Natural Hazard Mitigation Plan
for the
City of Athens

Prepared by the Hazard Mitigation Planning Committee

Ric Abel, Mayor

October 2003
Revised JUNE 2004
Revised OCTOBER 2005
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Members of the Natural Hazard Mitigation Planning Committee:

- Bob Troxel, Chair and Fire Chief, City of Athens
- Ric Abel, Mayor, City of Athens
- Ray Hazlett, Assistant Service/Safety Director, City of Athens
- Nick Carr, Director of Utilities, City of Athens
- Terry Courtney, Secretary, Hocking Conservancy District
- Tim Kern, Planning Engineer, Facilities Planning, Ohio University
- Jill Harris, Director, Athens County Emergency Management Agency
- Ron Lucas, GIS Specialist, City of Athens
- David Ingram, President, Near East Side Neighborhood Association
- Steve Ferryman, Environmental Specialist, Division of Water, Ohio Department of Natural Resources
- Bob Eichenberg, Planning Director, Athens County Regional Planning Commission

Funding for this project came from a grant from the Ohio Department of Natural Resources Appalachian Flood Risk Reduction Initiative (AFRRI). The Ohio Department of Natural Resources (ODNR) received a grant from the United States Department of Commerce, Economic Development Administration, in order to make the AFRRI program possible. Each grant provided $5,000 to assist with plan preparation and was matched with a $5,000 local in-kind contribution. Additionally, the ODNR provided technical assistance to map approximately one mile of stream length in order to provide 100-year flood elevation and floodway boundary information. The value of ODNR’s technical assistance for the stream mapping was estimated at $10,000. Margaret’s Creek was the stream that received additional work for updated mapping.
Chapter 1
Introduction

Section 1 – Natural Hazard Mitigation Planning

A Natural Hazard Mitigation Plan provides the means for a region’s population to live safely protected from the extremes of nature’s forces. While life is not risk-free, good planning can help minimize the dangers posed by nature’s extremes. The Federal Emergency Management Agency (FEMA) defines hazard mitigation as “any action taken to reduce or eliminate the long-term risk to human life and property from hazards.” For purposes of this plan, hazards are limited to those events, such as earthquakes, tornadoes, or floods, not primarily activated by human activity. While human activity may be what turns a natural event into a disaster, Mother Nature, rather than human activity, is what initiates the natural event.

Natural hazard mitigation planning involves participation in a process that accomplishes the following:

- Natural hazards analysis – Previous natural hazard events are studied to determine which natural hazards should be given priority status in the Plan.
- Asset identification – Structures and utilities that are vulnerable to natural hazard events are identified.
- Loss estimation – The amount of loss from a given scale hazard event (such as the 1% annual chance flood\(^1\)) is calculated.
- Mitigation strategy – Goals and actions that reduce risk from hazard events are proposed.
- Gathers public input and provides information to the public – Citizen input is sought and information about the planning process is regularly provided.

The Disaster Mitigation Act of 2000 (DMA2K) requires that a natural hazard mitigation plan be developed before a community can be eligible for some forms of federal disaster relief. The Ohio Natural Hazard Mitigation Planning Handbook states, “The purpose of the plan is to ensure that the community has established goals and objectives, in addition to a well thought out process for mitigating future damages before approving projects.” It also says that “a community or jurisdiction without a natural hazard mitigation plan will not be eligible for most sources of mitigation funding.”

Section 2 – Information About the City

The City of Athens is located in Athens County in southeastern Ohio approximately 75 miles southeast of Columbus, the state capitol. The City’s population

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1 The 1% annual chance flood is the magnitude of flooding that has a statistical chance of occurring once every 100 years. This does not mean that a large magnitude flood won’t happen more frequently than once in a great while. Because we are dealing with unpredictable weather patterns and statistical odds, it is possible to have several large floods within close proximity to one another. Also, a large flood that has a 1% chance of occurrence in any given year.
is 21,342 according to the 2000 census. Of this number, approximately 5,000 are considered year-round residents and the remainder are transient students. Ohio University is the City’s largest employer. Several major transportation routes pass through the City limits. U.S. route 50 travels in an east-west direction and U.S. route 33 travels in a north-south direction.

The City has 6,715 housing units and covers an area of 8.34 square miles. The City’s population density is 2,560 residents per square mile and housing density is 806 units per square mile. For comparison, Ohio’s population density is 277 residents per square mile and its housing density is 117 units per square mile. The same numbers for the City of Columbus are, respectively, 3,384 and 1,556. Additional City census data can be found in Appendix 1.

The City is an urban place located in a rural, regional setting comprised of the rugged topography that makes up the unglaciated Allegheny Plateau region. The landscape is comprised of hills, narrow ridges, and stream valleys. Underlying bedrock is composed of shales, siltstone, sandstone, limestone, and coal. The shales have weathered to produce many soils that are prone to instability. The narrow stream valleys have historically been chosen as settlements because they offer some of the flattest ground for building. Unfortunately, the same stream valleys are prone to flooding and have been the sites of flood disasters since people settled the area.

Elevations in the City range from a low of less than 630 feet to a high of slightly more than 1000 feet. The Hocking River, with an overall watershed of 1,200 square miles, drains the City and travels through it or adjacent to it for approximately eight miles. A significant portion of the population of the City of Athens lies within the floodplain created by the 1% chance flood.

After the serious floods of 1963, 1964, and 1968, the Hocking Conservancy District was created to provide flood control for the City. A reach of the Hocking River approximately five miles long was channelized to reduce the losses from flooding. Since its completion in 1970, the channelization project has kept floodwaters from the heart of town. There has been nuisance flooding on some of the roadways leading into town and flash flooding on some of the tributaries continues to be an issue. The channelization project has worked as intended, however, the channelization project was not designed to prevent flooding from larger magnitude floods such as the 1% chance flood.

Appendix 2 shows the location of Athens County within the state of Ohio and Appendix 3 shows a base map of the City of Athens.

Section 3 – The Planning Process

The planning process used by the City of Athens followed a combination of guidelines set forth by the Federal Emergency Management Agency, the Ohio Department of Natural Resources, the Ohio Emergency Management Agency, and the Athens County Regional Planning Commission. The planning process took
approximately two years (early 2002 to early 2004) from initial organization to submittal of a draft document. Committee meetings were usually well attended by committee members and open to the public. Meeting agendas were designed to gather and discuss specific needs for the planning document. The planning process involved the following general steps:

- Organizing to plan
  - The City Plan Committee was represented by:
    - The Mayor, Assistant Service-Safety Director, Utilities Director, GIS Coordinator, and the Fire Chief. The entire City staff brought a body of knowledge about assets in the City. The GIS Coordinator prepared detailed hazard maps and had extensive data about City and University assets. The Fire Chief had valuable experience with hazard planning and emergency response.
    - Planning Director of the Athens County Regional Planning Commission who has experience with natural resource and hazard planning;
    - Athens County Emergency Management Agency Director;
    - David Ingram, a citizen of Athens who is a professor at Ohio University, a member of the City’s Tree Commission, and a member of the City’s near East Side Neighborhood Association;
    - Tim Kern, an engineer with Ohio University’s Facility Planning Office. Tim assisted with the preparation of the University’s flood hazard plan;
    - Terry Courtney, Secretary of the Hocking Conservancy District, the administrative body for the flood control project through the City of Athens.
    - Steve Ferryman, Environmental Specialist, ODNR Division of Water, Floodplain Management Section. Steve has experience with resource management and hazard mitigation.
  - Members of the planning committee were chosen from the community and represented local government, the citizenry, neighborhood organizations, and Ohio University. The Athens County Regional Planning Commission agreed to provide technical assistance and write the plan. It was determined by the committee to hold monthly meetings.
  - A total of four public meetings were planned at various stages during plan writing to allow citizens an opportunity to participate in the process. Local media was also given information about the process and some coverage was provided. Appendix 4 contains a sample advertisement and newspaper articles. In addition to the formal public meetings all plan committee meetings were advertised and open to the public.
  - Letters were sent to agencies and organizations that have an interest in this plan and may wish to offer comment. A list of letter recipients is shown in Appendix 5. Representatives from the United States Geological Survey and the Ohio Department of Transportation also attended one of our meetings in order to gather and provide information. Meeting facilitation and technical assistance was provided by the ODNR Division of Water, Floodplain Management Program as part of the AFRRI grant.
A review of existing plans and legislation insured that this mitigation plan would be woven into the City’s planning process. The City has zoning, subdivision regulations, a housing code, a land development ordinance, a floodplain management program, and a comprehensive planning process. The land development ordinance pays particular attention to natural hazards by addressing stormwater and landslide potential. The comprehensive plan will attempt to incorporate aspects of the hazard mitigation plan.

- Identify natural hazards that affect the City
  - Previous natural hazard events were profiled to help determine levels of risk for each hazard.
  - Information from the profile in the previous step was quantified according to hazard probability and expected impact from the hazard. A high, medium, or low risk value was then assigned to each hazard.

