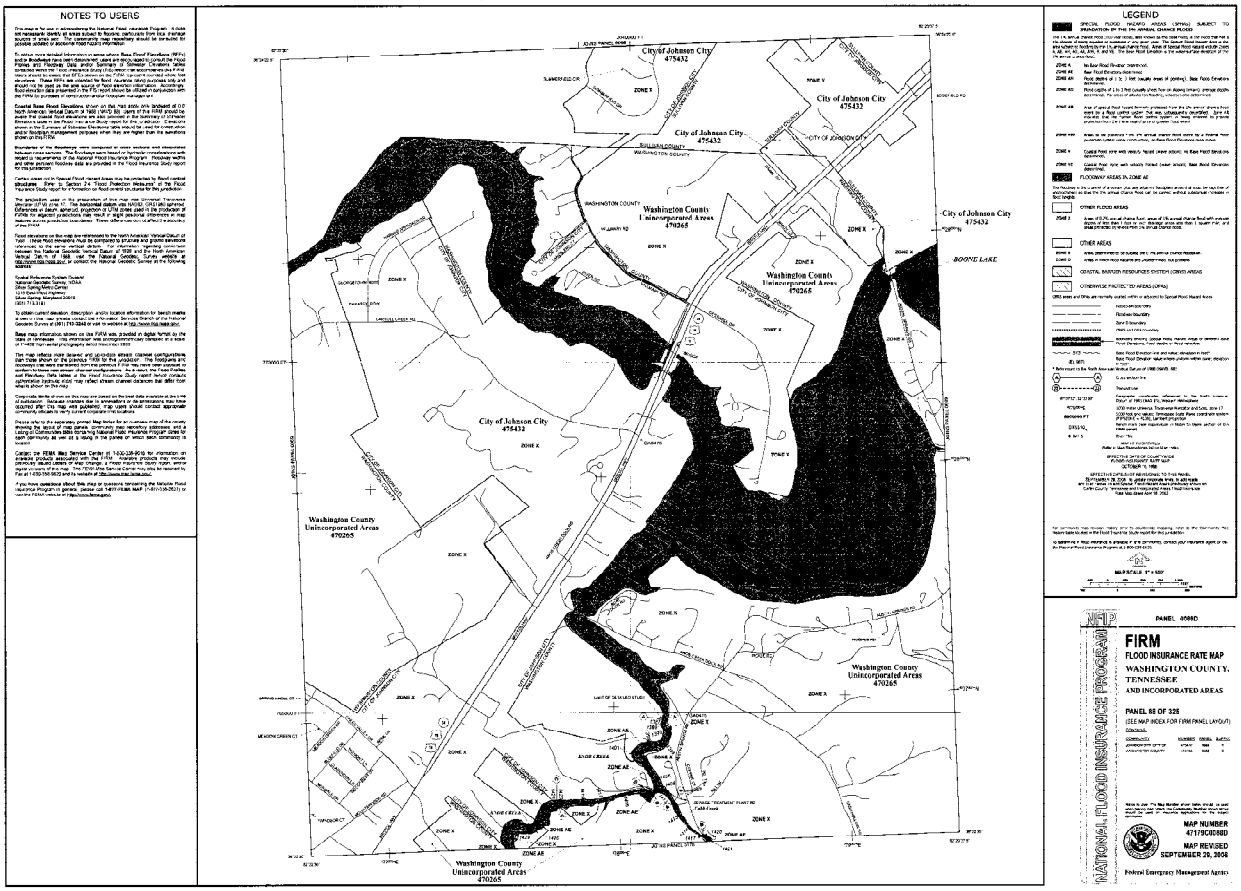
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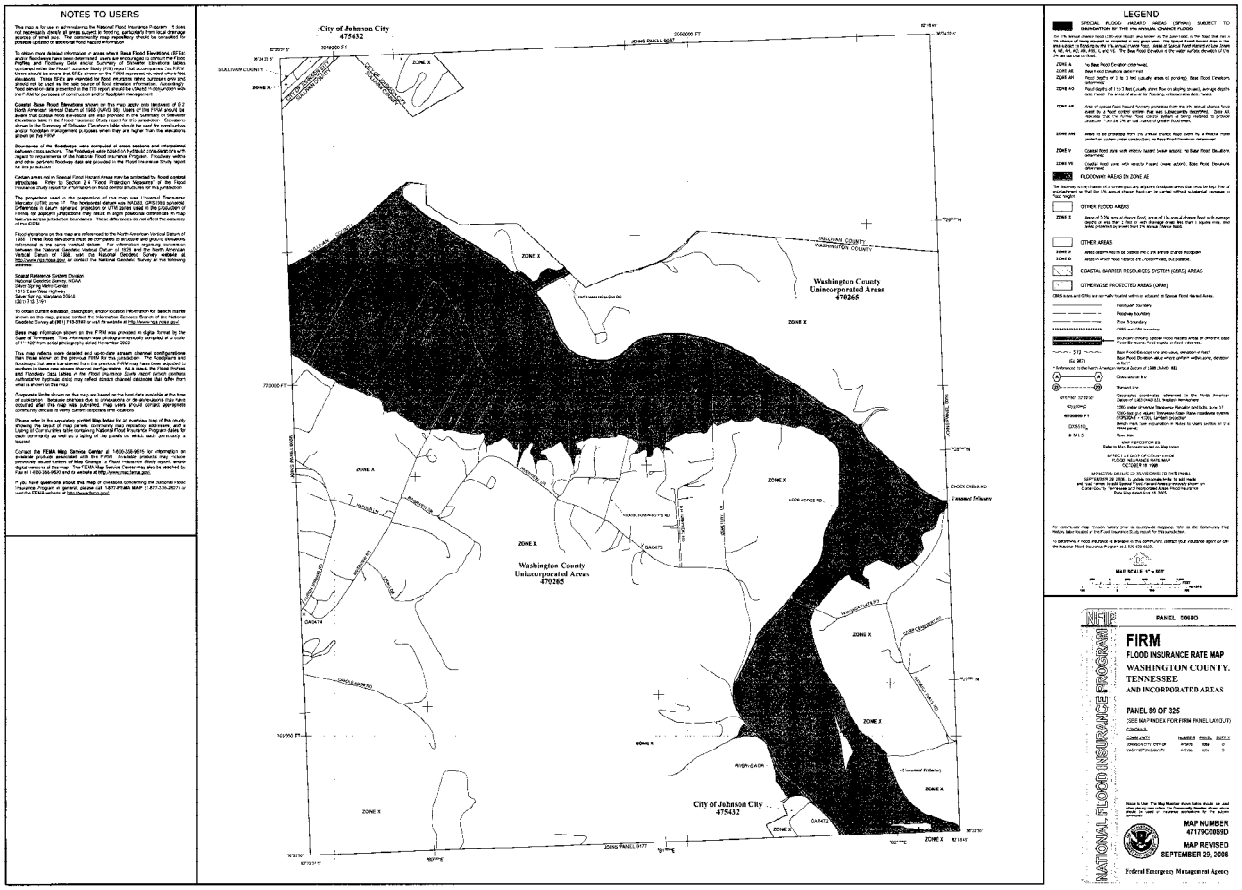
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Tennessee Tributary
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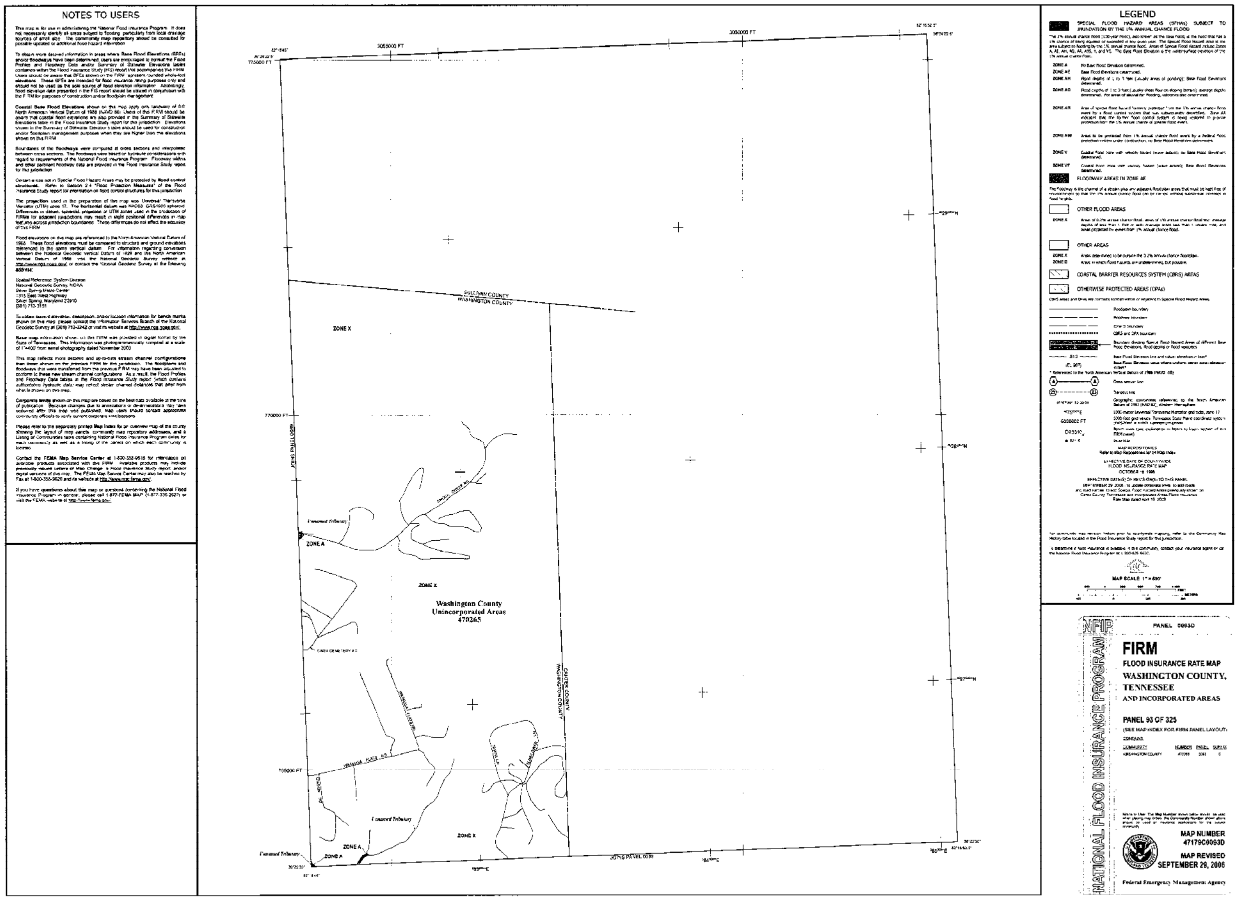
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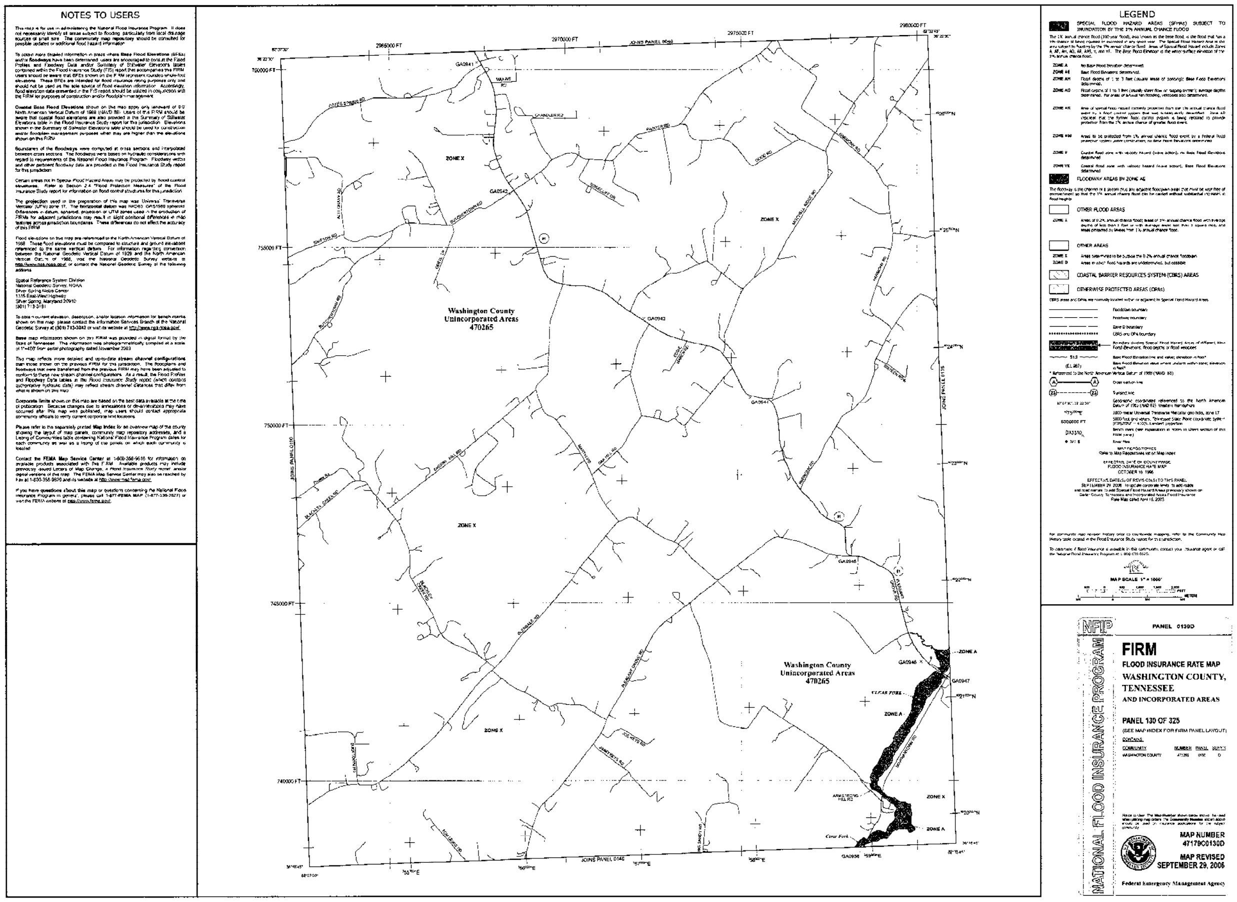
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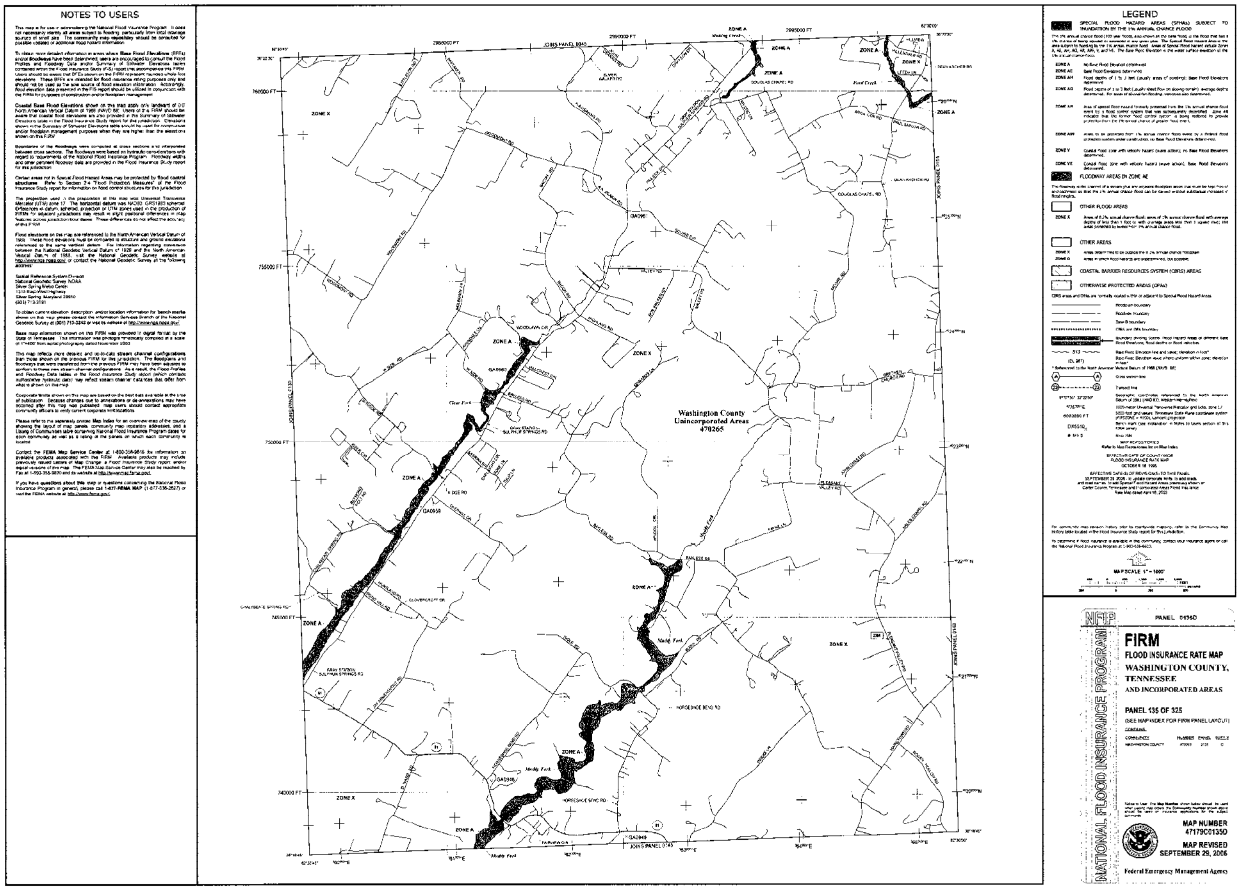
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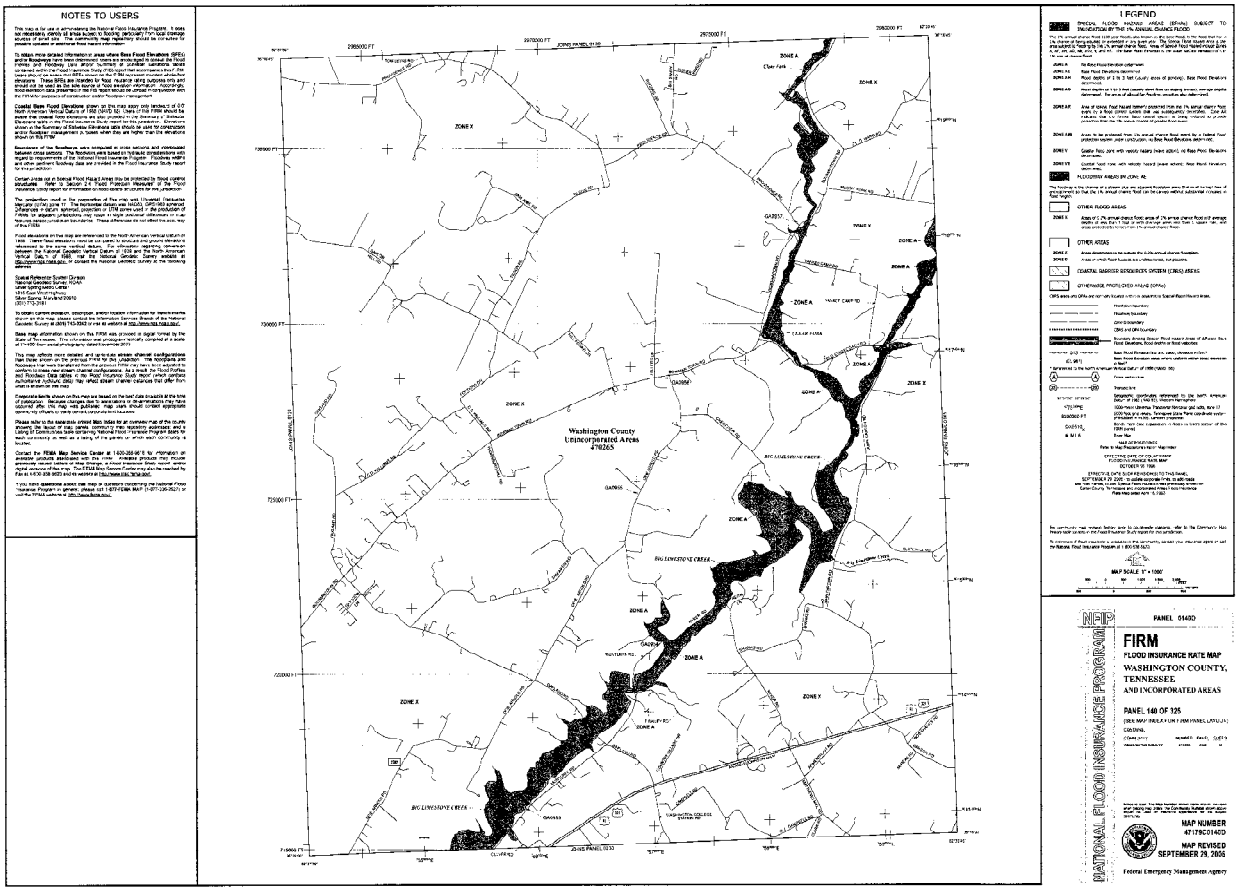
