State of Ohio
Hazard Identification and Risk Analysis
(HIRA)

Ohio Emergency Management Agency
2855 West Dublin-Granville Road
Columbus, Ohio 43235

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FOREWORD

This 2011 edition of the State of Ohio Hazard Identification and Risk Assessment (HIRA) provides current research and updates on those natural, technological and human-caused hazards to which the state of Ohio is most vulnerable. Knowledge of these hazards, their frequency, and the state's overall vulnerability to them allows state and local government officials to better assess their risks and to plan and prepare for the consequences.

This revision is an update from the July 2008 HIRA. This HIRA has been reviewed in its entirety, with all information evaluated and updated as necessary. Similar to the 2008 version, this document was prepared by Plans Branch personnel at the Ohio Emergency Management Agency (Ohio EMA) with the assistance of all branches within the agency and other state/federal partners. The information contained in this HIRA is a compilation of research from federal, state, and local government sources, as well as from public sources.

Emergency managers have the task of coordinating mitigation, planning, response and recovery efforts for the threats and hazards that the citizens of the state, and the nation, face. It is important that all available information, tools, and expertise are incorporated into efforts to lessen the impact of disasters and to ensure as rapid a return to normal daily life as possible. We have developed this HIRA as an additional resource to help address these challenges.

NANCY J. DRAGANI
Executive Director

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INTRODUCTION

The intent of this document is to be a useful tool for state and local emergency management partners to rate the risk, determine vulnerability, and predict the adverse impact of disasters and emergencies. The HIRA does not provide policy or action-based recommendations to manage hazards. This document is one element of a comprehensive emergency management program that incorporates mitigation, preparedness, response and recovery. Mitigation plans, the State of Ohio Emergency Operations Plan, as well as standard operating procedures, round-out a comprehensive program to manage hazards.

Emergency management in Ohio is governed by Ohio Revised Code (ORC) 5502. Section 5502.21 mandates that the EMA, a division of the Department of Public Safety, is the primary coordinating agency for statewide emergency readiness activities to meet the threats posed by various hazards.[1] In cooperation with other state offices and agencies, the agency has developed this analysis of the primary hazards that may threaten both lives and property.

For the purpose of this HIRA, we will use the ORC definition of hazard. 'Hazards' in Chapter 5502.21 of the ORC are defined as: "… any actual or imminent threat to the survival or overall health, safety, or welfare of the civilian population that is caused by any natural, human-made, or technological event."[2]

A catastrophic incident, as defined in the National Response Framework, is "any natural or manmade incident, including terrorism that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions."

As defined by the ORC, "Hazard identification means an identification, historical analysis, inventory, or spatial distribution of risks that could affect a specific geographical area and that would cause a threat to the survival, health, safety, or welfare of the civilian population, the property of that population, or the environment."[3] The National Fire Protection Association (NFPA) Standard 1600 requires entities to "identify hazards, monitor those hazards, the likelihood of their occurrence, and the vulnerability of people, property and the environment, and the entity itself to those hazards"[4] as part of the risk assessment process.

Upon reviewing the literature in hazard analysis, over seventy hazards were identified. These hazards include those listed in NFPA 1600, the 15 National Planning Scenarios, a report produced for Ohio EMA by URS, Ohio EMA's State of Ohio Standard Mitigation Plan, and Ohio Homeland Security documents.

To help categorize the hazards, this HIRA analysis utilizes three major groups based primarily on the categories recommended in NFPA 1600 and the Federal Emergency Management Agency's Comprehensive Preparedness Guide 101. The categories are Natural, Human Caused and Technological as shown in Figure 1. Each of the hazards identified are not mutually exclusive. Some hazards are not germane to Ohio and/or not likely enough a scenario to warrant consideration in this hazard identification and risk analysis.

The following hazards are not analyzed for the HIRA, but listed in guidance documents such as NFPA 1600: Ancillary Support Equipment Failure (support and lab-based equipment), Central Computer, Mainframe, Server, Software, or Application Failure, Discrimination, Disinformation (deliberate), Dust Storm, Electromagnetic Pulse (intensely fluctuating magnetic field), Enemy Attack/War, Famine, Financial Issues (Economic Depression, Inflation, Financial System Collapse), Glacier, Harassment, Hurricane, Iceberg, Insurrection (revolt), Misinformation (non-deliberate), Physical or information security breach, Sabotage, Sand Storm, Strike or Labor Dispute, Telecommunications, Tidal Surge, Tropical Cyclone, Tsunami, Water Spout, Workplace/School/University Violence, and Volcano.