- Vulnerability assessment
  - Asset identification – Residences, public buildings, critical facilities, and businesses were identified.
  - Potential loss estimation – Data from the County Auditor, utilities, and FEMA were utilized to calculate asset losses for hazards listed in the high risk categories.
  - Future land use as it relates to natural hazards was analyzed.

- The Plan
  - The current status and desired status of the City’s hazard vulnerability were analyzed.
  - Problem statements, or reasons why the City was not achieving its desired status, were produced.
  - Goals, objectives, and activity steps were created.
  - Plan implementation and maintenance components of the Plan were developed.
Chapter 2
Natural Hazards that Affect the City

Section 1 – Natural Hazard Assessment

With only a few exceptions, the various natural hazards that might impact the City of Athens at some future time have likely been the same natural hazards that have historically impacted the City. Barring a major change in weather patterns, extreme weather events will likely occur in a similar fashion as the historic record indicates. There is a lively debate in scientific and policy-making communities about the causes and impacts of global warming. Because the variables are so many and the science about global warming is still in its infancy, this Plan will not attempt to predict future weather patterns different from those of the past.

When a hazard assessment is performed, it is important to realize that unique and extreme environmental conditions are necessary to create extreme hazards. For instance, widespread flooding conditions are the result of strong low pressure weather systems that bring in large quantities of moist air. The flooding can be made worse if the rain occurs on already frozen ground during a rapid period of snow melt. Occasionally several strong weather systems will pass through an area within days of each other and if each brings large rainfall amounts, the flooding can be made much worse. On a similar note, while highly unlikely in southeastern Ohio, should an earthquake occur when our slip prone soils are already highly saturated we could be faced with landslides that are larger and more frequent than those to which we are accustomed.

Generally speaking, the more severe or extreme the natural event, the less likely its occurrence because of the unique circumstances required for that extreme event to happen. While any scale tornado in Athens County is rare, a truly large and destructive tornado has never happened and its chances of happening are extremely remote due to topography and weather patterns. While flooding in the City is not uncommon, large floods that cause significant damage are rare and the largest floods that can cause catastrophic damage are extremely rare. Because we are working with chance events however, large floods can occur in close sequence as happened to the Village of Amesville, in northeastern Athens County, when a record flood in 1997 was followed by a record flood in 1998 that measured six feet higher than the 1997 flood.

The hilly and rugged topography in the City of Athens has an effect on natural hazards. Extremely cold weather can be intensified in low lying valleys where denser, cold air collects. Steep terrain can increase the intensity of flash flooding due to the velocity with which floodwaters run off of the land. The steep terrain is the fundamental physical feature required for landslides and rockfall. Heavy, water-absorbing, clay soils that are present in the City also contribute to the extent and severity of the landslide/rockfall hazard. The steep terrain is also a mitigating factor with the high wind, blizzard, and tornado hazards in that the hills can help to block or break up the wind direction and velocity at the microclimatic scale.
With the exception of earthquakes, natural hazards are associated with extreme events of weather. Even landslides require moisture and are more likely to occur after heavy rainfall events. Our climate has much to do with the type and severity of hazards that we face. An excellent book, Thunder in the Heartland, describes Ohio’s climate and weather extremes as follows:

“…Ohio is in the middle latitudes, at low elevations, in the eastern interior of North America, and south of the Great Lakes. This location in the Heartland of North America gives Ohio a climate with four distinct seasons, large seasonal temperature ranges, frequent precipitation, and the wide variety of weather so typical of the middle latitudes.

Severe and extreme weather of various sorts are also typical of the Heartland. Temperatures in Ohio have ranged from 113 degrees to nearly – 40 degrees. Frosts have blackened corn in July and shirtsleeves weather has prevailed at Christmas. Blizzards have isolated communities for days and flood waters have surged twenty feet deep through the main streets of Ohio’s cities….Drought has withered crops, hail the size of baseballs has punched through roofs of homes, and winds have blown lake freighters through bridges, trains off tracks, and homes onto sleeping occupants.”

The first step of hazard identification is the production of a list of the natural hazards that could occur in the City. Between the expertise provided by members of the planning committee and historical research from a variety of sources, the following list of hazards for the City was compiled. The list is alphabetical and not in any particular order of likelihood of occurrence or severity.

- Dam failure
- Drought
- Earthquake
- Extreme heat
- Extreme cold
- Flooding (Flash)
- Flooding (Riverine)

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3 The primary source for identifying hazards was the National Weather Service’s list of Athens County Natural Hazards, a comprehensive list of historic natural hazards, their severity levels, and damages caused. Other sources utilized were articles printed in the Athens Messenger detailing outcomes of previous natural hazard events, particularly the flood hazard. The Regional Planning Commission, the County Emergency Management Agency, and the Ohio Department of Natural Resources, Division of Water worked cooperatively to identify these sources and bring them before the Hazards Planning Committee.
4 Land subsidence and pestilence were considered but not included. There are no abandoned underground mines, common in southeastern Ohio, within the City’s corporate limits so subsidence is highly unlikely. Pestilence is a natural hazard but the Ohio Department of Health is so equipped to deal with such hazards that pestilence was not included in the scope of this Plan. Also ruled out because environmental conditions make the hazard’s occurrence impossible are avalanche, coastal erosion, coastal storm, hurricane, tsunami, and volcano.
5 Dam failure is included, even though it is an event caused by failure of a manmade structure, because such failure will most likely occur during or after a flood event.
• Hail
• High wind
• Ice Storm
• Landslide/Rockfall
• Thunderstorm and Lightning
• Tornado
• Winter storm/Blizzard
• Wildfire

Section 2 – Natural Hazard Profiles

The second step with hazard identification is profiling the hazards. Profiling uses historic documentation and currently available information and technology to assess the comparative degree of risk between the various hazards. Details of hazard events by type, date, time, location, magnitude, damage type and amount, and additional information are available in Appendix 6. The spreadsheet in Appendix 6 shows historical information about previous natural hazards and helps to organize information so that the hazards that pose the greatest risk can be given the most attention in the Plan.

The National Weather Service’s Athens County Natural Hazards (Appendix 6) was used in conjunction with probability definitions as provided by the Red Cross (Appendix 7). A limitation of the National Weather Service data is that smaller local events are not always captured in the data. The City of Athens will include an extra statistic, ‘natural hazard type’ in its police reports so that local natural hazard events can be quickly recalled for future hazard planning efforts. The table and chart in Appendix 7 show how the AFRRI planning committee ranked the various natural hazards according to each hazards’ relative risk. Risk was determined by multiplying a score for the probability of the hazard's occurrence by its possible impact. Probability and impact rating definitions are included. Each hazard identified by the Planning Committee will be described below. The hazard will be defined, explanations about historical events involving the particular hazard will be provided, and sources of information will be described, if necessary. Some of the historic weather data cited is at the county level. If a weather event occurred in the county at some previous time it is assumed that the same weather event or outcome could happen in the City, with the possible exception of flash flood severity (less in the City than in the County).

Subsection 2a – Dam Failure

There are several impounded water bodies in Athens County that could have an affect on the City of Athens were one or several of the dams holding this water to fail. The large water bodies are Burr Oak Lake, Dow Lake, and the lakes that make up the Margaret Creek Conservancy District. The Margaret Creek Conservancy lakes are Meeks Lake, Lake Snowden, site number 4, site number 5, and Fox Lake. The Burr Oak dam is managed by the Corps of Engineers, the Dow Lake dam is managed by the Ohio Department of Natural Resources, Division of Water Dam Safety Section, and the Margaret Creek Conservancy District manages the remaining five lakes.
Burr Oak Lake, impounded by the Tom Jenkins Dam located in Athens County, and Lake Snowden in southwestern Athens County could have an affect on downstream areas should the dams fail. These dams are rated Class I. According to the ODNR, dams in Ohio have been divided into four classes; I, II, III, and IV based upon downstream threat potential. The failure of a class I dam will likely result in loss of life and pose a serious hazard to health and property in the inundation area. A class I dam has a volume capacity over five thousand acre-feet or a height greater than sixty feet. Exempt from Ohio’s regulatory authority are dams less than six feet in height regardless of storage volume, dams less than 10 feet in height with not more than 50 acre-feet of storage, or not more than 15 acre-feet of total storage regardless of height.

Dam failure is defined by the Army Corps of Engineers as “any condition resulting in the uncontrolled release of water other than over or through a spillway or outlet works”. While dam failure is a highly unlikely event it is still possible and any natural hazard plan needs to consider it. The Flood Emergency Plan for Burr Oak Lake discusses inundation maps and states, “The attached maps indicate the area which would be flooded under the hypothesized conditions of: a) occurrence of a spillway design flood at Tom Jenkins Dam; and b) occurrence of a failure of the dam concurrent with a spillway design flood. The possibility is extremely remote that either condition will occur.” Failure of a dam will only occur during a major rainfall event when the impoundment has reached capacity and can no longer hold back the flow. Dams are designed with emergency spillways that allow for a controlled overtopping of the structure. In this way damage to the structure is non-existent or greatly reduced. However, should a dam fail, the damage below it can be far reaching and severe.