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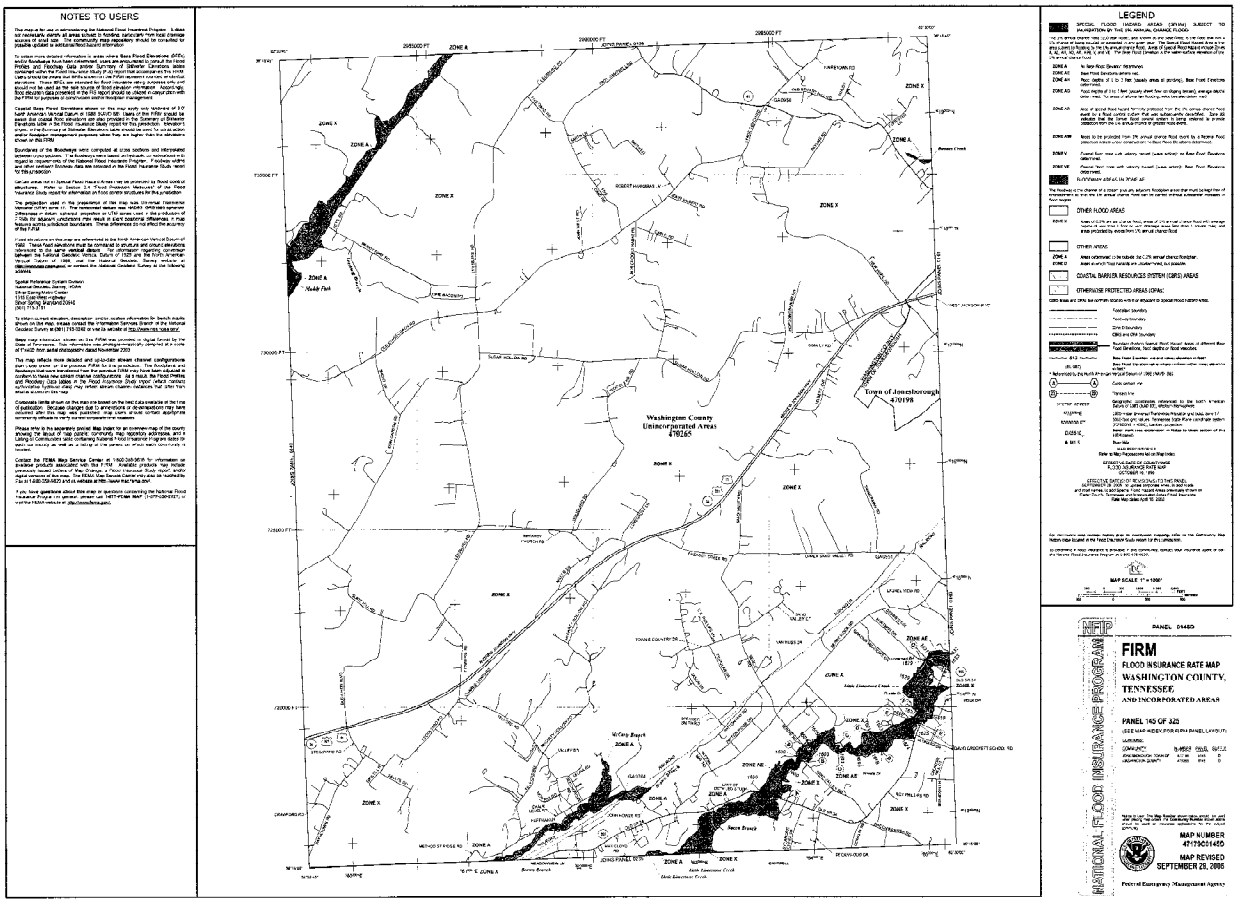
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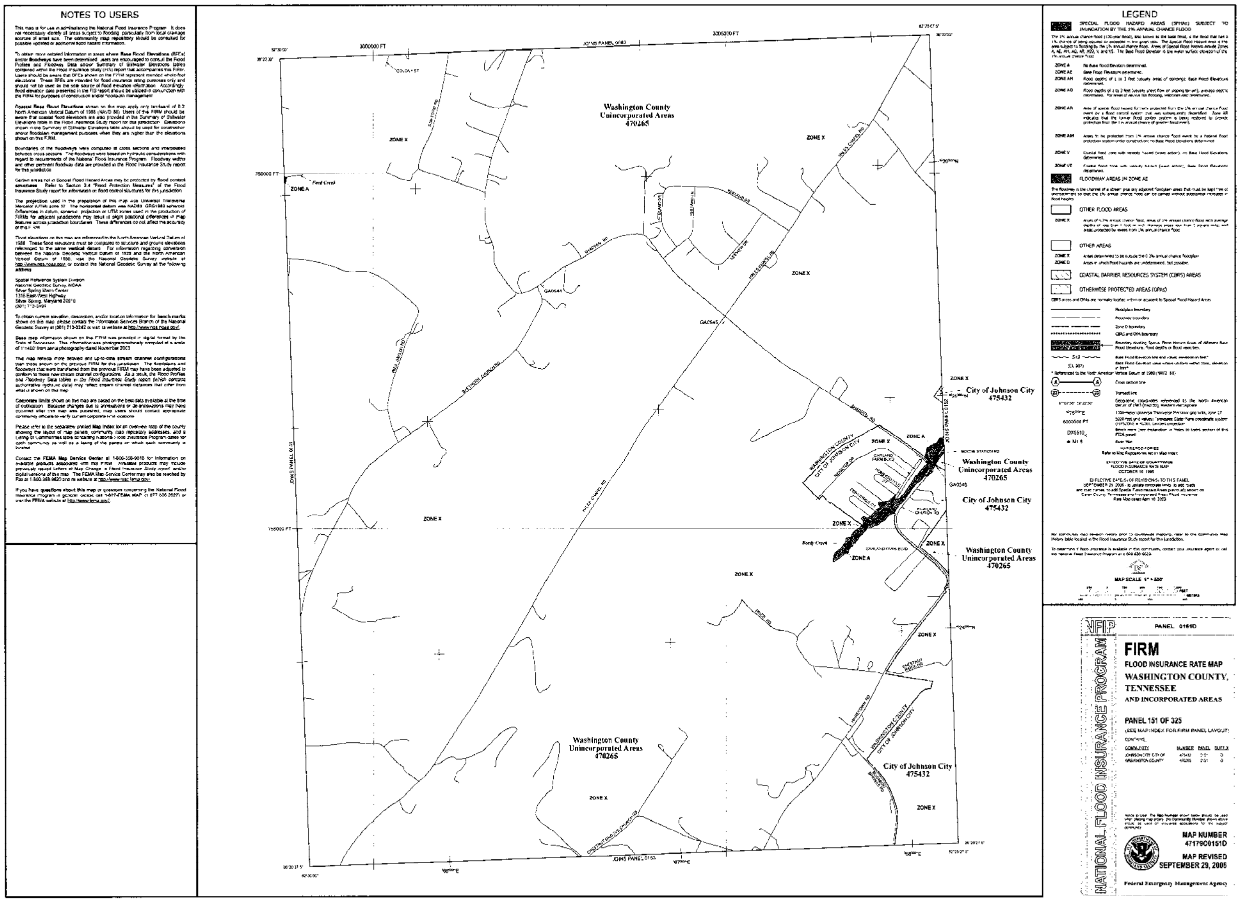
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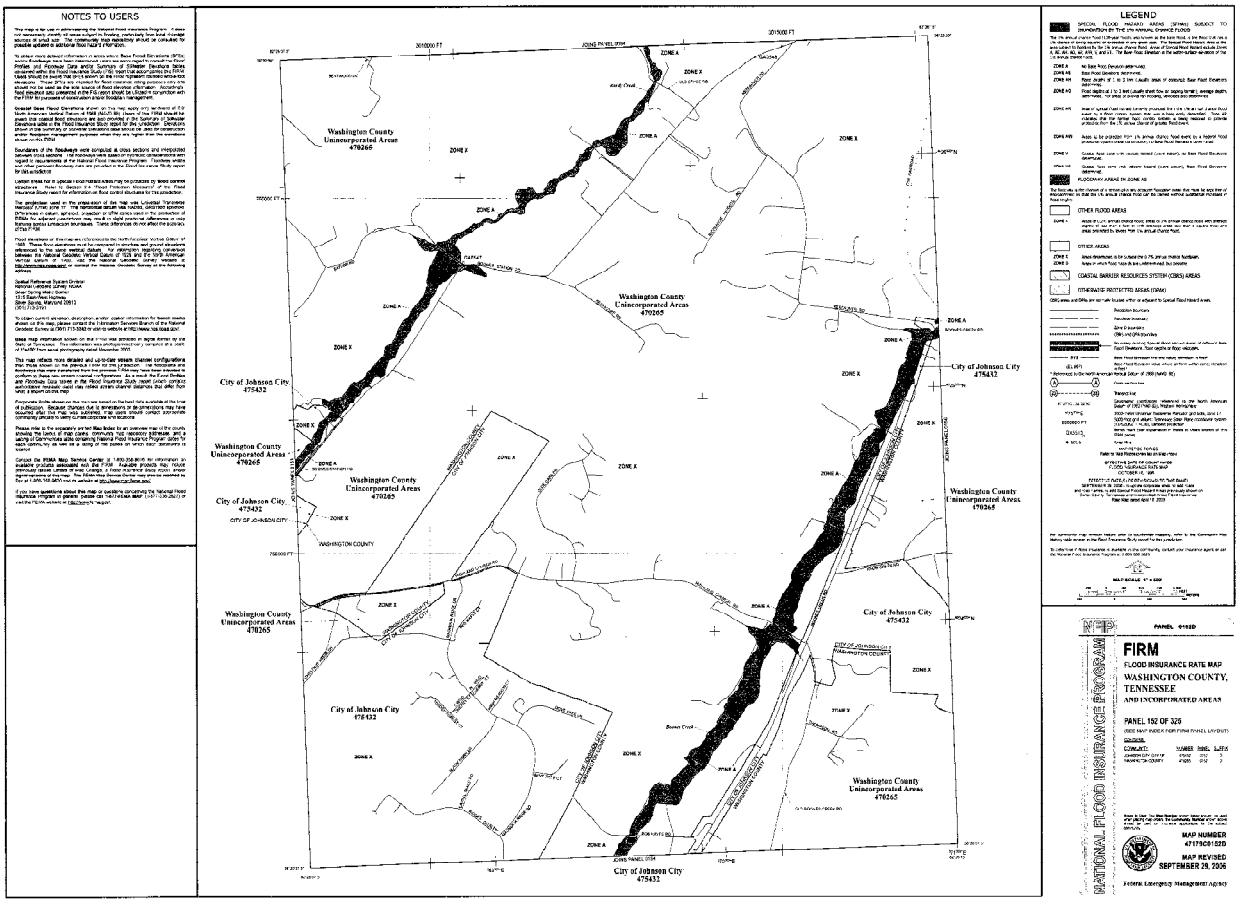
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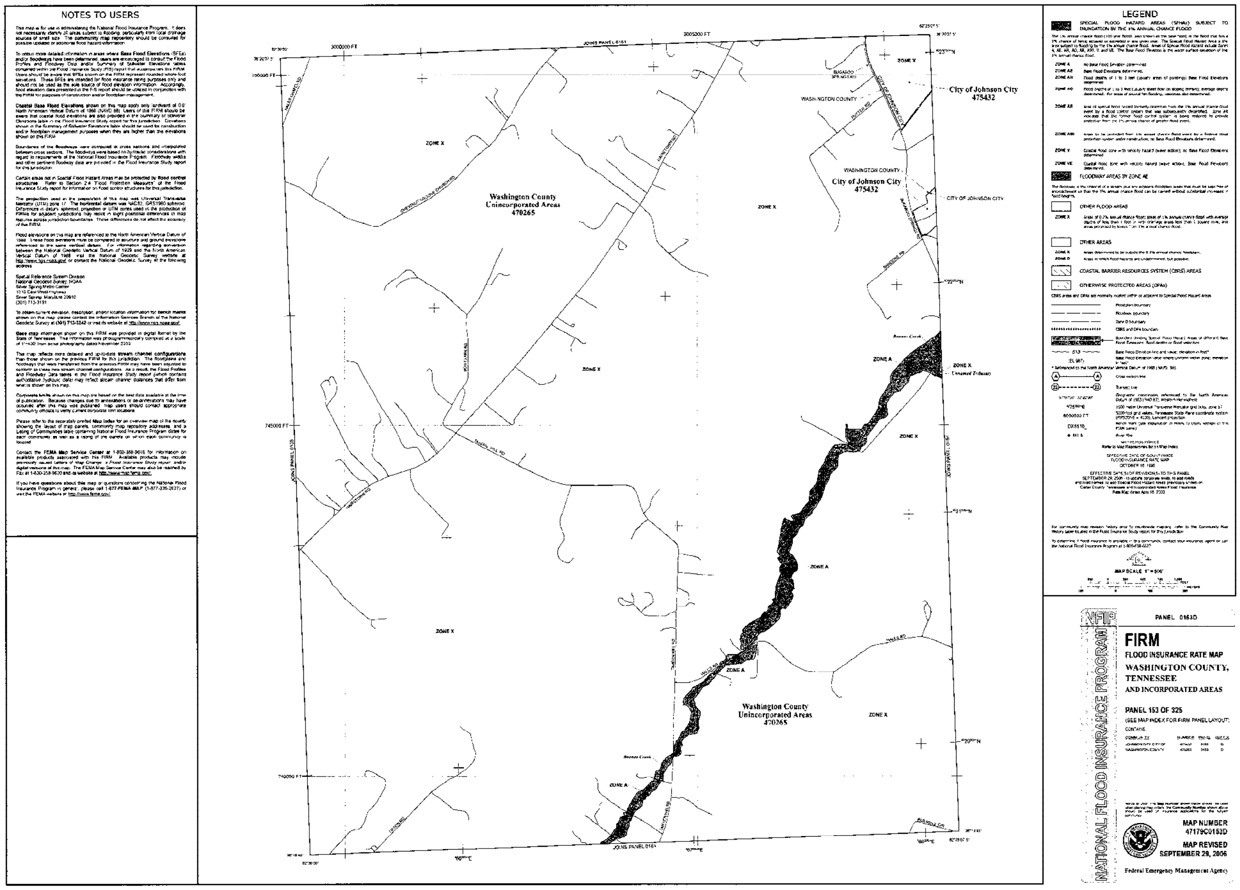
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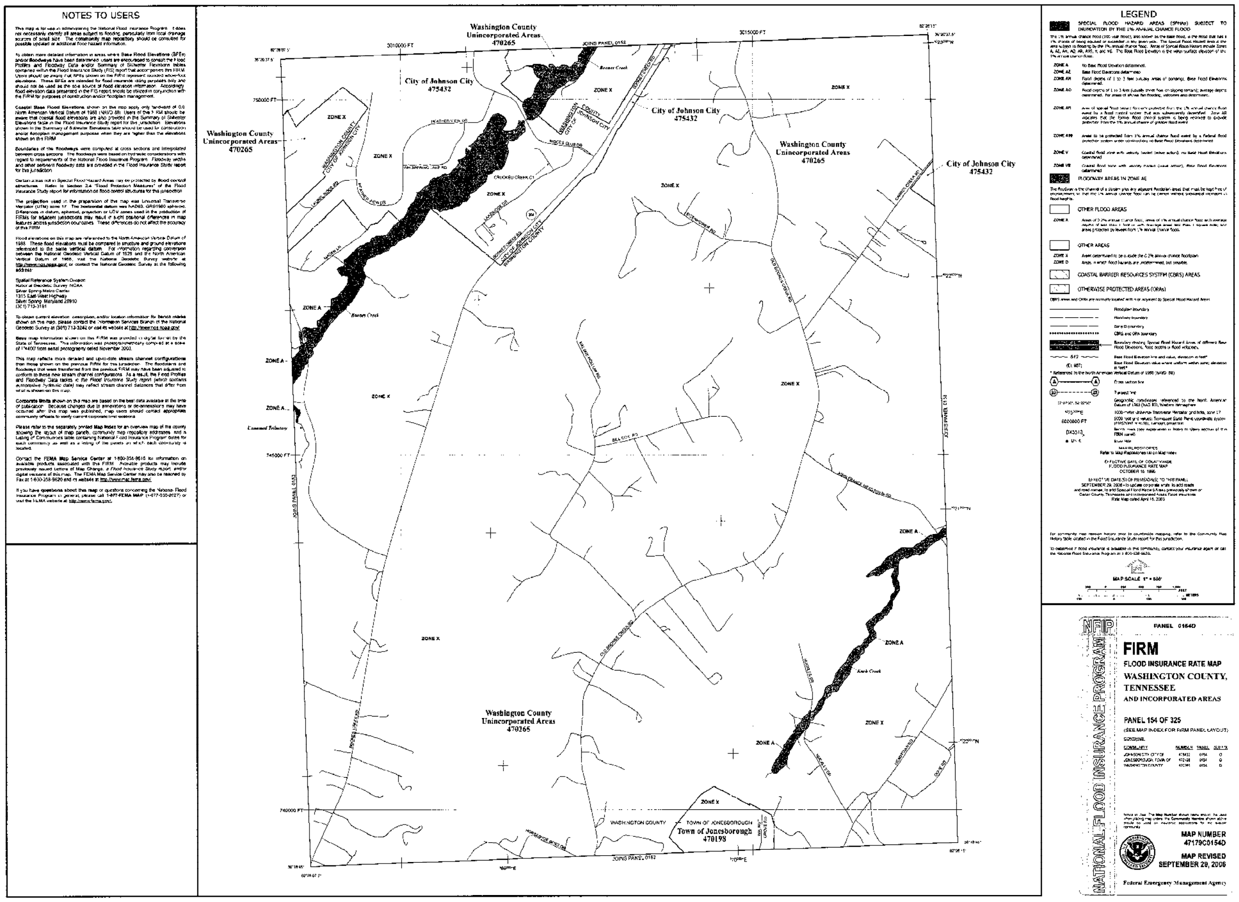
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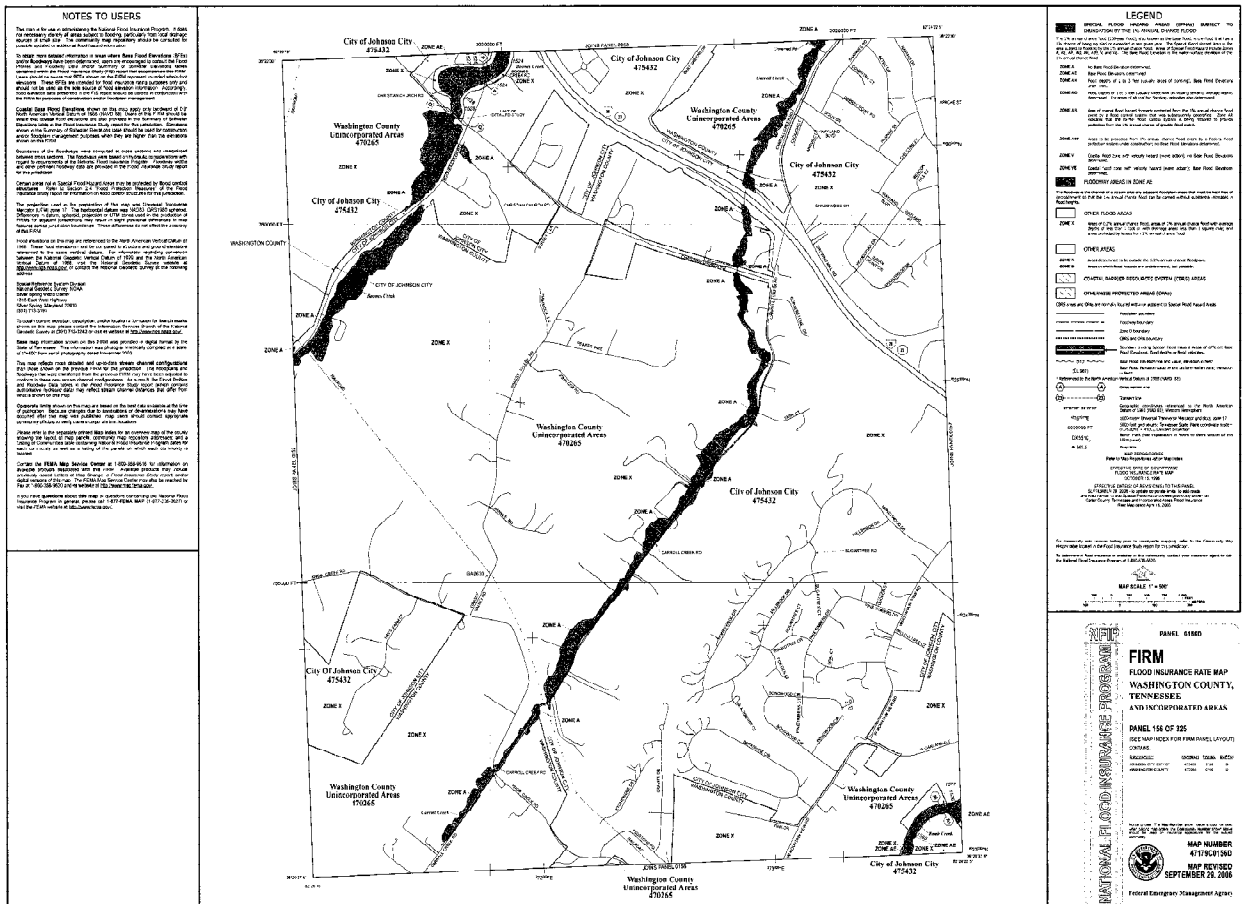