Figure 1: Hazards Identified

NATURAL HAZARDS	
Biological	Animal or Insect Infestation or Damage
	Disease – Human [Emerging disease, plague, smallpox, anthrax, West Nile Virus, Severe Acute Respiratory Syndrome (SARS), pandemic disease]
	Disease – Animal [Foot-and-mouth disease, Bovine Spongiform Encephalophy (BSE, a.k.a. mad cow disease)]
Geological	Earthquake
	Landslide, Mudslide, Subsidence
Meteorological	Drought
	Extreme Temperatures (heat, cold)
	Fire (forest, range, urban, wildland, urban interface)
	Flood, Areal and Riverine
	Flash Flood, Seiche (Standing) Wave
	Lightning Strikes
	Geomagnetic storm (temporary disturbance of atmosphere causing communications disruption, among other things)
	Snow, Ice, Hail, Sleet
	Windstorm, Tornado

HUMAN-CAUSED HAZARDS	
Accidental	Air/Water Pollution, Contamination
	Building/Structure Collapse [including bridges and transportation tunnels]
	Communications System Interruptions
	Energy/Power/Utility Failure
	Explosion/Fire
	Fuel/Resource Shortage
	Hazardous Material (explosive, flammable liquid, flammable gas, flammable solid, oxidizer, poison, radiological, corrosive) spill or release
	Mine Collapse*
	Product Defect or Contamination
	Radiological Incidents at Nuclear Power Generating Facilities*
	Space Debris*
	Transportation Accident
	Water Control Structure (dam/levee failure)
Intentional	Civil Disturbance, Public Unrest, Mass Hysteria, Riot
	Criminal Activity (vandalism, arson, theft, fraud, embezzlement, data theft)
	Cyber Attack
	Terrorism (chemical, biological, radiological, nuclear, explosive) CBRNE

TECHNOLOGICAL HAZARDS	
Accidental/ Intentional	Energy/Power/Utility Failure
	Communications System Interruptions

*Not explicitly listed in NFPA 1600

A General Overview of Hazards in Ohio

The most damaging hazards/events in Ohio are floods and tornadoes. Other severe weather events, such as winter storms, have also led to floods or costly recovery actions. Drought has also led to agricultural losses and forced water users to seek assistance during these sustained periods of insufficient precipitation. Ice storms can take a greater toll, especially in regards to travel, infrastructure, and power and communication lines. When an ice storm strikes, roads can turn deadly, leaving schools and businesses closed.

For over 200 years, earthquakes, often centered in the Anna (Shelby County) Seismic Zone, have also occurred in Ohio, with most classified as "minor" in nature. Northeastern Ohio, east of Cleveland, has been particularly active in recent years. A large-scale (regional) event involving the New Madrid, Missouri fault, could significantly affect portions of southwestern Ohio.

Activities associated with humankind also have their effects; woodland and field fires show a need to reduce this costly resource depletion. Mine closings have led to issues related to subsidence and landslides. From the 1940s until the present, closings were made without actions to prevent shaft collapses. Urban expansion, or new highway construction, has led to damages related to these collapses. Class I and other earthen dams also pose a potential threat to adjacent or downstream communities. Many of these dams serve as up-ground reservoirs or recreational sites. If not properly built or maintained, they may fail, leading to downstream flooding and strained response capabilities.

In addition to fossil fuels, electric power generation now uses nuclear technology. Three nuclear generating facilities are sited in, or within five miles of, Ohio. The 50-mile ingestion pathway from the Enrico Fermi plant in Michigan also extends below the state line.

Three separate U.S. Department of Energy (DOE) facilities also pose a potential risk. The issue of on-site waste treatment and the removal from these sites poses a unique hazard for adjacent communities. In the event of a problem, local subdivisions (and the state) would be engaged in extensive recovery actions. Two of the three DOE facilities are in the process of being decommissioned.

Passenger and cargo airlines continue to cover the state's airspace daily and railway accidents remain a matter of concern in areas of high traffic density. Like other hazards, transportation events may not occur regularly, but authorities in areas with a high density of air or rail traffic should weigh the potential of a transportation emergency.

Since 1964, nearly 47 major emergency events in Ohio have received a Presidential Declaration of Disaster. As a result, Ohioans have received hundreds of millions in federal assistance monies. The EMA has assisted both the public and private sectors in obtaining this assistance.

Although hazards may either decrease, or increase, from a strictly numerical standpoint, inflationary labor and material trends have caused overall recovery costs to rise. Each new event is more costly to the state and nation than its predecessors.