During a heavy rainfall event in March 1997, water flowed over emergency spillways at Meeks Lake, site #4, and site #5. Subsequent to the 1997 floods, the dam at Lake Snowden was elevated to what is considered a “100% level”. According to Scott Jerome, a planning engineer with the Natural Resource Conservation Service, a dam at this level is capable of holding 24”-28” of rainfall in an eight hour period. Historically, this is more than the twice the amount of rainfall that has fallen in the Athens area.

Inundation maps were produced for the Margaret Creek Conservancy lakes and for Burr Oak Lake. The inundation map for Margaret Creek does not contain flood elevations but a comparison between it and the FEMA 1% chance floodplain map indicates that the area affected is significantly larger than the 1% chance flood along some reaches of the Creek. The Burr Oak Flood Emergency Plan for the Tom Jenkins Dam calculated floodwater arrival times, peak flood times, and water elevations at various cross sections on the Hocking River from Nelsonville to Guysville in the events of a spillway design flood and dam failure. The spillway design flood is defined by the Corps of Engineers as “the maximum flow which a dam’s spillway is designed to pass safely.” At cross section #36, near the location of the Convocation Center on Ohio University’s campus, the following data was provided:

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6 One acre-foot is the amount of water that covers one acre to a depth of one foot or about 326,000 gallons.
7 Burr Oak Inundation Plan and Map, U.S. Army Corps of Engineers
Subsection 2b – Drought

Drought is a normal, recurrent feature of climate. In general, a drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. This deficiency is often the result of a persistent high pressure that lowers humidity, precipitation and cloud cover and blocks moisture from entering the region. Droughts are slow, coming without warning over several weeks. They can effect vegetation, crops, and the water supply and can contribute to extreme heat events and wildfires.

Predicting drought is difficult because it relies on forecasting so many variables, primarily temperature and precipitation. Drought in Ohio has been recorded since 1895 using the Palmer Hydrological Drought Index (PHDI). Since then, six great Ohio droughts have occurred in 1895, 1930-31, 1934, 1953-54, 1963-64, and 1988. Droughts are usually widespread phenomena so that a drought elsewhere in Ohio or even nationally will affect southeastern Ohio. Additional information about droughts can be found at http://www.drought.unl.edu/index.htm.

Subsection 2c - Earthquake

The City of Athens has a relatively low susceptibility to severe and damaging earthquakes. According to the United States Geological Survey, Athens County has a Peak Ground Acceleration (PGA) of 2.626851 %g with a 10% chance of being exceeded over 50 years. The PGA is a measurement of the strength of ground movements and is used to determine the maximum severity of a possible earthquake. The City’s PGA value is low and there has only been one recorded earthquake, that being in 1886. The PGA for Athens City means that the maximum severity of an earthquake will be relatively small (2.6%) with a 10% chance of an earthquake exceeding this severity over 50 years. The USGS Peak Acceleration map in Appendix 8 also shows Athens City to have dark gray shading, coinciding with a PGA between 2 and 3%g with 10% chance of exceedance in 50 years. The Historic Earthquake Map for Athens County obtained from the ESRI/FEMA Project Impact Hazard Site (http://data.esri.com/hazards/makemap.html) shows the 1886 earthquake had a magnitude between 2 and 3.

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8 Schmidlin, p. 147.
**Geo Facts**, by the Ohio Department of Natural Resources, Division of Geological Survey identifies Southeast Ohio as “particularly susceptible to seismic activity.” Ten earthquakes have occurred in the area, with minor to moderate damage occurring in Scioto, Meigs, and Perry County. A map also identifies the previously mentioned Athens County earthquake of 1886. It shows the earthquake’s intensity to be between IV and VI on the Modified Mercalli Scale. A level VI earthquake, the most extreme possible level of the 1886 earthquake is characterized as follows: “Felt by all, many frightened and run outdoors; falling plaster and chimneys, damage small.”

Subsection 2d – Extreme Heat

According to FEMA’s website, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity that the body cannot tolerate. Extreme heat in Ohio, with temperatures of 110 degrees or more can have a disastrous effect on the state.

A necessary condition for extreme heat in Ohio is a Midwest drought. Soils and vegetation are dry during these droughts, allowing the hot, dry air from the Southwest to enter Ohio without the cooling effects of evaporation. Ohio heat waves are most severe in Southern Ohio, while the Northeast is tempered by the cooler waters of Lake Erie.

Extreme heat in Southeastern Ohio can have widespread effects on human health, energy use, vegetation and crops, and the behavior of construction materials. In addition to the high temperatures, the duration of a heat wave plays an important role in how people are affected. When extreme heat periods last more than two days, an increase in these effects occurs. Specific populations in Athens County that are at a high health risk during periods of extreme heat include the elderly, young children, isolated individuals, people without access to air-conditioning, and those with respiratory difficulties.

Southeast Ohio has a history of both high temperatures and prolonged heat waves. On August 6, 1918 Amesville (Athens County) recorded 110 degrees, a state record. Excluding a suspicious 113-degree reading in Gallia County, Amesville exceeded the previous highest Ohio temperature of 108 degrees in Pomeroy, Ohio.

The summer of 1934 again brought extreme heat to Southeast Ohio. It was preceded by the driest May in history. It is estimated that 160 Ohioans died from heat during the 1934 summer heat wave. On July 21, 1934 Gallipolis recorded a temperature of 113 degrees, the hottest temperature ever recorded in Ohio. Southeast Ohio also experienced extreme heat periods in July of 1936, August of 1947, August of 1983, and June of 1988.

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9 Schmidlin, p. 129
10 Schmidlin, p. 131.
11 Schmidlin, pp. 133-146..
FEMA provides information on Extreme Heat at http://www.fema.gov/rrr/talkdiz/heat.shtm. This site has tips on how individuals can plan for extreme heat, and what to do during a period of extreme heat.

Subsection 2e – Extreme Cold

The lowest temperatures in the wintertime come with arctic air masses from Canada. The coldest temperatures occur after a low pressure storm system has passed and left a fresh covering of snow. Arctic air follows as a high pressure system and centers itself in the Midwest. Clear skies will allow heat to radiate to space and the snow cover serves as an insulator between the warmer earth and the colder air.\(^\text{12}\)

The state’s coldest temperatures are not in the north, but in the valleys of southern and central Ohio. The hilly topography allows cold air to settle in valleys and some of these areas are far enough away from the temperature moderating effects of the Ohio River. The official record cold temperature for Ohio was –37\(^o\) set in 1912 near New Lexington in Perry County. January 19, 1994 was the greatest cold wave in Ohio when a greater part of the state registered –25\(^o\) or less than at any previous time on record. There were unofficial temperature readings of –40\(^o\) in Athens County.\(^\text{13}\)

Flooding

The flood hazard is broken into two types of flooding, flash and riverine.\(^\text{14}\) Before discussing the particulars of each type of flooding, some background information about flooding, in general, is warranted. Flooding is the phenomenon of drainageways (creeks, runs, streams, tributaries, branches, forks, and rivers) receiving more water runoff than they can contain within their banks. As water flows over the waterway’s banks it occupies low lying areas, known as floodplains, adjacent to the waterway. The magnitude of floods is measured by their frequency interval or how often they occur, at that magnitude, on average. A large flood that only occurs, on average, once every 100-years is known as a 1% annual chance flood. A flood of this magnitude has a 1% chance of occurring in any given year.

It takes unique climatic circumstances to create large-scale flooding on major streams and rivers. Contributing factors can include already saturated soils, snowmelt, and intense rainfall. The intense rainfall comes from strong low pressure weather systems that can occur in quick succession.

Larger waterways on more gently sloped land have larger watersheds and it takes longer for the flood to reach its peak level. This leads to what this Plan terms a riverine

\(^{12}\) Schmidlin,
\(^{13}\) Schmidlin,
\(^{14}\) In its Hazard Analysis and Risk Assessment, the Ohio EMA breaks floods into four categories: riverine, flash, urban and small stream, and coastal. For simplicity, this Plan will combine flash flooding with urban and small stream flooding under the title of “flash flooding.” Since Athens County does not have a Lake Erie coastline, coastal flooding is not an issue.
flood. Smaller watersheds in steeper terrain will drain faster and the streams will therefore rise more quickly and fall more quickly. Water velocity will also be greater on more steeply sloped terrain. The rapid rise of high velocity water leads to what is termed a flash flood. These floods can be dangerous because of the force of the rushing water and because there is little to no warning before they hit.

The largest natural disaster to impact the state of Ohio was a flood in the spring of 1913. While no part of the state was spared, the greatest impact was felt in the southwestern and west-central portions of the state. Two strong storm systems came through the same geographic areas only two days apart. According to Thunder in the Heartland, a total of 467 persons lost their lives. “Never before 1913, and never since, has so much rain fallen over so much of the state in such a short time.” The Flood of 1913 set the record water levels on many Ohio streams.  

Southeastern Ohio and Athens County were spared the worst of the flooding from the storms of March 1913. While flooding was severe in 1913, other storms have brought higher flood levels in southeastern Ohio. The largest flood on the Hocking River occurred in March 1907 with other large floods occurring in 1873, 1884, 1937, 1945, 1963, 1964, and 1968. The 1968 flood is considered to be the 1% annual chance flood for the Hocking River and is the second largest historic flood that the Hocking River valley has seen.  