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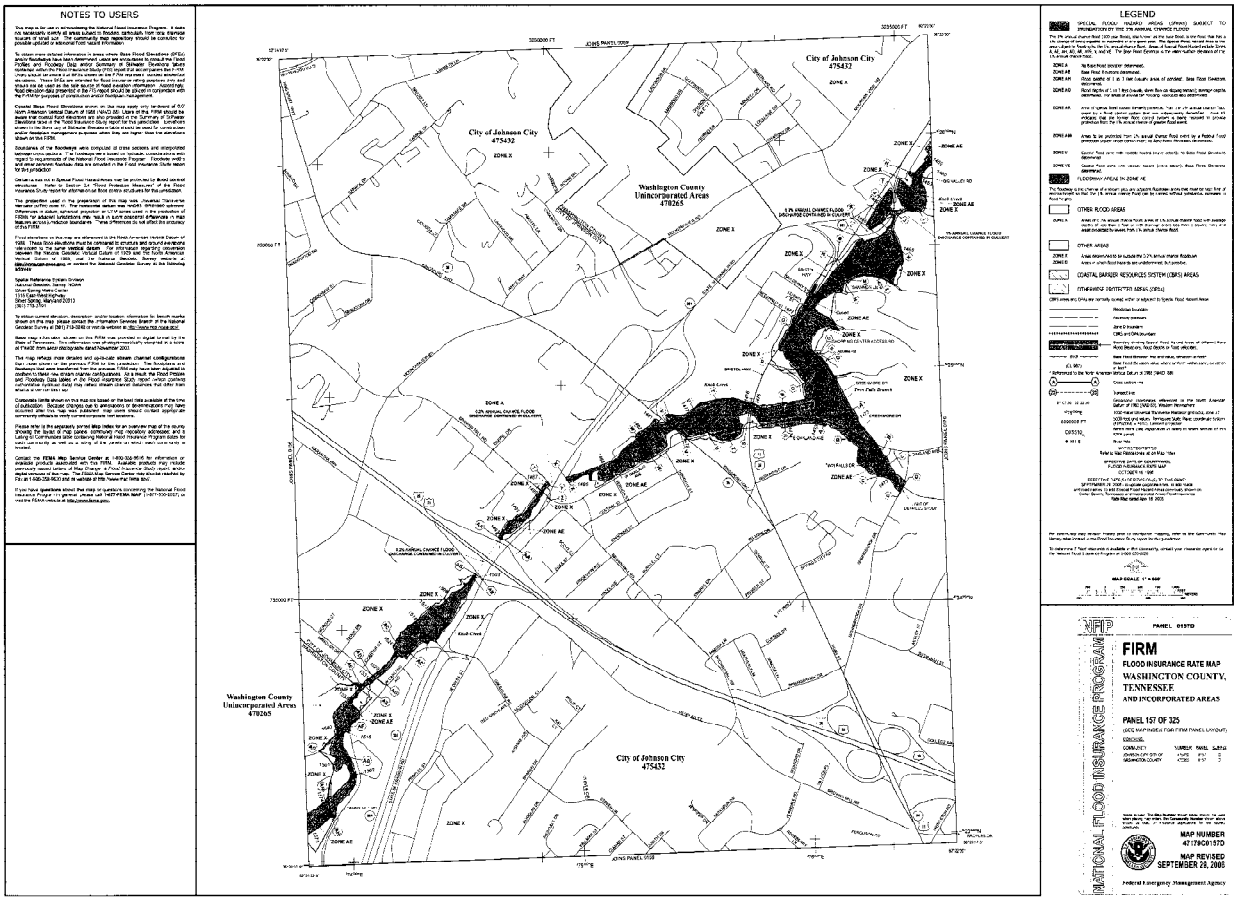
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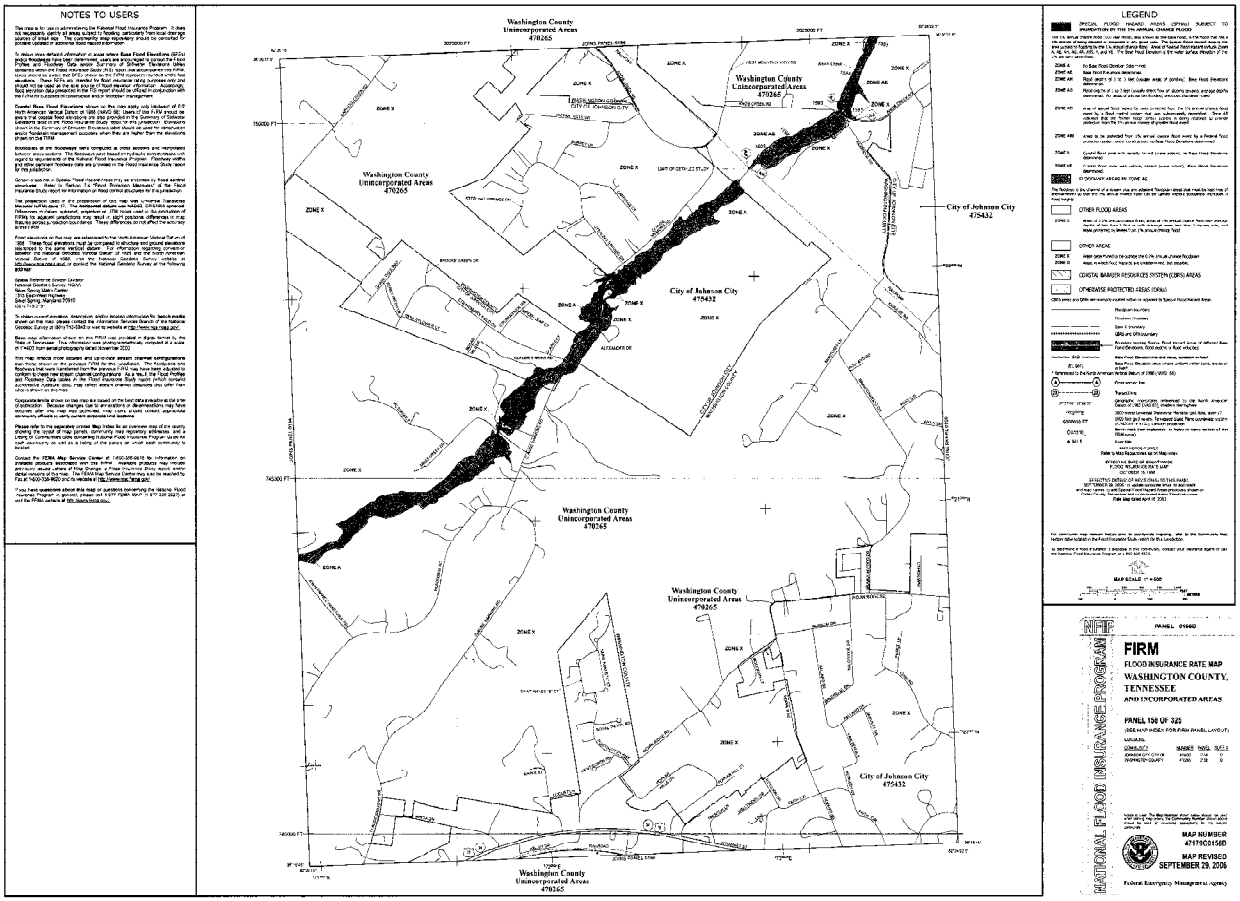
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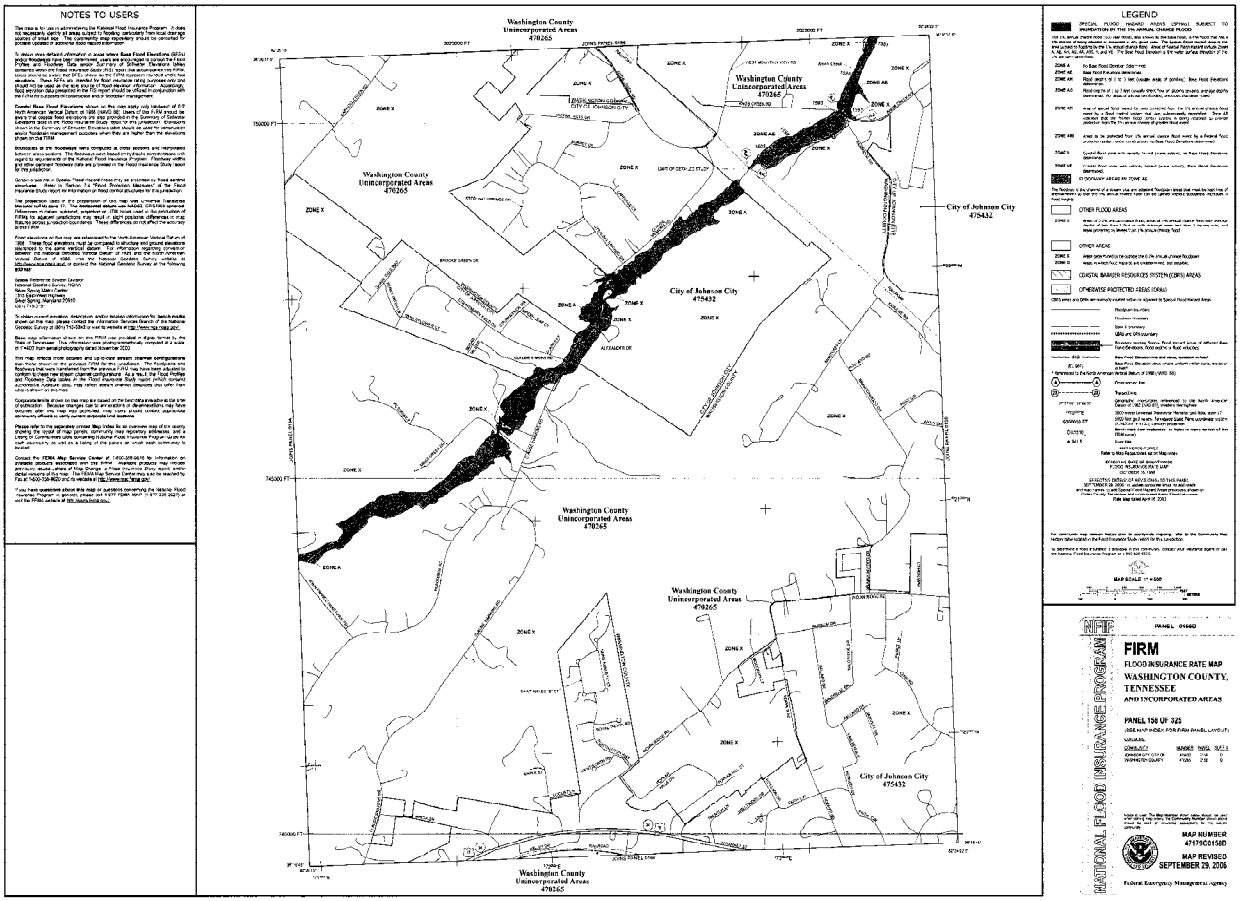
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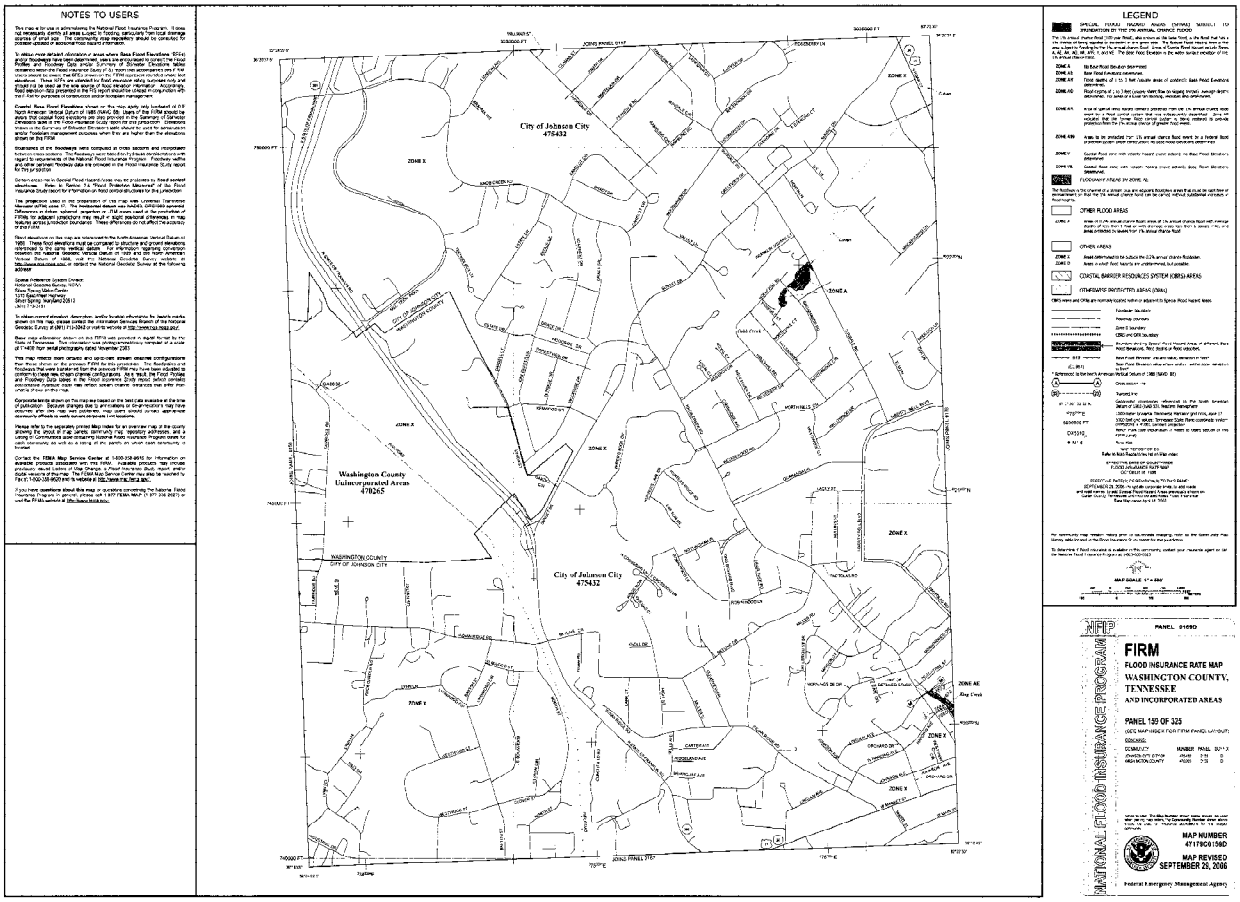
Federal Emergency Management Agency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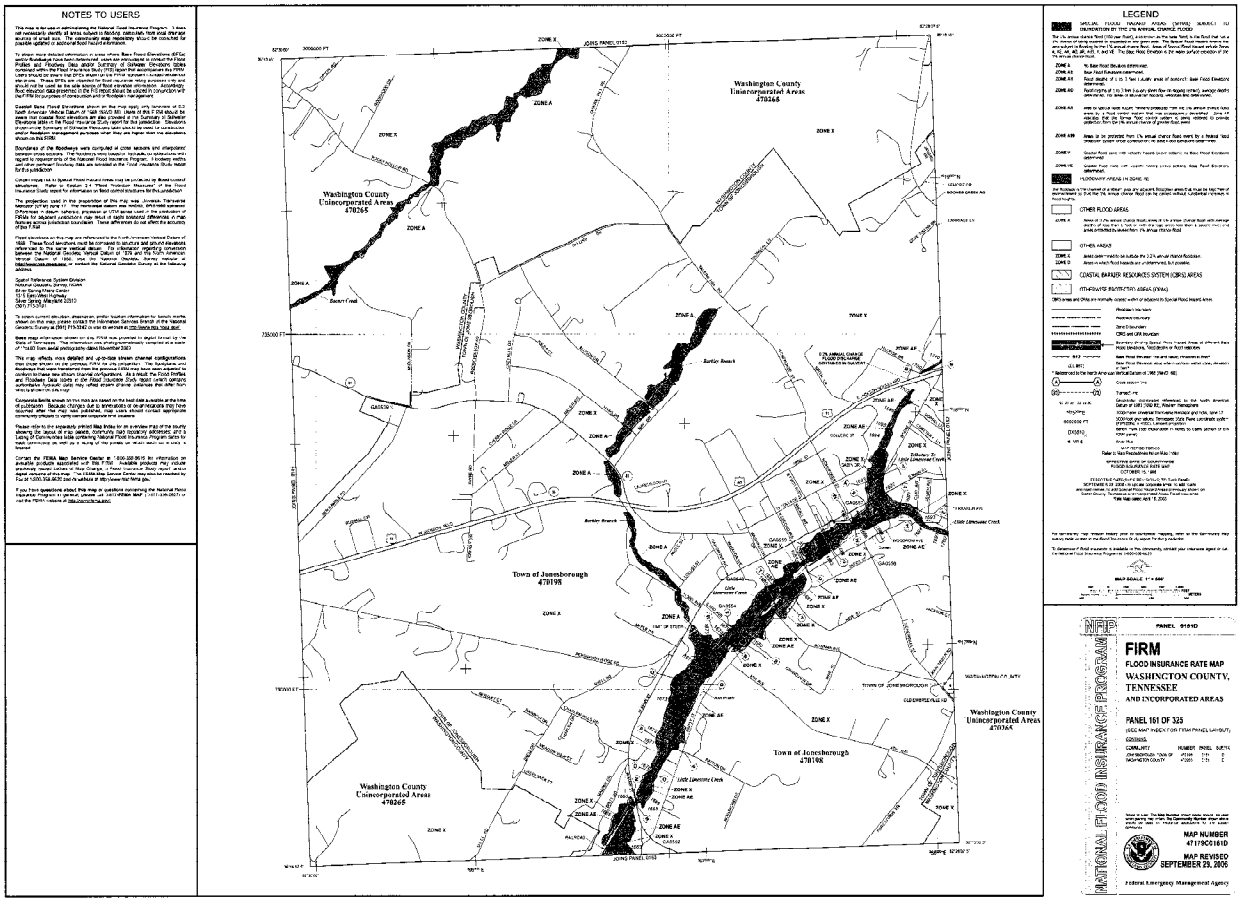
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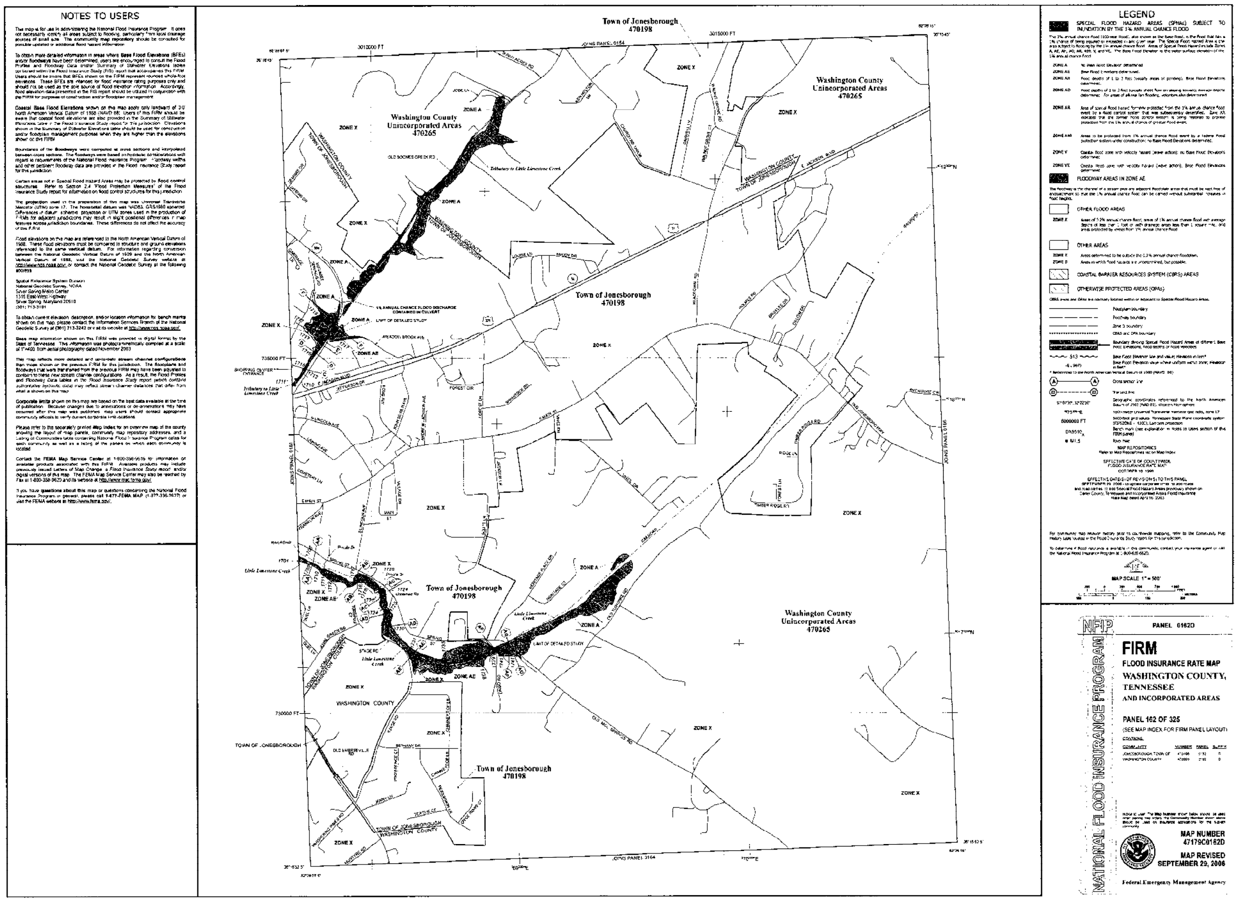