Historically, damages from flooding in Athens County have amounted to well over six million dollars. This places flooding as Athens County’s and Athens City’s most costly hazard for property damage. The Flood Risk Map in Appendix 11 shows the areas in the City that will be affected by the 1% annual chance flood.

Subsection 2f - Flash Flooding

The City of Athens experiences periodic flash flooding. Intense thunderstorms will bring creek water out of stream banks on Coates Run, Dairy Run, and along Cable Lane. Fortunately, the majority of these incidents are inconvenient nuisances, at worst. Occasionally, such as occurred in 1997, intense thunderstorms will drop significant rainfall amounts in the City bringing tributaries out of their banks and creating problems for local residents and business owners.

Subsection 2g – Riverine Flooding

The flood of 1907 was the highest flood on the Hocking River. “Fire bells began ringing in the Hocking Valley to warn of the impending flood on Wednesday, 13 March. The Athens Journal reported a great flood along the Hocking with several lives lost and a wide disruption of communication and transportation. Dozens of homes in Athens were swept away, overturned, or lifted off foundations. Telephone and telegraph wires were

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15 Schmidlin, p. 172.
17 National Climatic Data Center, a summary of severe weather events.
down and the waterworks and electric lights plants were flooded. Rail lines all along the Hocking were cut by the raging river. Large areas of Athens were inundated, causing large losses among business and railroads……Several commercial buildings at Gloucester (Glouster) were lifted and washed away by Sunday Creek, including three grocery stores, a restaurant, and Will Reese’s poolroom, according to the Athens Journal. Many homes and other businesses were damaged. The coal mines around Gloucester suffered heavy losses. Mine 256 was flooded, resulting in the loss of thirteen horses, machines, motors, cars, and other equipment. All homes in Trimble were flooded.”

As much as 8 inches of rain fell in the Hocking River watershed during 4-10 March 1964 and brought major flooding to Athens County. The Hocking River crested in Athens on March 11 at 24.15 feet. The flood level was the highest since 1907.

Two heavy rain periods within five days of each other brought flooding to the Hocking River valley between May 23rd and May 27th, 1968. Three to six inches of rain fell on already saturated soils on 23-24 May. The Hocking River reached flood stage on May 24th. The rapid rise of waters from this flood prevented residents from moving personal belongings out of harm's way. Even though riverine flooding happens more slowly than flash flooding, it is apparent that floodwaters on the Hocking River can still rise rapidly enough to catch people off guard.

The most recent large flood to impact the City of Athens occurred in March of 1997. The City was included in the federal disaster declaration area and received $61,865 from FEMA.

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18 Schmidlin, pp. 170-171.
19 “Athens County schools dismissed early to allow buses to deliver children home before roads were flooded by rising rivers, and Ohio University students removed their cars from basement garages at West Green dormitory. National Guard troops, firemen, and police worked through the night to evacuate residents of Rockbridge and South Logan upstream along the Hocking River…..All schools and main highways were closed in the region on Wednesday, mail delivery was curtailed, fifteen hundred Ohio University students were evacuated, and 380 Athens homes were flooded, according to the Athens Messenger.” (from Thunder in the Heartland).
20 “The Hocking River reached 24.63 feet at Athens, more than 7 feet above flood stage and the highest since 1907. All communities along the Hocking were flooded, and roads, schools, businesses, and factories were closed throughout the river basin. Amesville businesses were flooded and for the first time in memory, there was water on the floor of the First National Bank Building. Three feet of water in Amesville Nursing Home forced residents to the second floor. The Athens Messenger reported that a helicopter delivered food to the stranded nursing-home residents. Homes were evacuated and highways blocked in Nelsonville, Murray City, Logan, Rockbridge, and Chauncey. The quick overnight arrival of the flood prevented residents from moving household goods to higher positions and, even when goods had been moved, they often had not been raised high enough. The flood came at a time of tension on university campuses as students protested the Vietnam War. Ohio National Guardsmen were on duty at Ohio University as a precaution against civil unrest, but instead they saw duty in the flood. The Athens Messenger reported that ‘it was strange to see the Guardsmen and students working together in the flood’ when only days before they had been antagonists.”
Subsection 2h – Hail

Hail forms in thunderstorm clouds as water drops are cooled to form ice pellets and additional water is frozen onto the small pellets in ever larger concentric circles. Strong updrafts allow the pellets to stay aloft for long periods and grow into hailstones. While all thunderstorms contain hail, few thunderstorms produce hail that reaches the ground because it melts back to rain before reaching the earth.\(^{21}\)

A thunderstorm can produce hail for several minutes leaving a “hailstreak” one-half mile or more wide and several miles long. A slow moving thunderstorm can produce hail for twenty minutes leaving hail to a depth of one foot. Any location in Ohio can expect hail on an average of two days per year. Most hail is small and causes no damage except bruising of fruits and vegetables. Hail one inch or more in diameter can cause dents in cars and aluminum siding, break windows, tear awnings, strip leaves from trees, and destroy crops. Animals have been killed by large hail and persons have sustained injuries from large hail. Hail in Ohio has been recorded at up to three inches in diameter.\(^{22}\) According to the NCDC report, hail caused $230,000 damage in Athens County in 2002 and a total of $285,000 damage in the years 1982 to 2002.

Subsection 2i – High Wind

According to Thunder in the Heartland, minor damage to property and vegetation begins with winds at speeds as low as 45-50 mph. Trees are uprooted or snapped off by winds at 60-70 mph. Additionally, shingles are blown from roofs, windows are broken, electric and telephone lines are blown down, and mobile homes may be pushed off foundations or overturned. At wind speeds greater than 100 mph, large trees are uprooted or snapped off, moving cars are blown off roads, mobile homes are demolished, and roofs are blown from frame houses. Winds of more than 150 mph tear roofs and walls from well-built frame homes, toss cars through the air, and topple entire forests.\(^{23}\)

Besides tornadoes there are two types of damaging winds in Ohio, large-scale and microburst. Large scale winds with speeds greater than 50 mph may occur behind a cold front associated with an intense low pressure system. Such winds may cover an extensive area and last for several hours. Microbursts are strong downdrafts, associated with thunderstorms. They can be as large as one mile wide and two to three miles long. The winds descend from a thunderstorm, strike the ground, and spread out in a fan shape.\(^{24}\)

The Athens area has had a number of high wind events according to the NCDC Storm Events Report. The report showed that a severe high wind event occurred in the City on August 9, 2000, in which eight people were injured. The Athens Messenger, in an

\(^{21}\) Thunder in the Heartland, p. 303.
\(^{22}\) Ibid., pp. 303-304.
\(^{23}\) Schmidlin, p. 227.
\(^{24}\) Thunder in the Heartland, p. 227.
article titled *Storm collapses tent; 8 injured*, August 10, 2000 reported “a powerful thunderstorm caused the collapse of a tent covering the swine show ring at the Athens County Fairgrounds...At least eight people were treated by O’Bleness Memorial Hospital for personal injuries.” Another high wind event, associated with thunderstorms occurred on June 4, 2002. One home was severely damaged when a tree was blown onto it. Overall damage was estimated at two hundred thousand dollars for that particular storm event.

Subsection 2j – Ice Storm

An ice storm occurs when precipitation occurs as rain but below-freezing temperatures on the ground cause the rain to freeze onto any objects with which it comes in contact. Ice storms create hazardous driving and walking conditions and can add significant weight to overhead utility cables and tree branches.

The average air temperature at ground level is 30 degrees during freezing rain but this phenomenon can occur at temperatures as low as 15 degrees. Freezing rain occurs in bands 25 to 100 miles wide, oriented west to east as a low pressure system and accompanying warm front approach from the south or southwest. Freezing rain only lasts an hour or two because the weather systems move through at thirty to fifty miles an hour. Prediction of ice storms is difficult because a slight temperature change at the ground surface can move the location of the ice storm more than 100 miles. Forecasting of the location and amount of ice accumulation is not precise.25

Two ice storms in early 1994 created havoc in southeastern and southern Ohio as electric utility lines were damaged from the weight of ice and from tree limbs falling on them. Widespread power outages occurred. Falling tree limbs damaged automobiles and houses. According to the NCDC, forty people were injured and damages were estimated at $10 million for these two events. The President's Day Storm of 2003 dropped up to two feet of snow in Athens County but counties south of Athens, where temperatures aloft were warmer, had significant ice accumulation that knocked out electrical power for over one week in some situations.

Subsection 2k – Landslide/Rockfall

Landslide is the “…downward and outward movements of slopes due to rains or melting snow with accompanying damage and debris deposition.”26 As used in this section, landslide is the term that will describe all downslope movement of earth with the exception of rockfall which is the relative free-fall of rocks down a vertical or very steep slope. Downslope movement of earth has been grouped into several categories based on rate of movement and the type of geologic material associated with the movement. The types common to Athens County are rockfall, debris fall, slump, earthflow, and creep.27

26 Hazard Analysis and Risk Assessment, OEMA, p. 19.
There are many causes of slope movements, but they can be grouped into two general categories, geologic conditions and triggering actions. The geologic conditions are steep slopes, angle of rock layers, highly fractured rock, abundance of ferric oxide (red colors) in clay or clay shales, porous or permeable rock, soluble rock, water soluble cementing agents associated with certain rocks such as sandstone, presence of clay seams, clay soils, or clay shales subject to groundwater lubrication, and an influx of water from rain or drainage. The triggering actions are vibrations either natural or manmade, oversteepening of slopes, removal of lateral support at the toe of a slope, the collapse of drift mine workings, the weighting of the upper portion of a slope with fill or buildings, removal of vegetation from a slope, and water in excess that adds weight, dissolves rock, lubricates clay seams and increases pore water pressure in the soil.

Areas of the City with moderate and severe landslip potential are shown on the map in Appendix 9. This map was created using soil classifications from the county soils map produced by the United States Natural Resource Conservation Service.

Records of landslide on state highways are kept by ODOT at the District level. District 10, which includes Athens County, lists 180 – 200 landslides per year compared with 15 for District 8 (southwestern Ohio), 12 for District 9 (southern Ohio), and 20 for District 11 (eastern). County, township, and municipal highway departments also spend considerable resources trying to prevent and having to repair landslides.

In addition to expenses for the maintenance and repair of streets and roads impacted by landslide, building foundations and utility lines are also affected. Buildings can be rendered useless and worthless if negatively impacted by landslide to a great enough extent. Landslides and rockfall can also be dangerous if they destroy a house that is occupied or destroy a roadway giving no advance warning to an unsuspecting motorist. The City has experience with the effects of landslides. The following areas are currently experiencing or have experienced landslides in the City of Athens: Grosvenor St., Franklin St., Columbia Ave., and the Monticello Apartments. The map in Appendix 10 shows the locations of structures potentially affected by landslip.

Subsection 2l – Thunderstorm and Lightning

Thunderstorms and lightning are mentioned as a separate category even though the subsections entitled High Wind and Flash Flooding cover some of the hazard issues. A thunderstorm often brings all three hazards; high winds, lightning, and intense rainfall. Two deaths and one injury were caused by lightning in Athens County in the mid 1990’s. Damages from lightning in 1995 and 2001 totaled $81,000 in Athens County.

Subsection 2m - Tornado

The City of Athens is located in the Wind Zone IV, and has a high risk of extreme winds rating. One tornado and varying levels of windstorms have been recorded in Athens County, all resulting in limited damages. Predicting what parts of Athens County

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28 Ibid., pp. 21-22.
have a greater chance of being struck by a tornado, however, is difficult. Tornadoes can strike with very little warning.

Athens County is classified as having a High Risk level of risk from extreme winds. Maps obtained from FEMA’s Taking Shelter from the Storm: Building a Saferoom in Your House (http://www.fema.gov/fima/tsfs13.shtm) were used to determine the wind speed zone and tornado activity of The City of Athens. According to the map, Wind Zones in the United States, Athens County is in the Zone IV (250 mph) wind zone. The map, Tornado Activity in the United States, shows that between 1 and 5 tornadoes were recorded per 1,000 square miles from Athens County. By using FEMA’s Assessing Your Risk chart, Athens County is calculated to be in the high level of risk from extreme winds.

A search done through Tornado Project Online at http://www.tornadoproject.com found one recorded tornado occurring between 1950 and 1995 in Athens County. The May 12, 1980, tornado had no recorded deaths or injuries. It measured F1 on the Fujita Tornado Measurement Scale. F1 tornadoes are classified as moderate tornadoes (73-112 mph winds) causing moderate damages.

The Historic Tornado Touchdown Map (Appendix 12) was produced using the ESRI/FEMA Project Impact Hazard Site. This map shows the May 12, 1980 tornado occurring in Athens County with a severity level of 1 on the Fujita scale. A tornado rated at level 5 on the Fujita scale hit Gallia County on April 23, 1968 according to the National Climatic Data Center. The National Climatic Data Center also indicated that six people have died from four southeastern Ohio tornado incidents dating from 1886. While this hazard has proven extreme, incidents are extremely rare and for this reason it did not receive a higher risk rating. No deaths were recorded for Athens County from any tornado events.

Subsection 2n – Winter Storm/Blizzard

Winter storm and blizzard are combined into one hazard. Winter storms are typically associated with heavy snowfall and windy conditions. Blizzards are extreme winter storms that have snowfall, high winds, and extreme cold. The high winds in blizzard conditions create poor visibility and dangerous driving conditions even if snowfall is not heavy because dry snow can be blown around giving the effect of heavy snowfall. Some of the dangers associated with winter storms and blizzards are falling tree limbs, dangerous driving, utility outages, extreme cold, and collapsed roofs.

There are several storm systems that can bring snow to southeastern Ohio. Those originating in the Canadian prairies are known as Alberta Clippers. Other places of origin are the Southern Plains, the Gulf of Mexico, and the Atlantic Coast. Very heavy snowfall can occur if moisture from the Gulf is drawn up into cold air sitting over Ohio. The heaviest snowfall occurs in a band less than one hundred miles wide so less than half of Ohio is usually affected by any single storm. Snowfall of six inches or more is considered a heavy snowfall in Ohio. This depth is expected once or twice a year in
northern Ohio and only once every two or three years in extreme southern Ohio. Ohio’s greatest snowfall amounts from a single storm have occurred in Ohio’s eastern counties where storms moving along the Appalachian mountains bring in moisture from the Atlantic Coast. Twenty to thirty inches of snow can fall during these events.29

The City of Athens is on the edge of this area and can receive large quantities of snow if conditions are appropriate. The Thanksgiving snowstorm of 1950 is an example. Athens City received between twenty and twenty-five inches of snowfall during the storm.30

Subsection 2o - Wildfire

The peak seasons for Wildfires in Southeastern Ohio are March, April and May, before vegetation “greens-up” and October and November, after leaf drop. These are the months when warm, windy, low humidity conditions are prevalent and vegetation is more susceptible to burning. Other factors that determine an areas susceptibility to wildfires include topography and fuel. Slopes greater than 60 degrees have a high vulnerability to wildfires, slopes between 40 and 60 degrees are considered moderate and slopes less than 40 degrees have low wildfire susceptibility. Ground fuel is vegetation and woody debris that is found underneath the forest canopy. Areas with a large amount fuel are more at risk of damaging wildfires than areas relatively clean of undergrowth. A fuel model map of the U.S was found at (www.fs.fed.us/land/wfas/nfdr_map.htm), but at this time the accompanying data information is unavailable.

Research on the occurrence of previous wildfires in Athens County was done and produced evidence that in 1999, Southeastern Ohio was plagued with forest fires. There were a reported 31 wildfires in Athens County which burned 112 acres. No significant structural damage occurred. In comparison, in year 2001 Athens County experienced 22 fires which burned only 49 acres. These statistics can be found at (www.ohiodnr.com/forestry/Fire/wildstats.htm). Other extensive internet and library research produced no evidence of devastating wildfires in Athens County which caused significant human injury or structural damage. Based on the history of wildfires in Athens County the risk of a devastating wildfire event to occur appears to be relatively low. The City of Athens does not have any record of wildfire occurrence. However, some conditions, namely steep and vegetated slopes, that are associated with wildfire vulnerability are found in the City. The City does not have a wildfire risk map. Production of a risk map for wildfire is an activity in the City’s five year natural hazard mitigation plan.

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29 Thunder in the Heartland, p.6.
30 “At Marietta, where weather records extend back to the early 1800’s, the Marietta Daily Times reported the twenty-seven inches in this storm was the greatest in any known record here…..The press reported up to seventy persons were killed in Ohio by the storm, mostly from overexertion and heart attacks.”, Thunder in the Heartland, pp. 39-40.
Chapter 3
Vulnerability Assessment

Section 1 – Asset Identification

The purpose of asset identification is to make City leaders and residents aware of the extent of vulnerability to natural hazards. Numbers of residents and numbers of structures and their values are analyzed to arrive at potential loss estimates. The term “asset”, for purposes of this Plan, was primarily used to mean building. Rolling stock, other equipment, and critical facilities were not included in the replacement cost calculations.

The 2000 census revealed a population of 21,342 and a housing unit count of 6,271. This figure includes single family, multi-family, and University housing. Data available from the County Auditor made it possible to obtain the replacement costs of single family homes. County Auditor data was not available in digital format for Ohio University, multi-family, public, or commercial structures. The entire population of Ohio University structures was analyzed with GIS to determine square footage and a replacement cost. Statistical sampling was used to determine replacement costs for multi-family, public, and commercial structures.

Single Family Residential Property

The County Auditor listed 2,646 structures as residential real estate. The Auditor’s data did not have replacement costs for twelve of the structures. The average cost of the remaining 2,634 structures is $112,922 and was used as the replacement cost for the twelve structures that had no data. The replacement value of these 2,646 homes is $298,790,509.

In addition there are eight singlewide mobile homes in the City. These structures are licensed and counted separately from real estate. The replacement value for a mobile home was determined by contacting a local mobile home dealer.31 The replacement value of a single-wide mobile home is $25.97 per square foot based on a sale price of $24,000 for a home measuring 66’X14’. The total value of the eight mobile homes in the City is $192,000. The total of real estate and mobile home replacement costs is $298,982,509.