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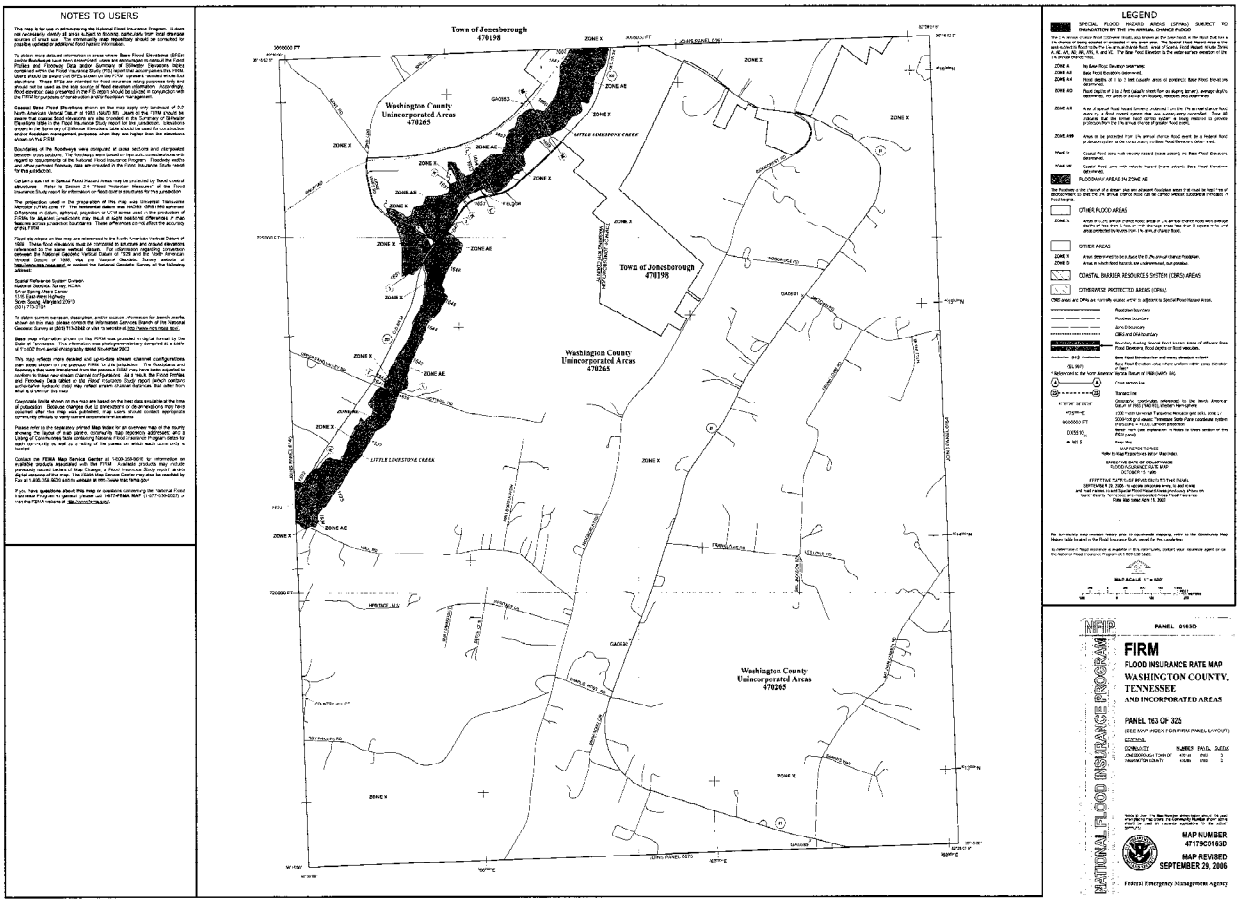
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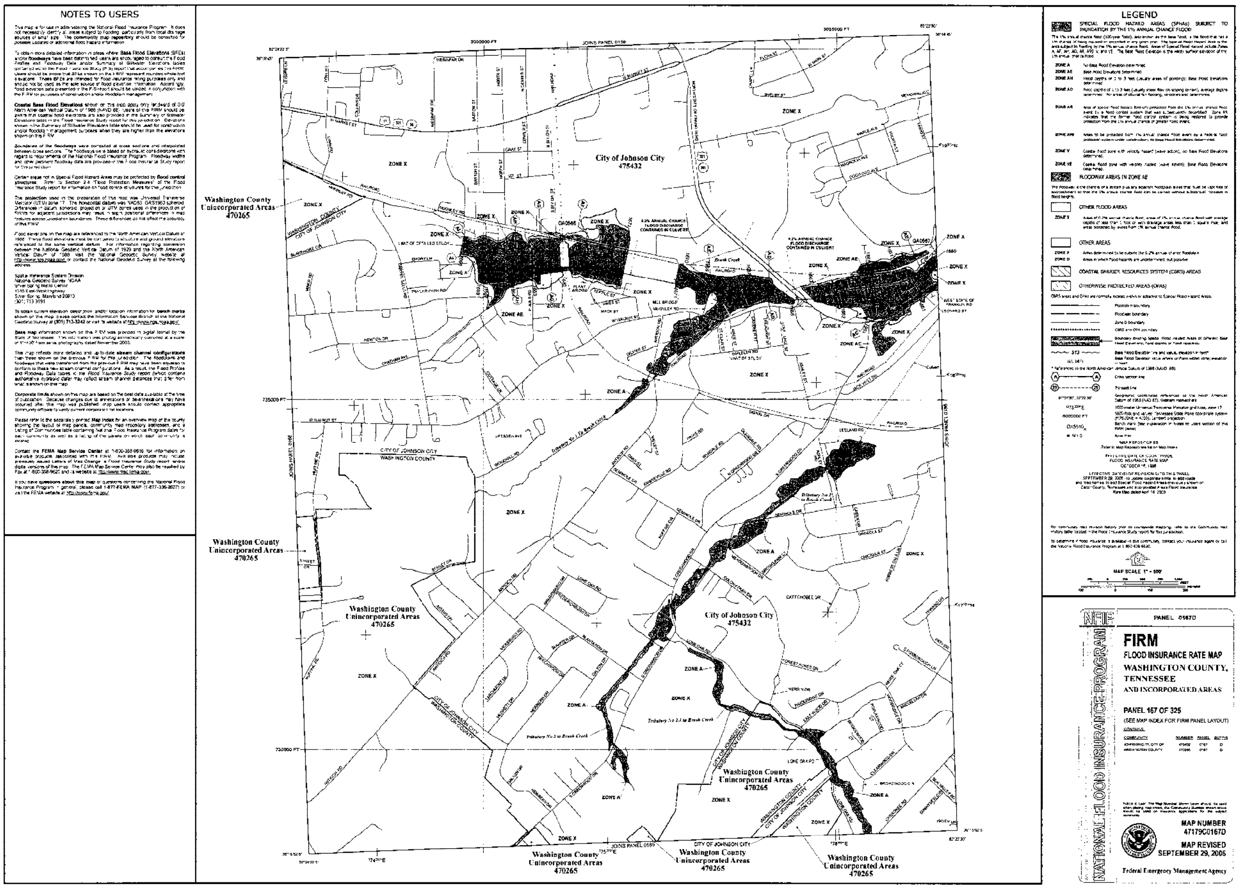
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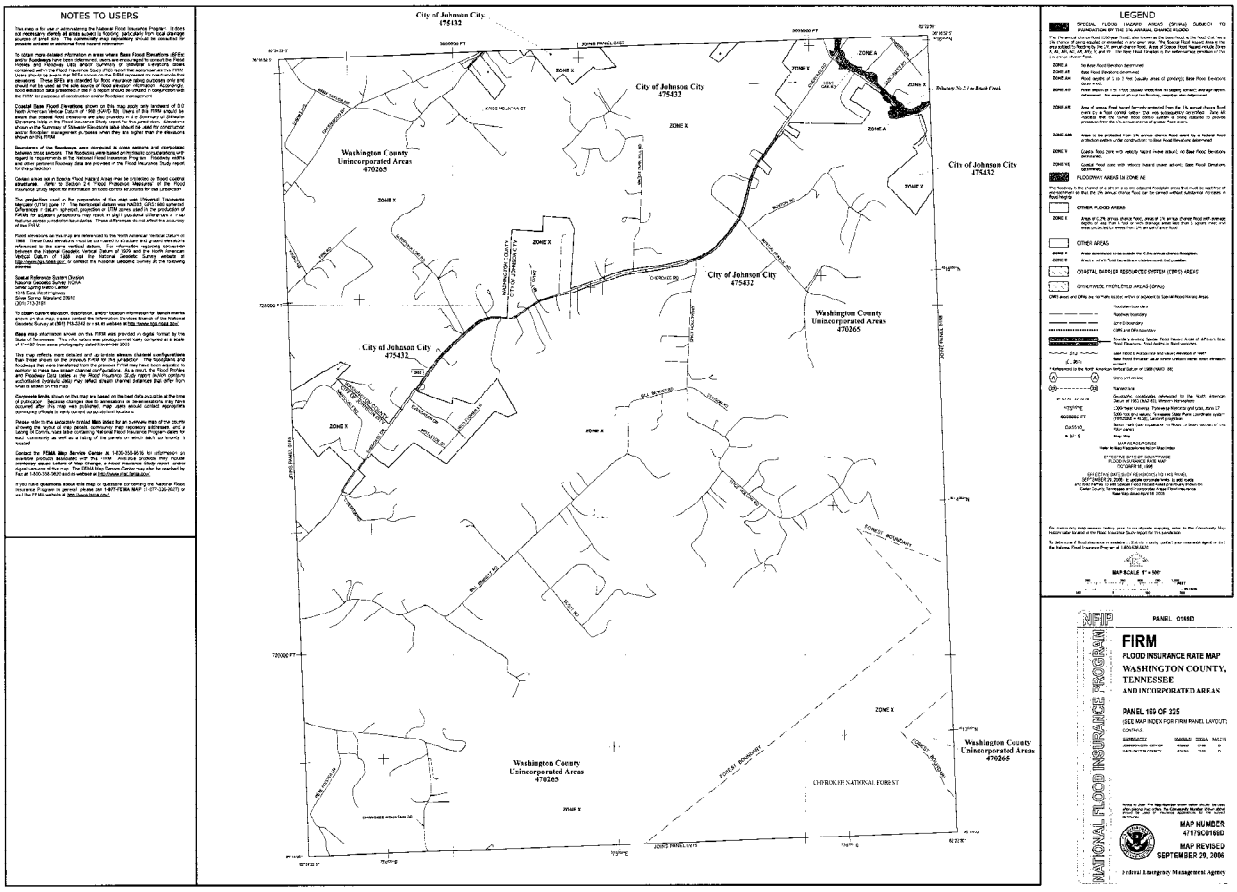
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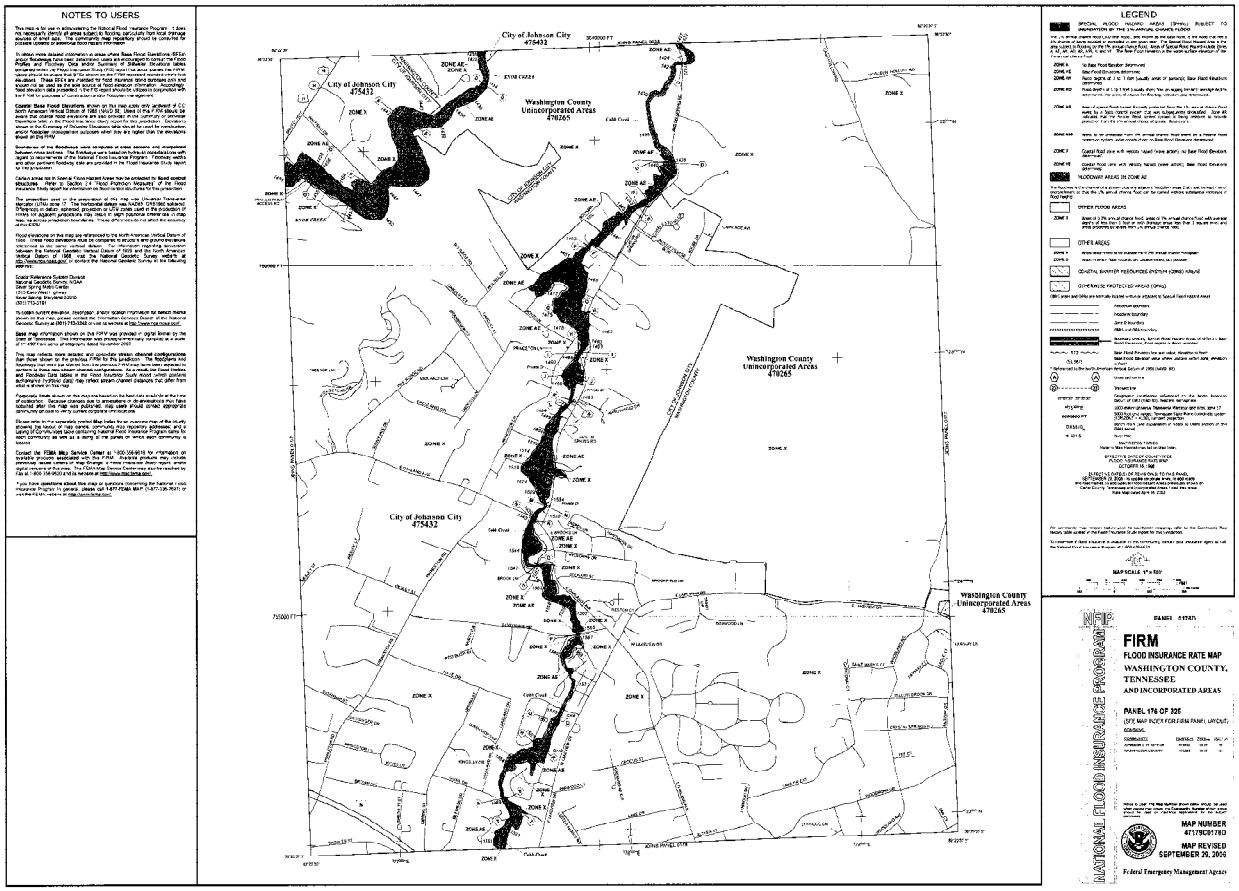
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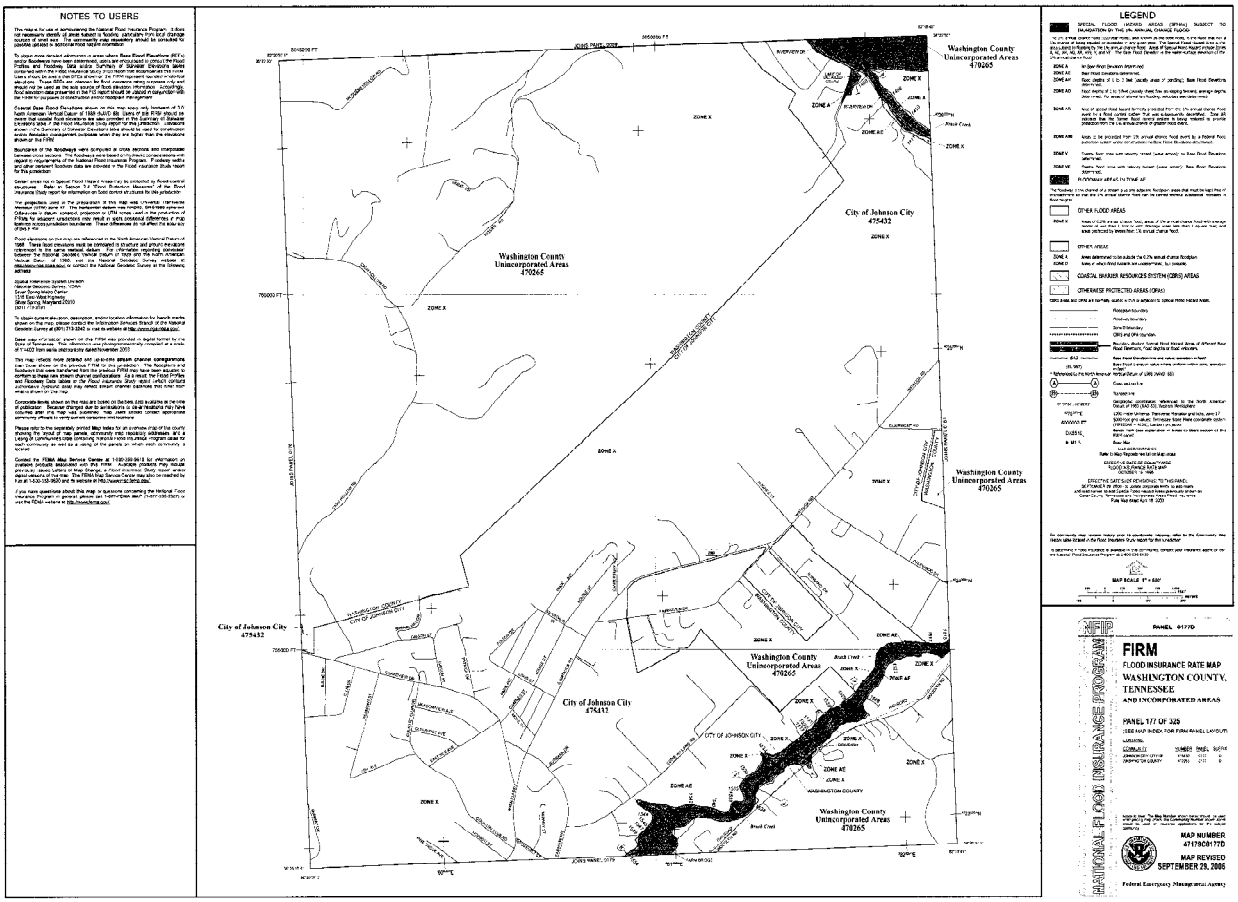
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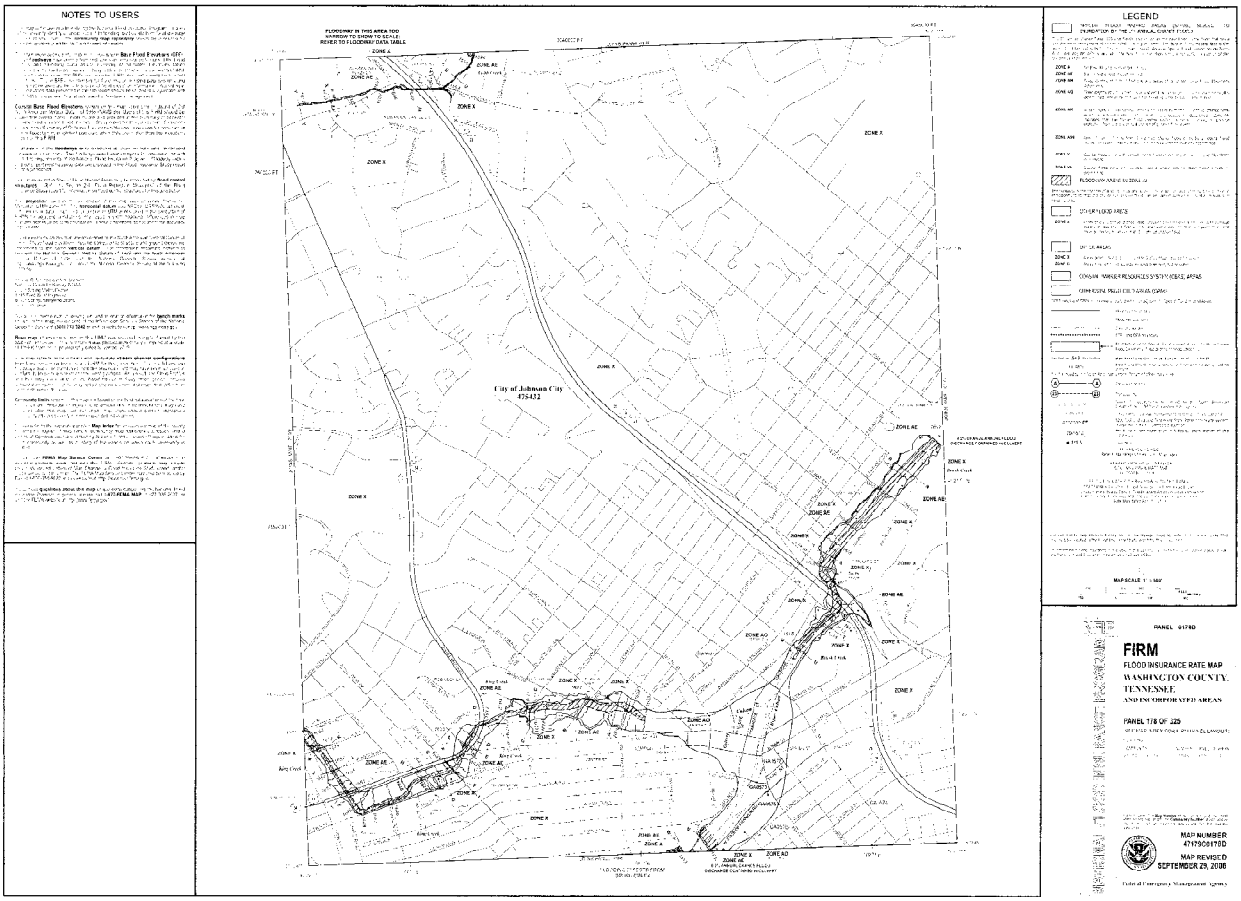