Multifamily Residential Property

Athens is a university community and has an exceptionally high number of multi-family rental properties. Replacement cost of multifamily residential property was calculated by using GIS to estimate the total square footage of 152 apartment buildings and multiplying that figure by FEMA’s replacement cost estimate of $98/SF. The

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31 Brian Call, salesman, at Dupler’s Homes on US Rt 33, Nelsonville, OH.
additional 905 multifamily units are converted single family homes and the average replacement costs from the single family homes in the previous section was used for replacement costs for these multifamily apartments. The replacement cost of the 152 large apartment buildings is $216,567,270 and the replacement cost of the 905 smaller buildings is $102,194,033 for a total multifamily replacement cost of $318,761,303.

Commercial Property, Industrial Property, and Public Property

The City’s property database grouped commercial, industrial, public, and mixed uses under a “commercial” category. A random sample of 50 of these commercial properties in floodplain areas yielded an average replacement cost value of $831,695.32 This figure was obtained by measuring the square footage of the 50 structures and multiplying that by the replacement costs in FEMA’s State and Local Mitigation Planning. The average value of a commercial property multiplied by the total number of 497 commercial properties in the City’s database yields a total commercial property value of $413,352,415.

Other

The City compiled a list of “other” structures that include garages and sheds. There are 764 such structures and it is estimated that they have an average replacement cost of $10,000 placing their total replacement cost at $7,640,000.

Ohio University Property

Ohio University has a total of 162 structures. An estimate of total floor area was obtained by utilizing aerial photography to measure the square footage of the building footprint. This was then multiplied by the number of stories to obtain total floor area. Figures of $115/SF for non-residential university space and $98/SF for dormitory space were taken from FEMA’s State and Local Mitigation Planning to arrive at a total asset value of $862,387,586. Since only the first and second floors of university structures would be adversely affected by the flood hazard, replacement costs were refigured for the value of just the first two floors and a basement, if one exists. The modified replacement costs for campus are $247,403,739. These modified replacement costs were later used as the basis for flood loss computations.

32 Time did not permit a sampling of commercial property outside of floodplain areas. While it can be argued that a random sample of floodplain commercial properties is not a random sample of all commercial properties, the replacement costs derived from this exercise are intended to show that there is substantial value of property in this land use category. Floodplain properties are likely to be representative of other properties in the City because while they may be slightly devalued due to the floodplain location, some of the larger commercial structures are in the floodplain and would therefore boost the replacement value. The results for commercial property value will not be used for any purpose other than to show significant overall value.
Critical Facilities

The Federal Emergency Management Agency defines critical facilities as:

- **Essential**—these are necessary for the health and welfare of everyone and are particularly needed after a disaster. Examples are hospitals, police and fire stations, emergency operations centers, and evacuation shelters.
- **Transportation**—examples include airports, bridges, railways, and roadbeds.
- **Lifeline Utilities**—examples are water and wastewater systems, oil, natural gas, electric power and communication systems.
- **High Potential Loss Facilities**—these would have a high loss (life and/or property) associated with their destruction. Examples include dams and nuclear power plants.
- **Hazardous Materials Facilities**—these house industrial hazardous materials such as corrosives, explosives, flammables, radioactive materials, and toxins.

Appendix 13 lists critical facilities that are either in the City of Athens or are important enough to be considered critical to the City during a natural hazard event. Essential services, transportation facilities, and lifeline utilities are rated according to how important it is that the facility remain functional during a natural hazard event. High potential loss facilities are rated according to likelihood of failure and degree of loss of life and property in the event of failure. Hazardous materials facilities are rated according to the degree of hazard posed should a release occur. Additionally, the facilities have listed which geographic-specific hazard (flood or landslides), if any, affects them. It is assumed that any of the non-geographic-specific hazards could affect any of the facilities.

Due to the number of critical facilities in the City and the limited time available for plan preparation, critical facilities replacement costs were not analyzed. One of the activities for the five year mitigation effort will be to analyze replacement costs for high priority facilities in the floodplain.
The following table summarizes the replacement values of the City’s assets:

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<td>905</td>
<td>$112,922</td>
<td>$102,194,033</td>
<td>$51,097,017</td>
</tr>
<tr>
<td>Commercial</td>
<td>497</td>
<td>$831,695</td>
<td>$413,352,415</td>
<td>$413,352,415</td>
</tr>
<tr>
<td>Other</td>
<td>764</td>
<td>$10,000</td>
<td>$7,640,000</td>
<td>$3,820,000</td>
</tr>
<tr>
<td>University</td>
<td>162</td>
<td>$5,323,380</td>
<td>$862,387,586</td>
<td>$862,387,586</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>4972</strong></td>
<td><strong>$1,901,123,813</strong></td>
<td><strong>$1,588,431,907</strong></td>
<td></td>
</tr>
</tbody>
</table>

Section 2 – Potential Loss Estimates

Background

For purposes of this plan, only the geography-specific hazards with a high risk were used to calculate potential losses. The Committee believed that limited planning resources are better spent on planning for those hazards with a higher degree of risk (probability x impact) than spreading thin those same resources over all the hazards. Most resources were spent on the riverine flooding hazard since it poses the greatest risk. Flash flooding and wildfire are medium-risk hazards that are geography-specific. Ice storm, blizzard, high wind, and thunderstorm/lightning are non-geography-specific, medium-risk hazards that have not created major damages to residential and commercial structures but pose serious threats to human life and to lifeline utility systems.

Flooding (Riverine and Flash)

A geographic information system is a powerful tool for use in calculating losses from specific natural hazard events. Particularly for geography-specific hazards, a GIS can readily locate assets that lie within certain hazard zones. GIS was used to isolate

---

33 Critical facilities that are buildings are included under commercial or public assets. Time did not permit a replacement cost analysis for critical facilities that are not buildings. Therefore, the total replacement value is low since high cost items such as bridges, water towers, water wells, and utility pumping stations were not included.
assets in flood zones.\textsuperscript{34} A surveyor’s level was used in conjunction with a handheld level to determine the level of the lowest floor (see Appendix 13 for details on this technique). Since this technique could only measure the height of the lowest floor above grade, nine feet was subtracted from this at-grade elevation to determine basement floor elevations.

In the City’s 1% annual chance floodplain there are 693 single family residential and small multifamily\textsuperscript{35} structures, 8 mobile homes, 44 large multifamily structures, 237 smaller, detached apartments, 191 commercial\textsuperscript{36} buildings, 63 Ohio University buildings, and 200 other buildings. There are no repetitive loss structures in the City of Athens at this time. For residential, single family properties, the structure loss estimate was determined by obtaining lowest floor elevations for 212 homes in the floodplain area. A spreadsheet utilizing % loss numbers, down time, and displacement time were taken from FEMA’s State and Local Mitigation Planning.\textsuperscript{37} Results for the sample of 212 floodplain residences are as follows:

<table>
<thead>
<tr>
<th>Single Family Residential-Sample</th>
<th>Total #</th>
<th>Replacement Cost New</th>
<th>Structure Loss</th>
<th>Contents Value</th>
<th>Contents Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full or Partial Basement</td>
<td>149</td>
<td>$20,874,610</td>
<td>$6,500,014</td>
<td>$10,437,305</td>
<td>$4,875,011</td>
</tr>
<tr>
<td>Crawl Space</td>
<td>56</td>
<td>$5,327,140</td>
<td>$262,472</td>
<td>$2,663,570</td>
<td>$196,855</td>
</tr>
<tr>
<td>Slab On Grade</td>
<td>7</td>
<td>$394,210</td>
<td>$42,869</td>
<td>$197,105</td>
<td>$32,152</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>212</td>
<td><strong>$26,595,960</strong></td>
<td><strong>$6,805,355</strong></td>
<td><strong>$13,297,980</strong></td>
<td><strong>$5,104,018</strong></td>
</tr>
<tr>
<td>TOTAL STRUCTURE + CONTENTS LOSS</td>
<td></td>
<td><strong>$11,909,373</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additionally, there were 4,784 downtime days and 45,480 displacement days with these losses.

A structure loss average of $32,101 and contents loss average of $24,076 were then applied to the 673 single family and small multifamily residences. The total structure loss estimate for 673 single family and small multifamily residences is $21,603,973. The total contents loss estimate for 673 single family and small multifamily residences is $16,203,148. Additionally, the eight mobile homes in the City are located in the floodplain. Detailed elevation survey work was not performed for these mobile homes but for purposes of damage assessment it is assumed that they will have one foot of water above their floor elevations. This equates to damage of 44% of the mobile homes replacement cost and 66% of its contents value. Appendix 14 shows the spreadsheet utilized for single family and small multifamily flood loss calculations.

The value of large multifamily residential structures in floodplain areas was calculated by utilizing the city’s GIS database to arrive at a total floor area and multiplying that by FEMA's $98/SF replacement cost. The replacement costs for the 44

\textsuperscript{34} The GIS flood zone was created by a process of digitizing the FEMA Flood Insurance Rate Maps.
\textsuperscript{35} Converted single family homes and duplexes
\textsuperscript{36} Includes industrial, mixed use, and many public buildings
\textsuperscript{37} Down time is the length of time that it takes for a family or business to temporarily relocate and set up in another location. Displacement time is the length of time it takes for a family or business to reestablish itself back in its original location.
large-scale apartments in the floodplain total $55,384,308 and the per structure average loss is $1,258,734. FEMA places contents value for residential properties at 50% of the building replacement value. Contents value is therefore $27,692,154. Time limits did not allow the computation of detailed loss estimates for these 44 buildings. Percentage figures from the commercial property losses were substituted because it is likely that the two land uses would have similar losses in the event of a flood. The results are as follows:

<table>
<thead>
<tr>
<th>Multifamily Residential</th>
<th>Total #</th>
<th>Replacement Cost New</th>
<th>Structure Loss</th>
<th>Contents Value</th>
<th>Contents Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large multi-unit</td>
<td>44</td>
<td>$55,384,308</td>
<td>$4,873,819</td>
<td>$27,692,154</td>
<td>$3,710,749</td>
</tr>
<tr>
<td>Slab On Grade*</td>
<td></td>
<td></td>
<td>8.8%</td>
<td>13.4%</td>
<td></td>
</tr>
<tr>
<td>Small detached***</td>
<td>237^</td>
<td>$26,764,617</td>
<td>$6,849,065</td>
<td>$13,382,309</td>
<td>$5,136,130</td>
</tr>
<tr>
<td>Loss Percentages**</td>
<td></td>
<td></td>
<td>25.6%</td>
<td>38.4%</td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>281</td>
<td>$82,148,925</td>
<td>$11,722,884</td>
<td>$41,074,463</td>
<td>$8,846,879</td>
</tr>
<tr>
<td>TOTAL STRUCTURE + CONTENTS LOSS</td>
<td></td>
<td>$20,569,763</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* assumed  
** from commercial land use  
*** Loss %'s same as single family residential  
^26.19% of total of 905  

Commercial property loss was calculated by utilizing the random sample of 50 of the city’s commercial floodplain properties. The City’s GIS floodplain map layer was established from the FEMA floodplain maps. The sample of 50 structures included some buildings that had been elevated on fill to comply with the City’s floodplain elevation requirements and some buildings that are likely not in the 1% chance floodplain because they are close to the floodplain edge and there are minor errors in the map boundaries. The average structure loss, contents loss, down time, and displacement time for these 50 structures was calculated using the same formulas that were used for loss calculations for single family residential property. The results are as follows:

<table>
<thead>
<tr>
<th>Commercial-Sample</th>
<th>Total #</th>
<th>Replacement Cost New</th>
<th>Structure Loss</th>
<th>Contents Value</th>
<th>Contents Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab On Grade</td>
<td>50</td>
<td>$41,584,771</td>
<td>$3,693,320</td>
<td>$41,584,771</td>
<td>$5,581,188</td>
</tr>
<tr>
<td>TOTAL STRUCTURE + CONTENTS LOSS</td>
<td></td>
<td>$9,274,508</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additionally, there were 533 downtime days and 2,822 displacement days with these losses.

The structure loss average of $73,867 and contents loss average of $111,624 were then applied to the 191 commercial properties. The total structure loss estimate for 191
floodplain commercial properties is $14,108,597. The total contents loss estimate for 191 floodplain commercial properties is $21,320,184.

Lowest floor elevations for Ohio University buildings was determined as part of an overall University floodplain study that was performed in 2002. There are 63 Ohio University properties in the 1% chance floodplain according to the City’s GIS. Since FEMA’s structure loss and contents loss calculations for the flood hazard are based on one and two story structures, the University’s structures were assigned values as if they only had two stories since upper floors would not be damaged in a flood. Using the same FEMA formulas that were used for residential and commercial losses, University building losses for the flood hazard are as follows:

<table>
<thead>
<tr>
<th>Structure Type</th>
<th>Total #</th>
<th>Replacement Cost New</th>
<th>Structure Loss</th>
<th>Contents Value</th>
<th>Contents Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab On Grade</td>
<td>39</td>
<td>$299,179,475</td>
<td>$34,848,803</td>
<td>$219,490,810</td>
<td>$59,522,690</td>
</tr>
<tr>
<td>Full or Partial Basement</td>
<td>23</td>
<td>$103,771,094</td>
<td>$24,534,483</td>
<td>$49,493,935</td>
<td>$31,228,530</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>62</strong></td>
<td><strong>$ 402,950,569</strong></td>
<td><strong>$ 59,383,286</strong></td>
<td><strong>$ 268,984,745</strong></td>
<td><strong>$ 90,751,220</strong></td>
</tr>
</tbody>
</table>

**TOTAL STRUCTURE + CONTENTS LOSS** $150,134,506

Additionally, there were 2,643 downtime days and 18,914 displacement days with these losses.

The Other category includes accessory structures such as garages and sheds. The same loss percentages that were derived from the single family residential category for slab-on-grade construction were used for these structures. Results are as follows:

<table>
<thead>
<tr>
<th>Other</th>
<th>Total #</th>
<th>Replacement Cost New</th>
<th>Structure Loss</th>
<th>Contents Value</th>
<th>Contents Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab On Grade</td>
<td>200</td>
<td>$2,000,000</td>
<td>$217,400</td>
<td>$1,000,000</td>
<td>$163,100</td>
</tr>
<tr>
<td><strong>TOTAL STRUCTURE + CONTENTS LOSS</strong></td>
<td></td>
<td><strong>$380,500</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overall asset losses for the flood hazard for the City of Athens can be summarized as follows:

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Total Number</th>
<th>Total Number in Floodplain</th>
<th>Total Replacement Value</th>
<th>Total Contents Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real Estate</td>
<td>2646</td>
<td>693</td>
<td>$298,790,509</td>
<td>$149,395,255</td>
</tr>
<tr>
<td>Mobile Homes</td>
<td>8</td>
<td>8</td>
<td>$192,000</td>
<td>$96,000</td>
</tr>
<tr>
<td>Multifamily Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apartment Buildings</td>
<td>152</td>
<td>44</td>
<td>$216,567,270</td>
<td>$108,283,635</td>
</tr>
<tr>
<td>Detached Structures</td>
<td>905</td>
<td>237</td>
<td>$102,194,033</td>
<td>$51,097,017</td>
</tr>
<tr>
<td>Commercial</td>
<td>497</td>
<td>191</td>
<td>$413,352,415</td>
<td>$413,352,415</td>
</tr>
<tr>
<td>Other</td>
<td>764</td>
<td>200</td>
<td>$7,640,000</td>
<td>$3,820,000</td>
</tr>
<tr>
<td>University</td>
<td>162</td>
<td>63</td>
<td>$862,387,586</td>
<td>$862,387,586</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>4972</td>
<td>1436</td>
<td><strong>$1,901,123,813</strong></td>
<td><strong>$1,588,431,907</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Structure Loss</th>
<th>Structure Loss as % of Total</th>
<th>Contents Loss</th>
<th>Contents Loss as % of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real Estate</td>
<td>$21,603,973</td>
<td>7.23%</td>
<td>$16,203,148</td>
<td>10.85%</td>
</tr>
<tr>
<td>Mobile Homes</td>
<td>$84,480</td>
<td>44.00%</td>
<td>$63,360</td>
<td>66.00%</td>
</tr>
<tr>
<td>Multifamily Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apartment Buildings</td>
<td>$4,873,819</td>
<td>2.25%</td>
<td>$3,710,749</td>
<td>3.43%</td>
</tr>
<tr>
<td>Detached Structures</td>
<td>$6,849,065</td>
<td>6.70%</td>
<td>$5,136,130</td>
<td>10.05%</td>
</tr>
<tr>
<td>Commercial</td>
<td>$14,108,597</td>
<td>3.41%</td>
<td>$21,320,184</td>
<td>5.16%</td>
</tr>
<tr>
<td>Other</td>
<td>$217,400</td>
<td>2.85%</td>
<td>$163,100</td>
<td>4.27%</td>
</tr>
<tr>
<td>University</td>
<td>$59,383,286</td>
<td>6.89%</td>
<td>$90,751,220</td>
<td>10.52%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>$107,120,620</strong></td>
<td><strong>5.63%</strong></td>
<td><strong>$137,347,891</strong></td>
<td><strong>8.65%</strong></td>
</tr>
</tbody>
</table>