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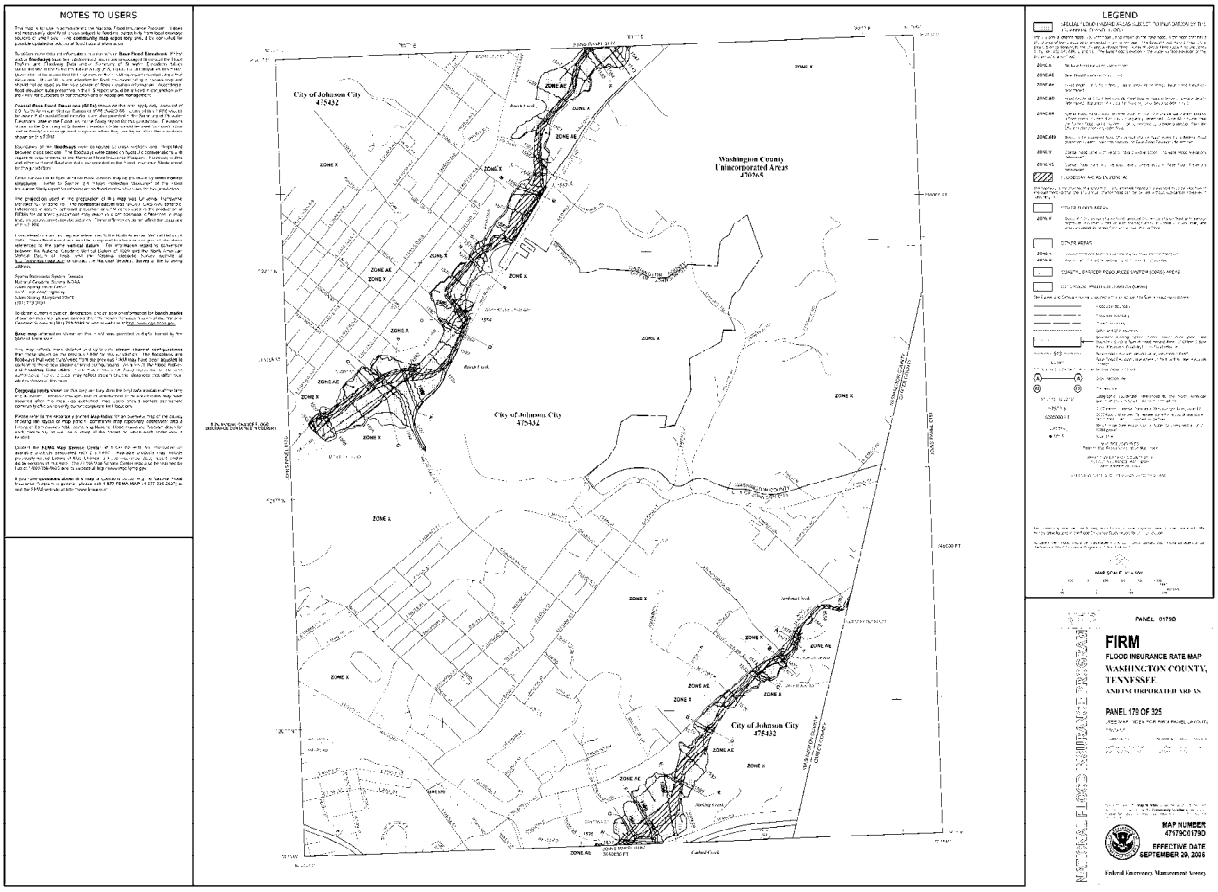
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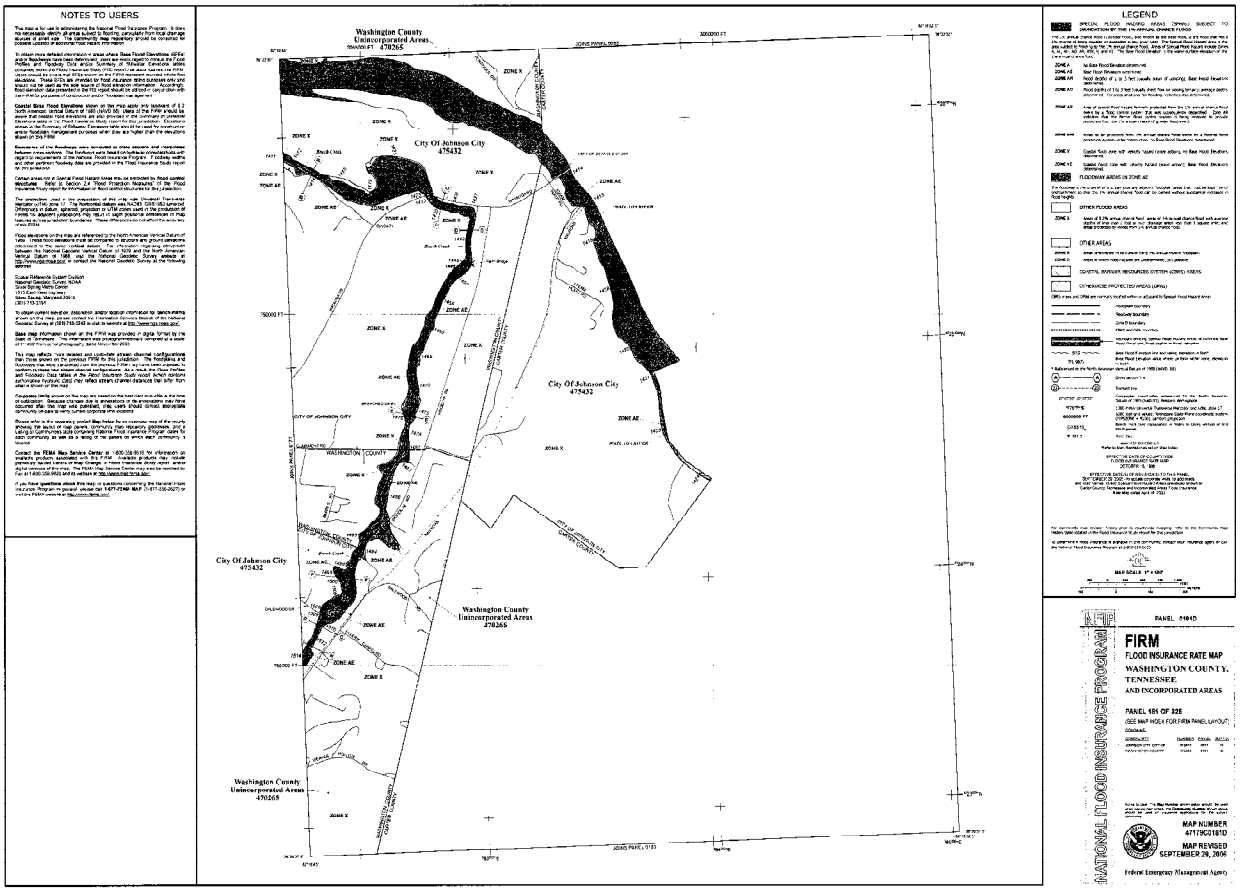
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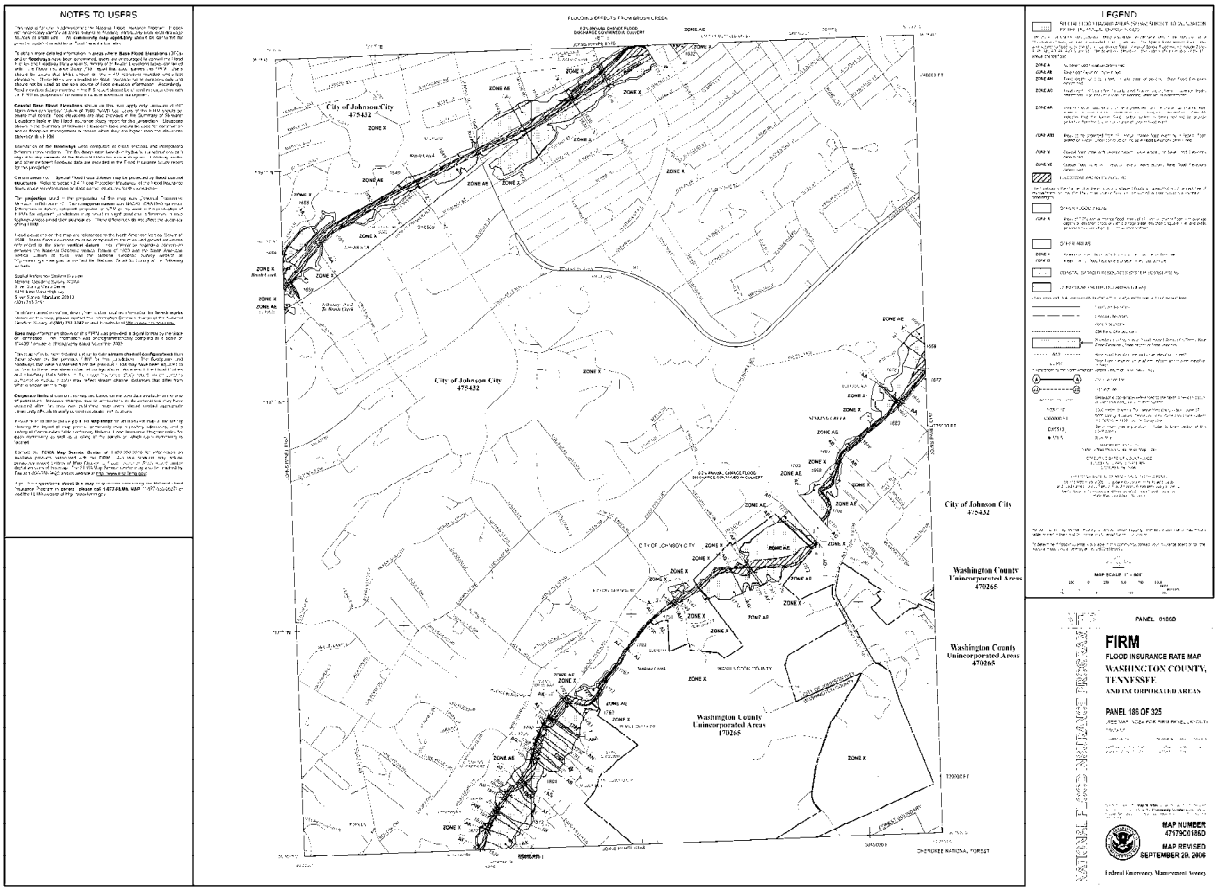
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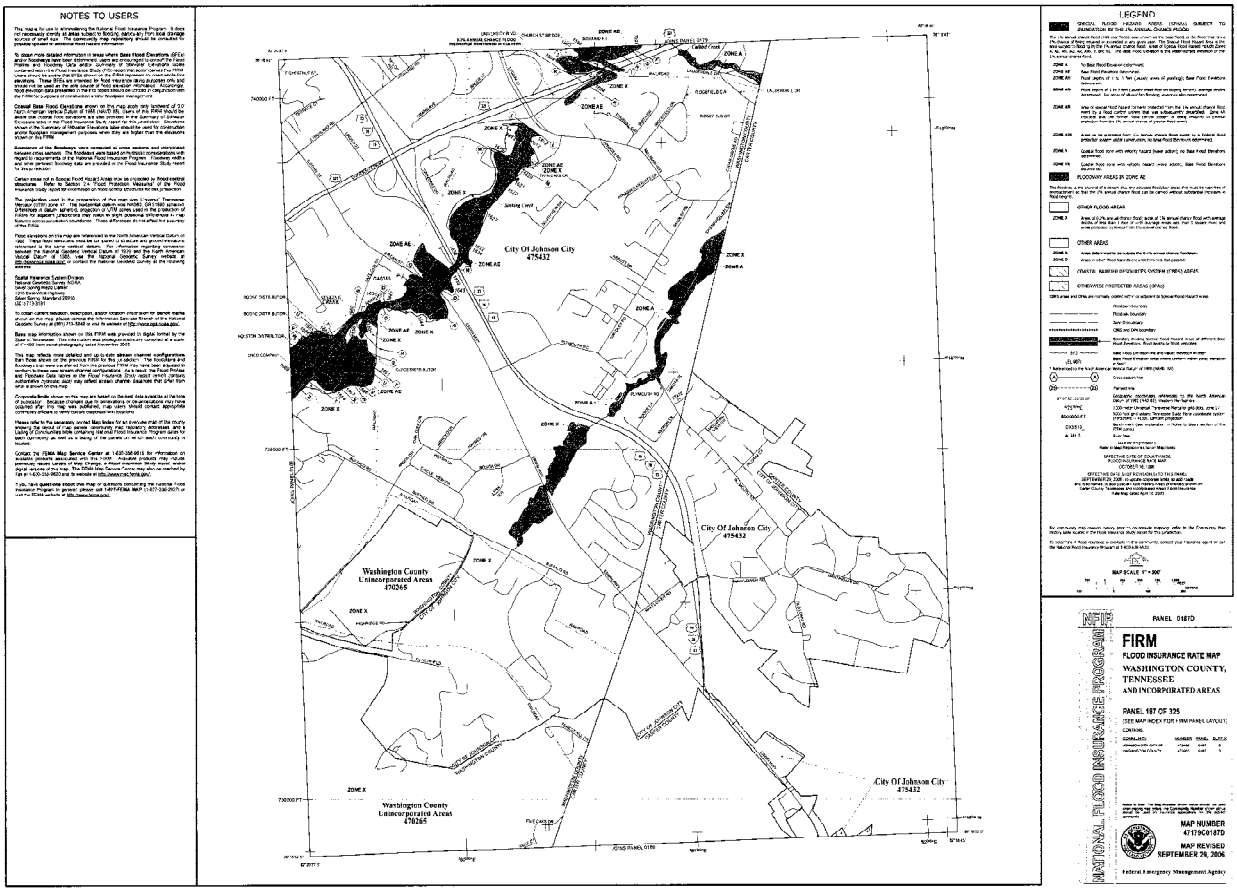
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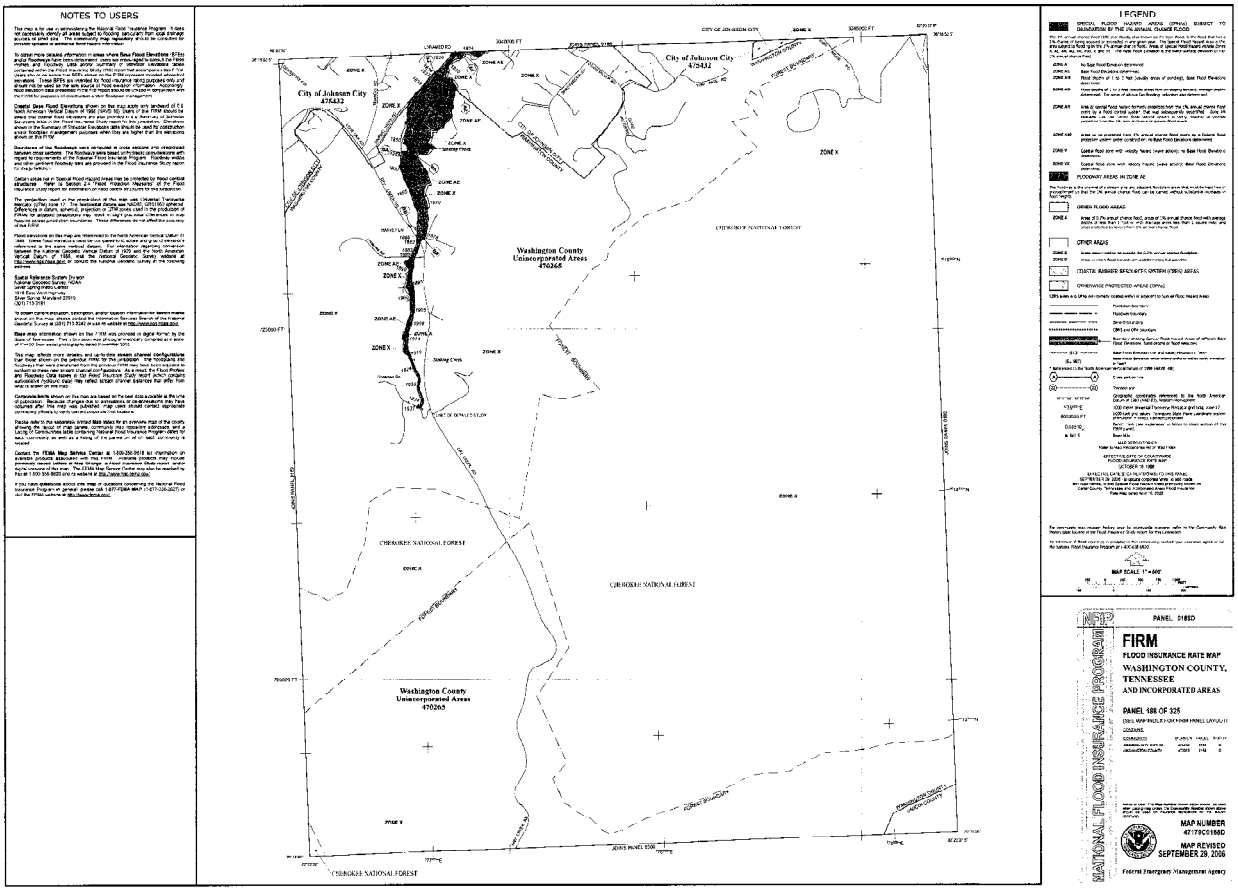
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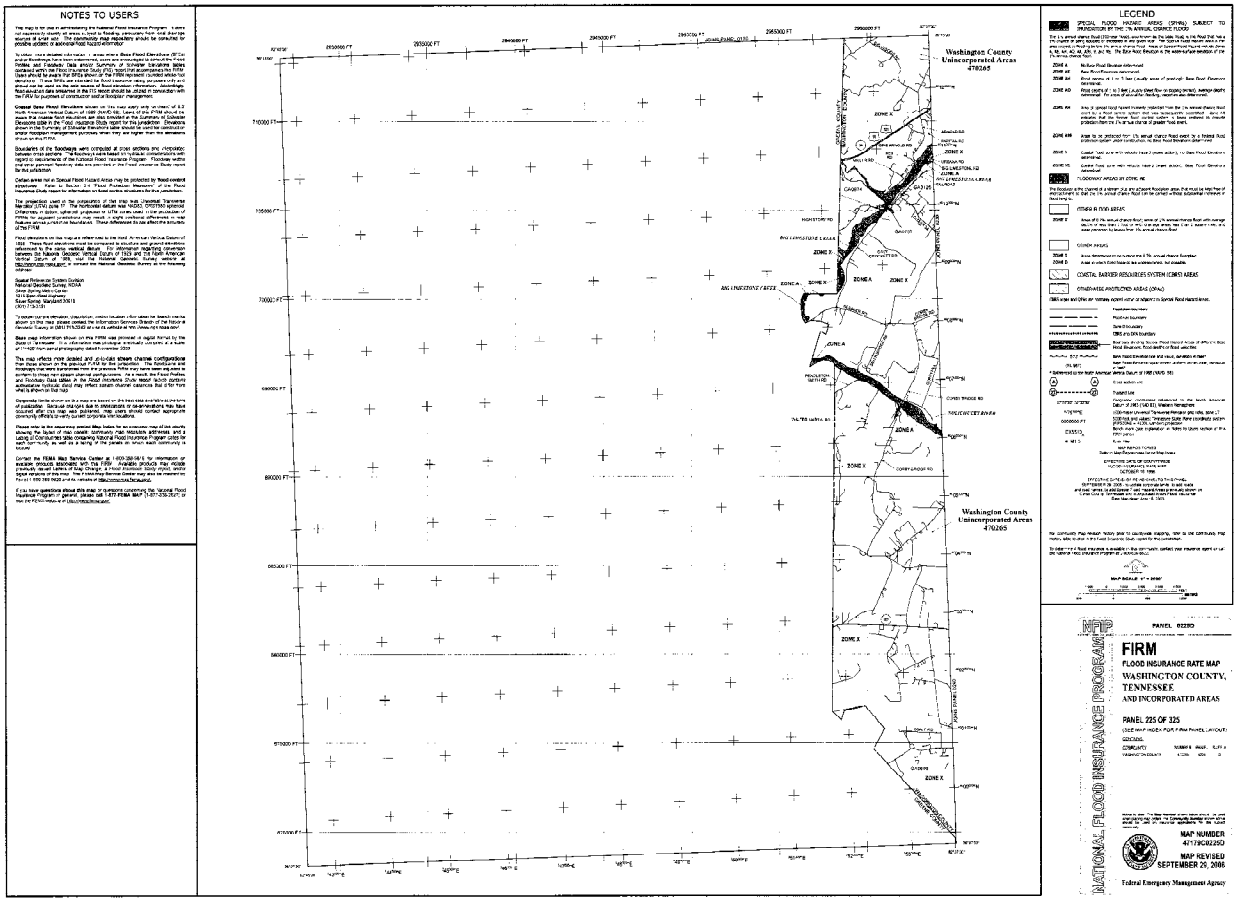