**TOTAL STRUCTURE + CONTENTS LOSS** $244,468,511

Section 3 - Development Trend Analysis

The population for the City of Athens is only expected to increase slightly over the next decade. While Ohio University states that it does not expect to get above a 20,000 student population, that decision is market driven and the City has little input into the enrollment size decisions. There is limited space for expansion of the City. The following table shows population figures in the 1900’s for the City of Athens:
<table>
<thead>
<tr>
<th>Place</th>
<th>1900</th>
<th>1910</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
<th>1950</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens City</td>
<td>3,066</td>
<td>5,463</td>
<td>6,418</td>
<td>7,252</td>
<td>7,696</td>
<td>11,660</td>
</tr>
<tr>
<td>Athens County</td>
<td>38,730</td>
<td>47,798</td>
<td>50,430</td>
<td>44,175</td>
<td>46,166</td>
<td>45,839</td>
</tr>
<tr>
<td>State of Ohio</td>
<td>4,157,545</td>
<td>4,767,121</td>
<td>5,759,394</td>
<td>6,646,697</td>
<td>6,907,612</td>
<td>7,946,627</td>
</tr>
<tr>
<td>29 Appalachian Counties</td>
<td>971,844</td>
<td>1,017,030</td>
<td>1,056,812</td>
<td>1,075,512</td>
<td>1,130,970</td>
<td>1,133,978</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens City</td>
<td>16,470</td>
<td>24,168</td>
<td>19,743</td>
<td>21,265</td>
<td>21,342</td>
</tr>
<tr>
<td>Athens County</td>
<td>46,998</td>
<td>54,889</td>
<td>56,399</td>
<td>59,549</td>
<td>62,223</td>
</tr>
<tr>
<td>State of Ohio</td>
<td>9,706,397</td>
<td>10,652,017</td>
<td>10,797,630</td>
<td>10,847,115</td>
<td>11,353,140</td>
</tr>
<tr>
<td>29 Appalachian Counties</td>
<td>1,226,559</td>
<td>1,237,660</td>
<td>1,376,130</td>
<td>1,372,893</td>
<td>1,455,313</td>
</tr>
</tbody>
</table>

While population is not expected to drop over the next decade, the rugged topography and extensive flood hazard areas make additional development in Athens quite challenging. There is limited potential for infill housing and a large apartment complex is proposed for an area adjacent to Richland Avenue and Dairy Lane. This will be student housing and, if built, will offset a number of dormitories and apartments on campus that will be taken offline. Some students may move out of single family rental housing and free up those homes as owner-occupied residences.

The bulk of City commercial space is in four locations: Richland Avenue, East State Street, Columbus Road, and downtown. Except for downtown, the commercial areas are in flood hazard zones. New development must meet the City’s elevation requirements of a one-foot freeboard. A lot of development activity is occurring on East State Street. The road is being widened to five lanes and many new commercial establishments have been built in the last several years. Columbus Road has also seen a number of new buildings in the past several years.

The City is in the process of producing a comprehensive plan and is considering the limitation of development in the floodway. These floodway areas would be reserved as permanent open space. The Plan, still in its formative stages, must also grapple with the areas towards which the City will grow. One option, to the east, provides level ground and four-lane access, but a high percentage of the land is in floodplains or on slip-prone soils.

In addition to the apartment complex that is proposed in the City, a subdivision on the south end is being expanded. These developments are not in the floodplain although care must be taken to protect against the landslip hazard.

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38 The floodway is an area closest to a river or stream where flood velocities are higher making the area much more dangerous. The floodway is an area that is usually off limits to development and is reserved for the movement and discharge of flood waters.
Additional development is expected for the Columbus Rd. and East State St. commercial areas. Some of the proposed commercial development area on Columbus Rd. is in the floodway and will require a hydrologic and hydraulic study before any construction can occur. Other commercial development is in flood fringe areas and requires extensive fill. A retirement facility is also proposed in a flood fringe area adjacent to Stimson Avenue. All such activity requires a floodplain permit from the City before activity can begin. The City will have to decide if development in these areas and in this fashion will continue and to what extent it will continue.
Chapter 4
The Plan

Section 1 – Goals, Objectives, and Activities

The Plan Committee followed a process of identifying a desired state or a series of desirable conditions of reduced risk to natural hazards. With good planning and a will to achieve, the City could better survive a natural hazard than they have previously. In addition to the list of desired conditions, a second list of problem statements, or reasons why the desired state could not be achieved, was developed (see Appendix 16 for a list of problem statements).

The desired state and problem statements were then used to formulate an overarching goal and a series of eight objectives. Subsequently, activities to meet the objectives were developed. The activities each have a time frame, a cost, and an individual or group who is responsible for implementing the activity. While the City of Athens has no planning staff it has departments and qualified department heads to help with plan implementation. The City also has a relatively stable income stream and is in far better financial condition than many Appalachian places. Athens County is also preparing a natural hazard mitigation plan and because there is significant overlap on many of the activities, the City will be able to piggyback on many of these efforts and thus achieve its goal and objectives. Objectives were formulated after lengthy discussion by the Plan Committee. Objectives will reduce or eliminate vulnerability in the following ways:

- Objective 1 – Educating citizens will make them more aware of their environment and able to identify and avoid natural hazards.
- Objective 2 – Information sharing will allow resources to be more effectively used before, during, and after hazard events.
- Objective 3 – Advance warning systems and awareness of critical areas and vulnerable populations will help with readiness and evacuations.
- Objective 4 – Flooding can be reduced when attention is paid to creating drainageways clear of debris.
- Objective 5 – Proper design of buildings and the landscapes around them will help reduce damage from storm events.
- Objective 6 – A mitigation program will identify structures most at risk and attempt to reduce that risk with techniques such as elevating, floodproofing, relocating, or demolition.
- Objective 7 – Appropriate legislation will help insure that a minimum safety from hazards is maintained.
- Objective 8 – Replacement of emergency service facilities, in the event they are destroyed, is crucial to insure the safety of citizens.
Section 2 – Implementation

The Table in Appendix 17 shows the goals, objectives, and activities adopted for the natural hazard mitigation plan. One of the key activities is the continuation of the natural hazard planning committee. Working in conjunction with the Athens County natural hazard mitigation committee, the Athens City committee will be able to receive necessary assistance and duplication of effort can be avoided. Many of the activities require that a larger governmental unit such as the County take the lead.

The City of Athens has a number of planning and plan implementation mechanisms in place. An active planning commission meets twice per month, City Council is interested in planning issues and plays an active role, and the City administration is active with planning for the future of Athens. Specific examples of the City’s role in planning include:

- The planning commission considers floodplain, drainage, and landslip issues when it reviews new development proposals.
- City Council has funded a comprehensive planning effort which will be completed in 2003. This effort will attempt to integrate natural hazard planning in future land use decisions. City Council’s planning and development committee takes an active role in planning for the City.
- The City administration updates its capital improvements program on a regular basis and has indicated a willingness to recommend appropriations for natural hazard planning and implementation. The City has a very active GIS program and continues to gather data that will facilitate land use planning efforts. The City tree commission will continue to address the issue of appropriate tree planting and maintenance so as to minimize threats from natural hazards.

Continued compliance with the NFIP will be maintained with the following strategy:

- The City Code Office will continue to be the permitting and enforcement entity for the City’s floodplain management program.
- City staff will attend continuing education seminars to stay up to date with floodplain management.
- Post-disaster substantial damage assessments will be performed in a timely and thorough fashion.
- An ongoing information and education program will keep citizens informed about the flood hazard and how to minimize it.

Activities are prioritized based on available finances. Limited staff hours required that the activities be spread over a five year period with highest priority tasks implemented earlier in the time frame. Some of the activities may require a more detailed cost/benefit analysis that can be performed in the future.

The City and its natural hazards planning committee will rely on several county programs to see that many of its activities are carried out. The County’s Regional Planning Commission, Emergency Management Agency, and 9-1-1 Office will
implement or continue many of the planning activities mentioned in the Hazard Mitigation Plan Table.

Section 3 – Maintenance

It is the intent of the City of Athens to update the Natural Hazard Mitigation Plan every five years. This will be an ongoing process that includes the following:

- Quarterly meetings of the natural hazard plan committee. More meetings or subcommittee meetings will be held as needed (this may be required in the first year in order to get the program off the ground). Progress on Plan implementation will be a regular agenda item at Plan Committee meetings.
- A subcommittee of the Hazard Planning Committee will evaluate the Plan on an annual basis. Evaluation criteria will include:
  - How have activities in the Plan improved situations during and after hazard events?
  - Have there been improvements in communication between parties responsible for implementing the Plan?
  - What hazard mitigation programs have been started or improved as a result of Plan implementation?
  - Are the activities and tasks on schedule and, if not, what are the reasons?
- The 5-year Plan update will be a joint effort between the City administration and the Directors of the Emergency Management Agency and the Regional Planning Commission. The Hazard Mitigation Planning Committee and the responsible governing body will formally approve the updated Plan before it takes effect.
- Public participation will be enhanced with public notices of the quarterly meetings of the Natural Hazard Mitigation Plan Committee. The City’s website will provide notices of meetings, minutes, plan updates and other pertinent hazard planning information. A table top display, maintained by the Regional Planning Commission and Emergency Management Agency, about hazard mitigation and planning has been and will continue to be present at fairs and events around Athens County. Any public comments will be maintained in a database at the Regional Planning Commission’s office and will be utilized when the Plan is updated.
- An annual report to the City Council by the natural hazard planning committee will keep the elected officials updated and be an opportunity to publicize the committee’s work. The report will focus on accomplishments, the next year’s work plan, and recommended changes to the Plan. This will serve as an opportunity for public participation as the meeting will be announced in the media. A written report will also be available and accompany the meeting presentation.