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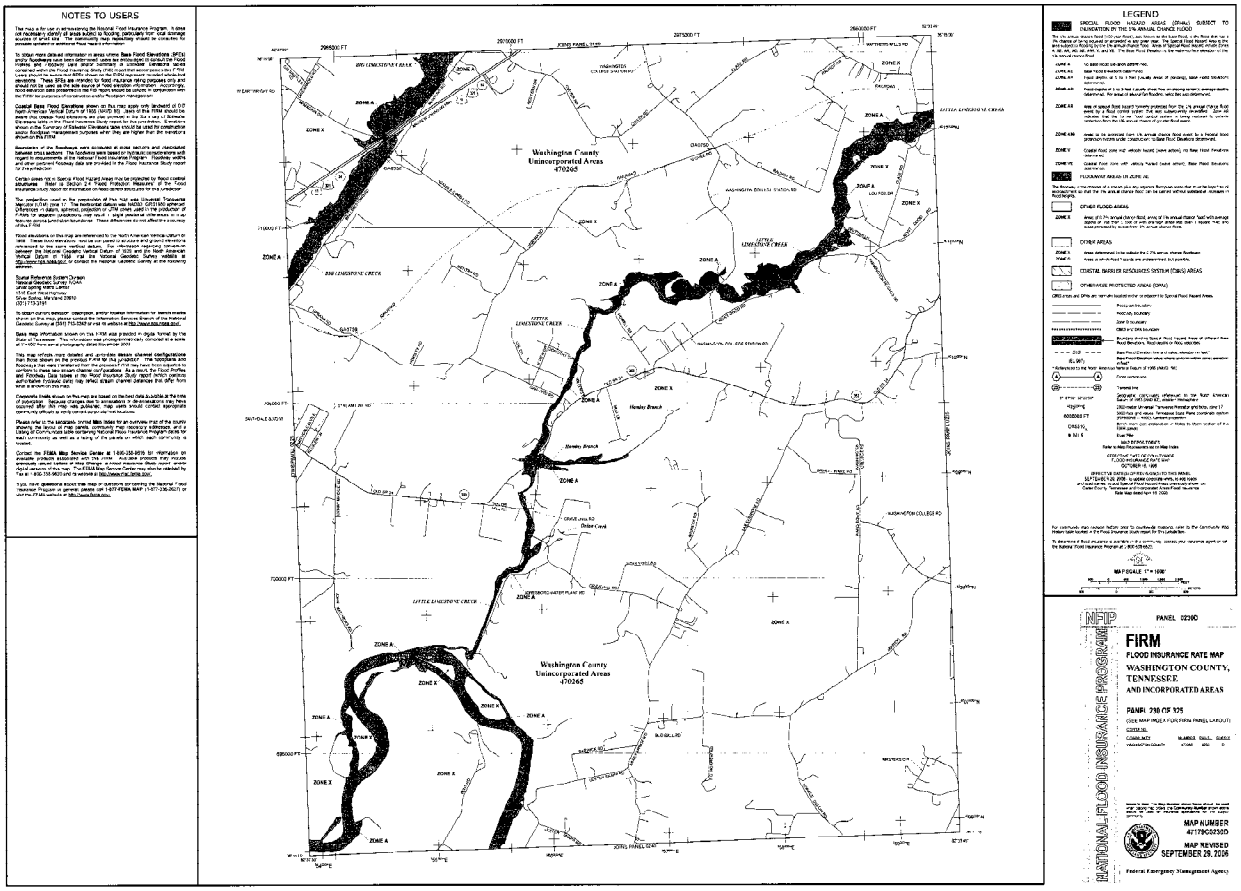
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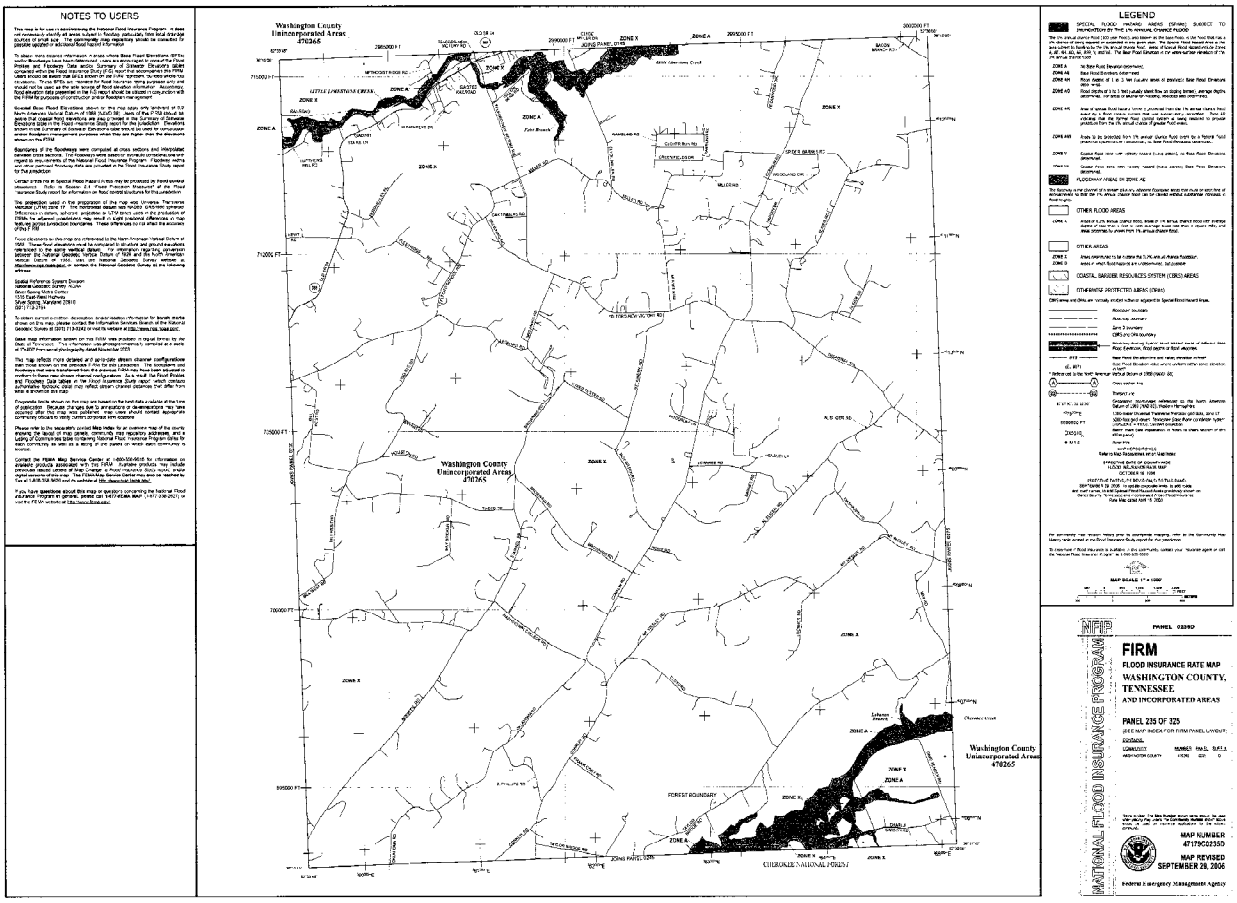
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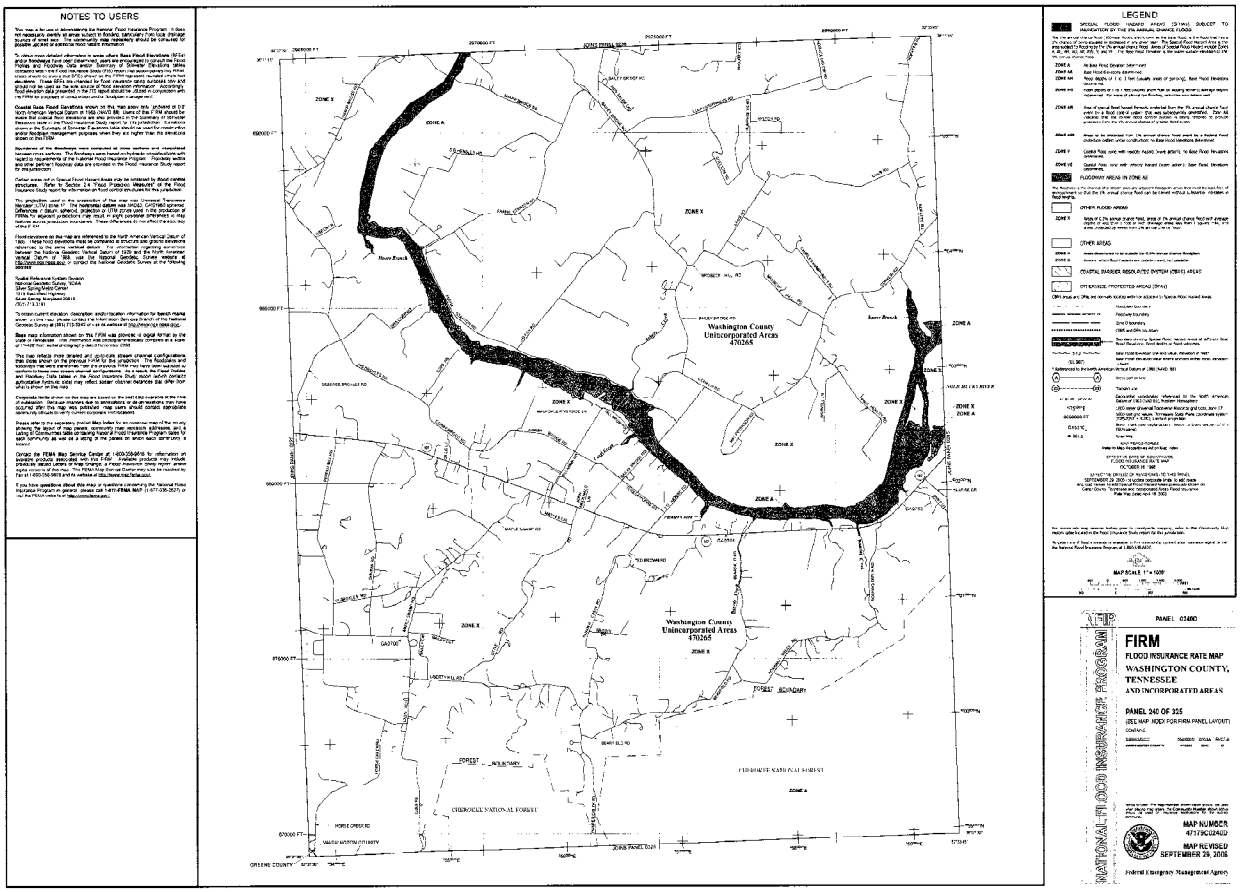
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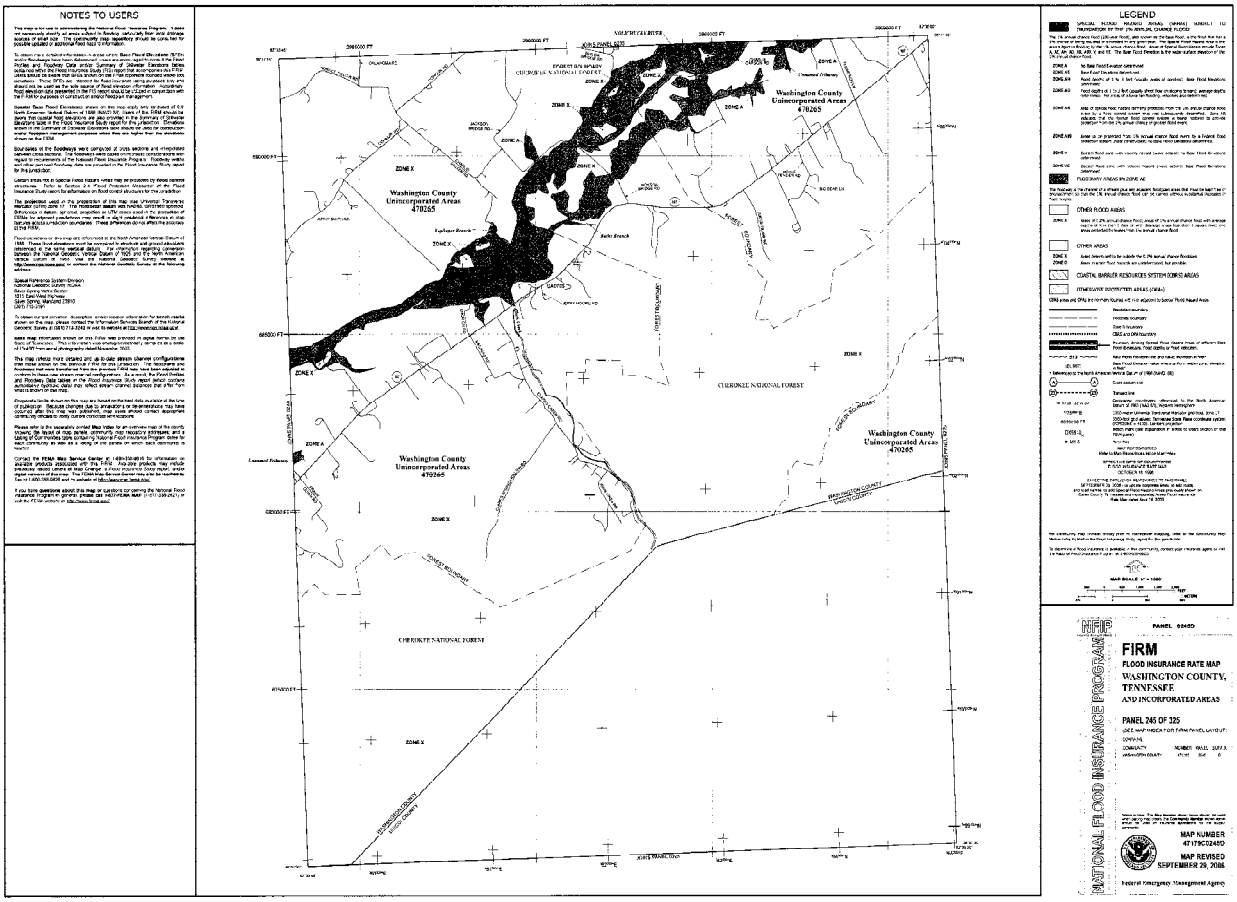
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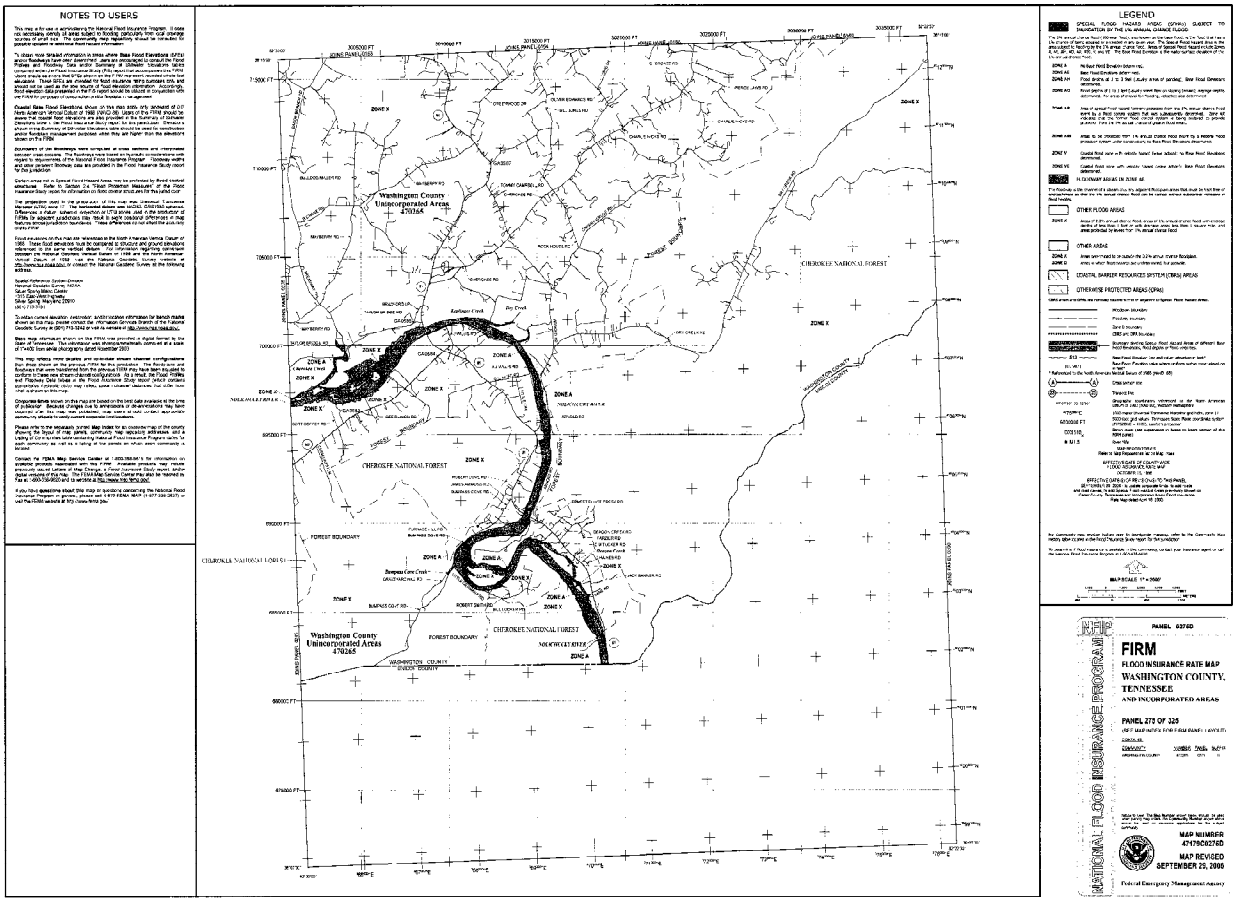
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Federal Emergency Management Agency

Appendix 4 - HAZUS

Hazus: Flood Global Risk Report

Region Name:	Washington_County
Flood Scenario:	Washington_County_500yr_Flood
Print Date:	Thursday, February 27, 2020

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Tennessee

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 330 square miles and contains 4,412 census blocks. The region contains over 51 thousand households and has a total population of 122,979 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 51,646 buildings in the region with a total building replacement value (excluding contents) of 12,354 million dollars. Approximately 91.83% of the buildings (and 71.53% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 51,646 buildings in the region which have an aggregate total replacement value of 12,354 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	8,837,087	71.5%
Commercial	2,003,338	16.2%
Industrial	590,683	4.8%
Agricultural	37,390	0.3%
Religion	276,874	2.2%
Government	57,134	0.5%
Education	551,460	4.5%
Total	**12,353,966**	**100%**

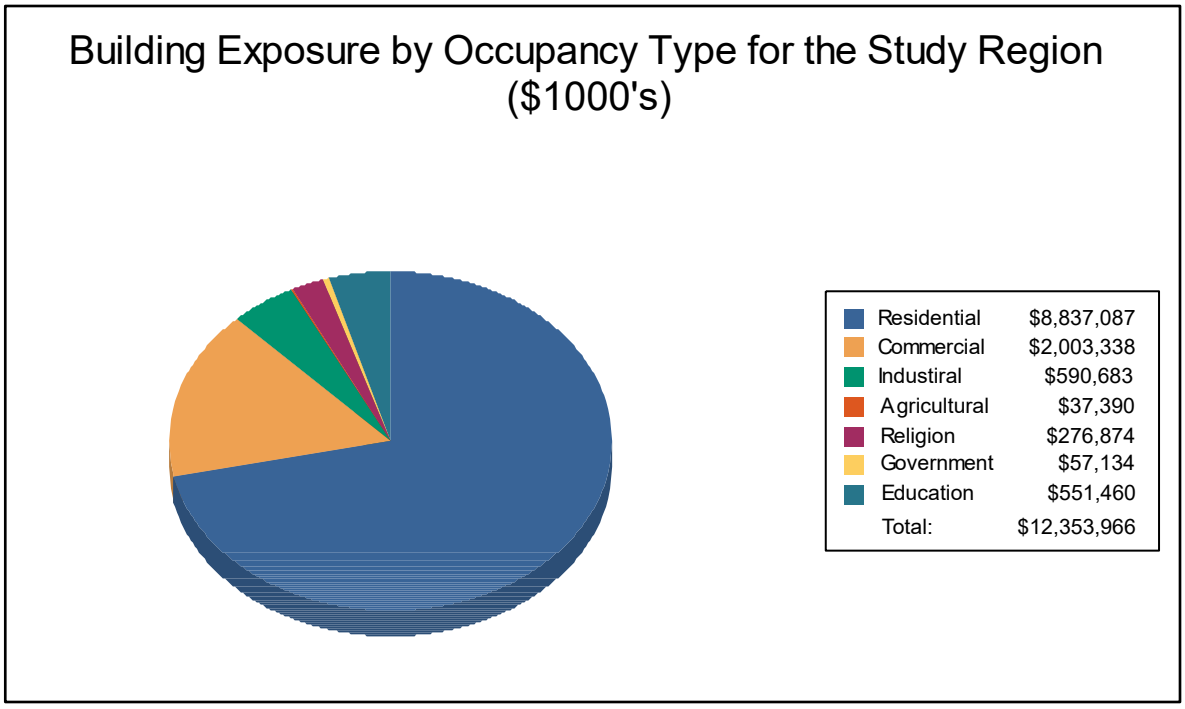
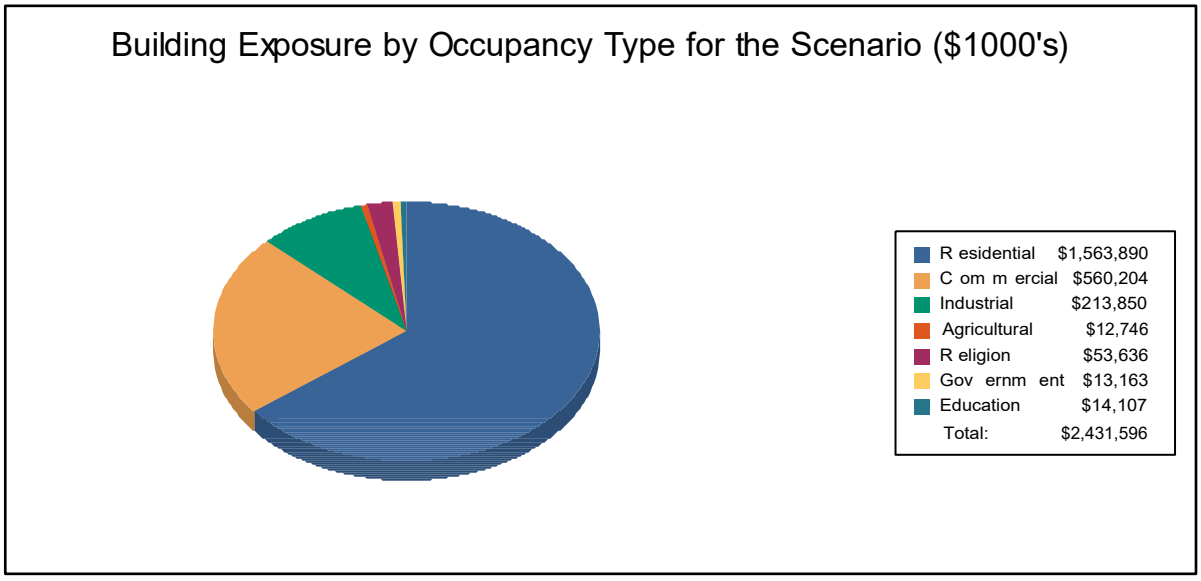


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,563,890	64.3%
Commercial	560,204	23.0%
Industrial	213,850	8.8%
Agricultural	12,746	0.5%
Religion	53,636	2.2%
Government	13,163	0.5%
Education	14,107	0.6%
Total	**2,431,596**	**100%**



Essential Facility Inventory

For essential facilities, there are 5 hospitals in the region with a total bed capacity of 1,257 beds.
There are 32 schools, 8 fire stations, 4 police stations and 2 emergency operation centers.

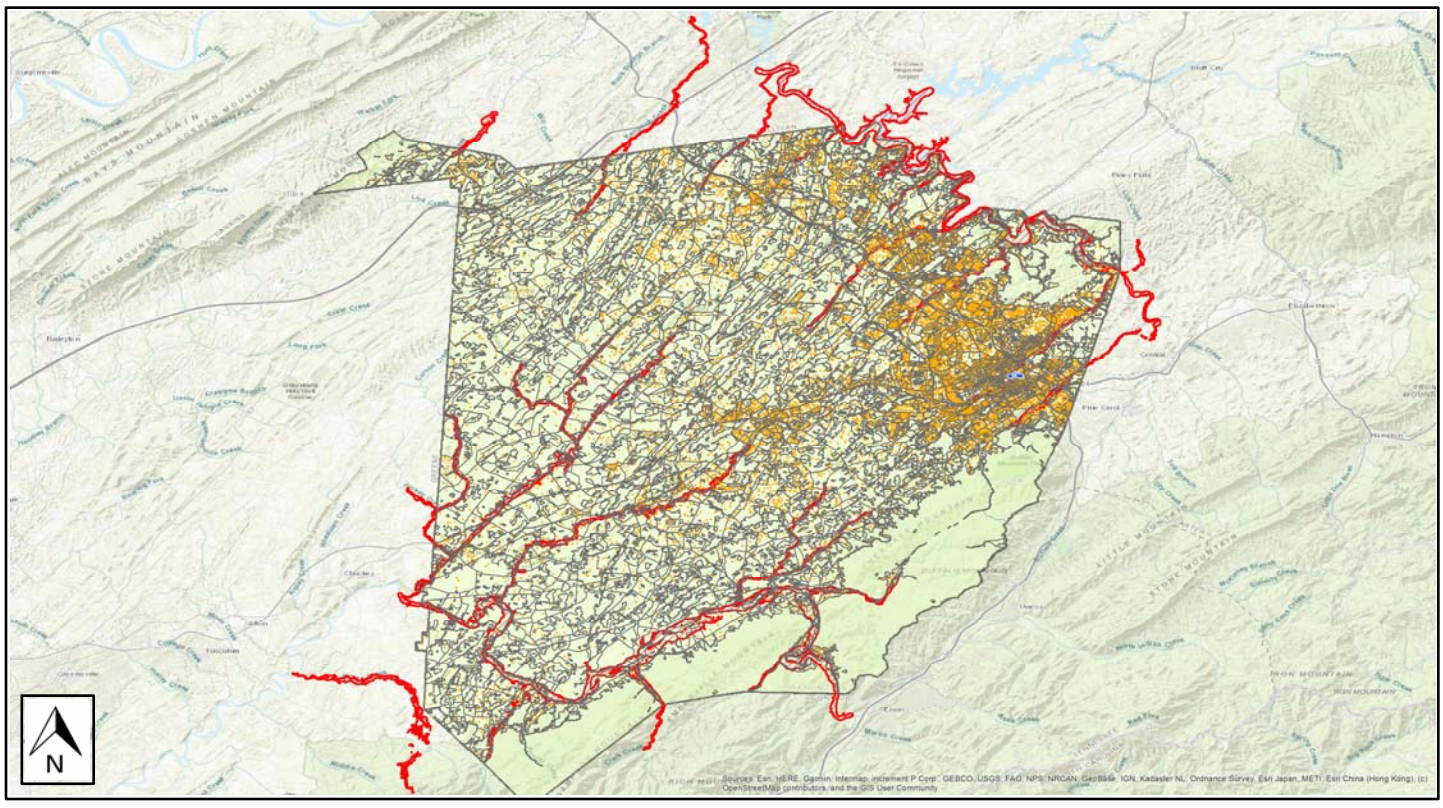
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Washington_County
Scenario Name:	Washington_County_500yr_Flood
Return Period Analyzed:	500
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 113 buildings will be at least moderately damaged. This is over 49% of the total number of buildings in the scenario. There are an estimated 36 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

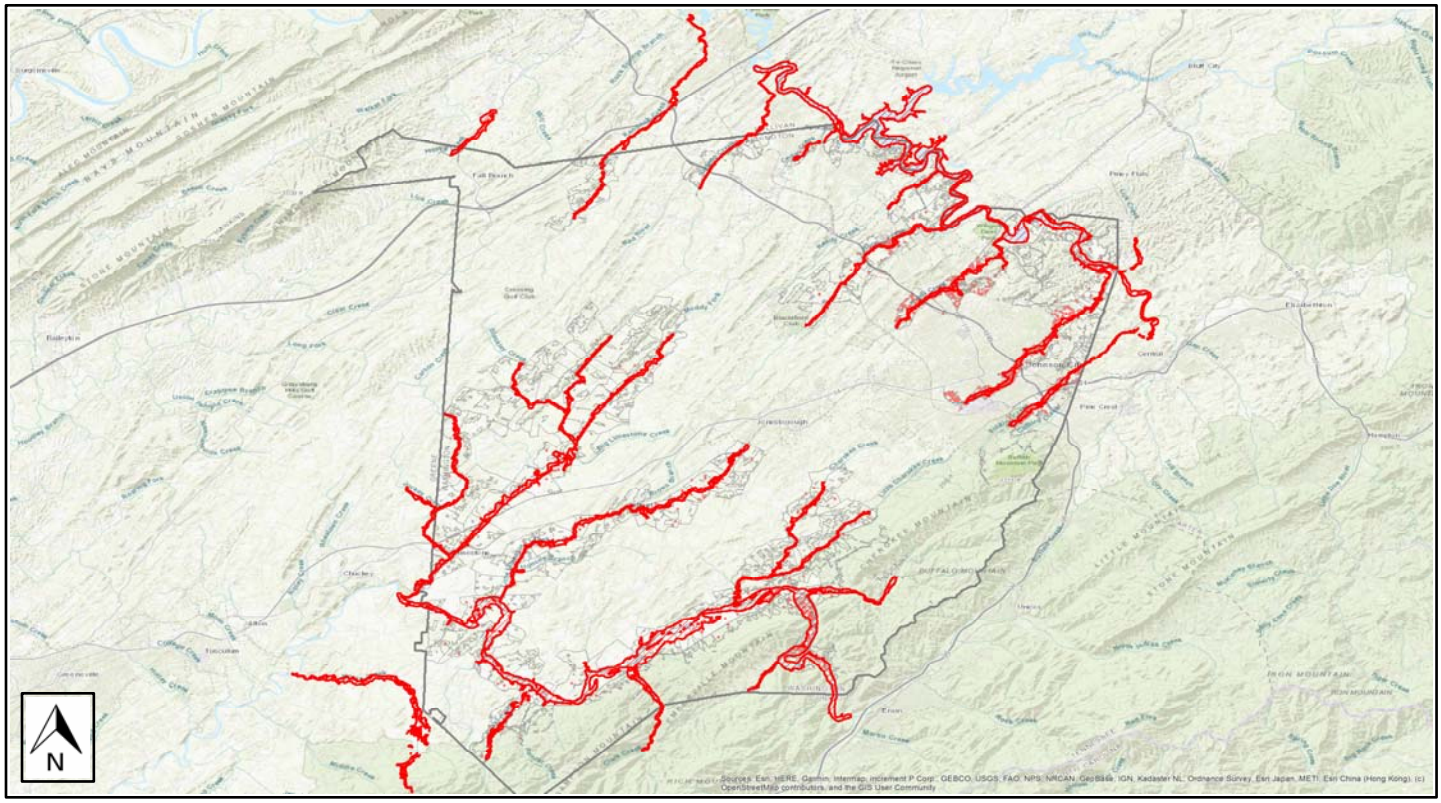


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	1	100	0	0	0	0	0	0	0	0
Commercial	6	33	11	61	0	0	0	0	1	6	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	1	100	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	24	20	35	28	12	10	8	7	8	7	36	29
Total	**30**		**48**		**12**		**8**		**9**		**36**	

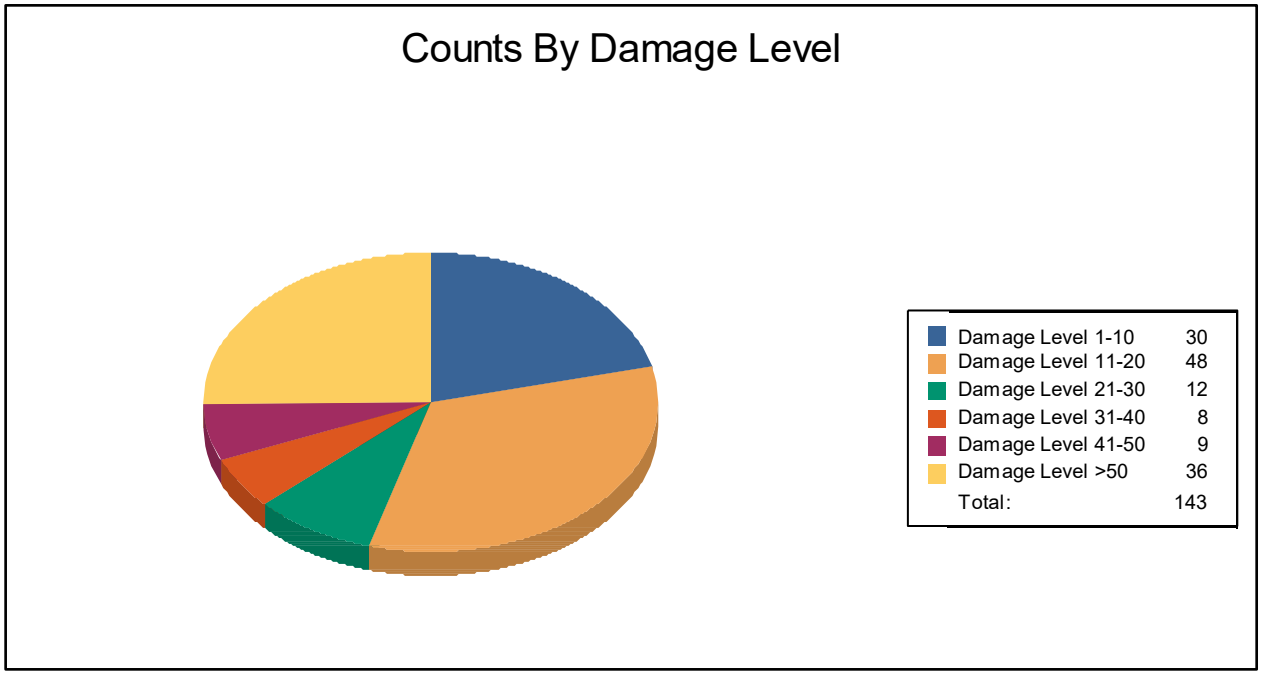


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	1	25	3	75	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	17	100
Masonry	2	40	3	60	0	0	0	0	0	0	0	0
Steel	1	33	2	67	0	0	0	0	0	0	0	0
Wood	23	22	34	33	12	12	8	8	8	8	19	18

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 1,257 hospital beds available for use. On the day of the scenario flood event, the model estimates that 1,257 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	2	0	0	0
Fire Stations	8	0	0	0
Hospitals	5	0	0	0
Police Stations	4	1	0	1
Schools	32	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

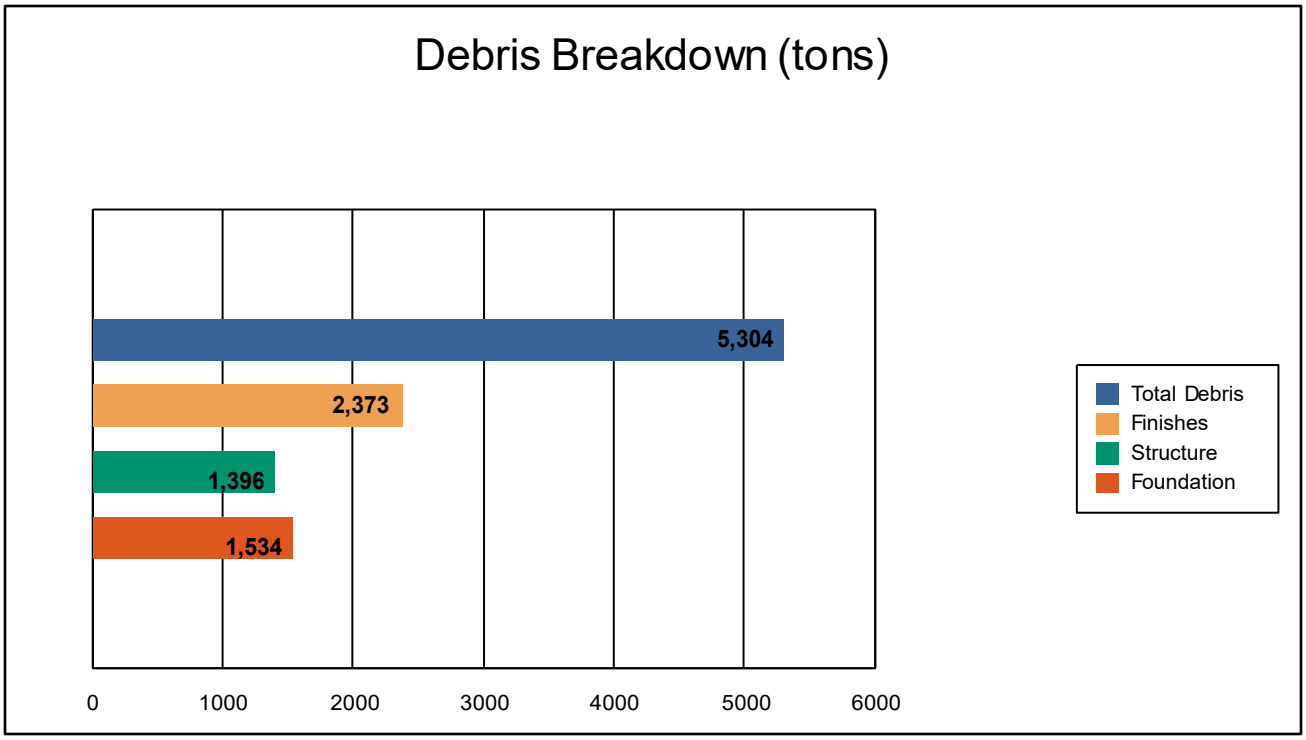
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

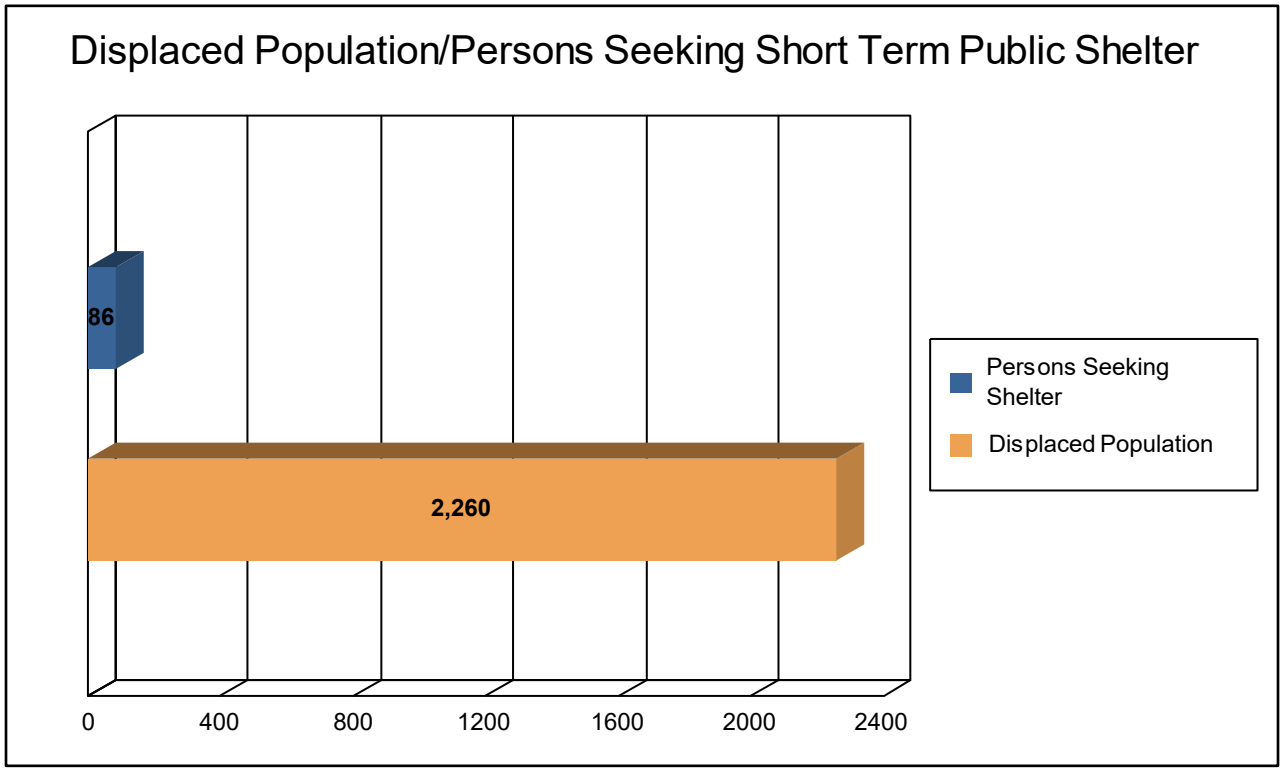


The model estimates that a total of 5,304 tons of debris will be generated. Of the total amount, Finishes comprises 45% of the total, Structure comprises 26% of the total, and Foundation comprises 29%. If the debris tonnage is converted into an estimated number of truckloads, it will require 213 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 753 households (or 2,260 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 86 people (out of a total population of 122,979) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 386.19 million dollars, which represents 15.88 % of the total replacement value of the scenario buildings.

Building-Related Losses

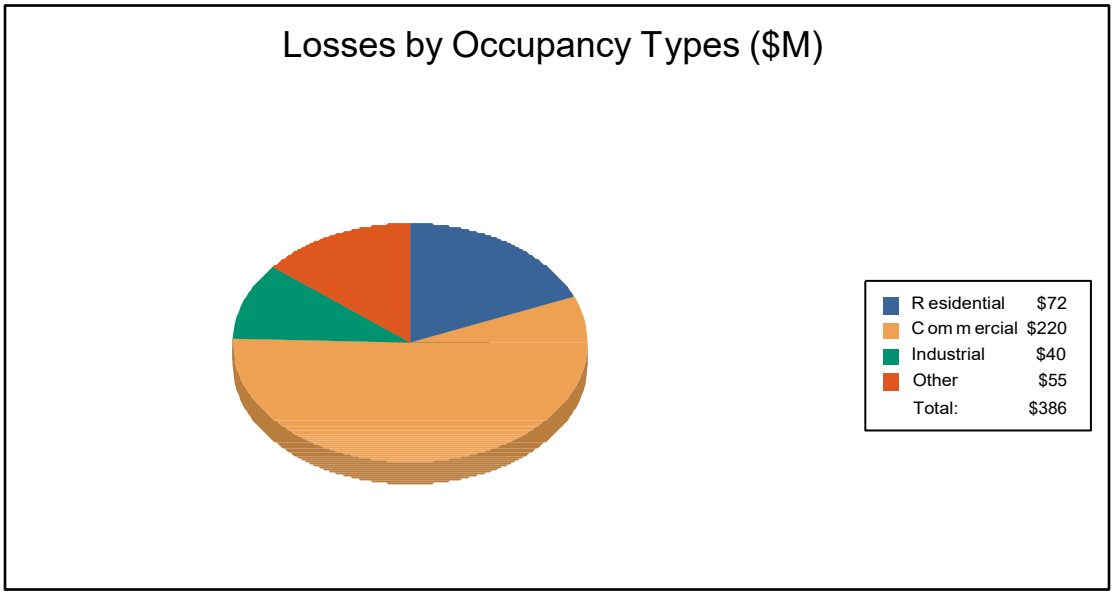
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 190.57 million dollars. 51% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 18.61% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	34.13	20.78	9.45	2.08	66.44
	Content	21.99	61.36	23.86	10.08	117.28
	Inventory	0.00	2.50	4.16	0.20	6.85
	Subtotal	**56.12**	**84.63**	**37.46**	**12.36**	**190.57**
Business Interruption						
	Income	0.25	51.27	0.51	3.56	55.58
	Relocation	10.01	17.62	0.80	1.98	30.41
	Rental Income	4.89	12.97	0.16	0.33	18.36
	Wage	0.59	53.32	0.90	36.46	91.27
	Subtotal	**15.75**	**135.18**	**2.36**	**42.33**	**195.62**
ALL	**Total**	**71.87**	**219.82**	**39.82**	**54.69**	**386.19**



Appendix A: County Listing for the Region

Tennessee

- Washington

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Tennessee				
Washington	122,979	8,837,087	3,516,879	12,353,966
Total	**122,979**	**8,837,087**	**3,516,879**	**12,353,966**
Total Study Region	**122,979**	**8,837,087**	**3,516,879**	**12,353,966**