As national mutual aid between states grows, our state may have to respond to hazards not necessarily associated with Ohio. For instance, Ohio sent numerous resources with the nearly 4,000 Ohio National Guard and civilian personnel to Hurricane Katrina and Rita in the fall/winter of 2005. Planning and procedures are being developed and/or revised to deal with events occurring in other regions of the country.

An Ohio Profile

All geographical and political subdivisions of the state are vulnerable to some form of natural, technological, or other hazard. The effects of these (regardless of type or size) upon the state may vary due to differences in climate, geography, or land use. A better understanding of both hazards and associated risks may be obtained by a brief examination of the characteristics of the state.

Geography and Climate

With a total land area of 40,948 square miles and a 2009 population in excess of 11,542,645, Ohio ranks 35th in land size and 7th in population in comparison with the balance of the U.S.[5]

Topographically, the state presents a varied combination of landforms, which are diagonally divided between the flat, glaciated, areas of the north - northwest to the unglaciated highlands in the south and southeast. The steeply incised landforms in the south and east have often contributed to flooding, mudslides, and other effects via rapid runoff from heavy rains and melt water. In the north and west, the level topography has also received a share of flooding when heavy snowstorms have been followed by rapid melt water discharges.

The state possesses a continental climate ranging through the year from cold, damp winters to warm, humid summers with prevailing westerly wind patterns. Annual temperature ranges vary from an average of 37.0 degrees F to an average of 85.0 degrees F in July. Average annual precipitation, both rain and snow, is 37.0 inches overall.

The Economy of Ohio (including transportation)

Ohio has a diversified economy based upon agriculture, extractive, manufacturing, and various service industries or activities. The southeastern highlands are especially rich in mineral resources, and although reduced in recent years, extractive mineral and mining activities (coal, oil, gas, and aggregates) add an annual $2+ billion to the economy.

Manufacturing contributes $245+ billion to the state’s economic picture. Agriculture, extractive forestry, and services contribute billions more to the total. The balance of economic activity consists of various research and development efforts.

An extensive transportation network supports this economy. State, federal and interstate highways form connecting links to, or around, major metropolitan areas. Both large and medium-sized cities host commercial air traffic carriers. Although reduced in total mileage and traffic volume, rail lines still link mining, industrial, and metropolitan centers. Waterborne commerce (via barge or ship) contributes to local economies along the Ohio River and the Lake Erie shore.

A Historical Review of Disasters

For almost 200 years, the State of Ohio has experienced disasters varying in origins and effects. The more noteworthy of these, which resulted in loss of life or economic damages, are listed here in Figure 2:

Figure 2: Historical Events and Incidents

Name of Disaster	Year	Hazard/Event Type	Location	Casualties
Cholera Epidemic	1849/50	Bio/Epidemiological	Statewide	5,000 +
Rail Bridge Collapse	1876	Transportation	Ashtabula	92
Collinwood School Fire	1908	Fire	Cleveland	17
Spring Floods	1913	Flood	S/SW Ohio	467
Influenza Epidemic	1918	Bio/Epidemiological	Statewide	Multiple Thousands
Sandusky/Lorain Tornado	1924	Tornadoes	Lorain and Sandusky	85
Cleveland Clinic Fire	1929	Fire	Cuyahoga	123
Millwood Mine Disaster	1930	Mine Fire – Collapse	Athens Co.	82
Penitentiary Fire - Columbus	1930	Prison Fire	Franklin Co.	322
Extreme Heat	1934	Heat Wave	Statewide	160
Winter Flood	1937	Flood	Statewide	250
Gas Explosion & Fire	1944	Technological + Fire	Cleveland	130
Blizzard	1950	Winter Storm	Statewide	Unknown
Penitentiary Fire - Columbus	1952	Prison Fire	Franklin Co.	0
Winter/Spring Floods	1959	Flood	Statewide	Unknown
Nursing Home Fire	1963	Fire	Marietta	95
Tornado	1965	Tornadoes	Toledo, Lima, Strongsville. Delaware, Mercer, Seneca, and Shelby counties	55
Lake Central/TWA Crashes	1967	Transportation	N&W Ohio	70 + (Combined)
Prison Riot - Columbus	1968	Other (Prison Riot)	Franklin Co.	5
Xenia Tornadoes	1974	Tornadoes	Greene Co.	30
Blizzard	1978	Winter Storm	Statewide	51
Explosion/Fire - Miamisburg	1986	Technological + Fire	Butler Co.	0
Train wreck-HAZMAT Spill	1986	Transportation	Miamisburg	0
Flash Flood – Shadyside	1990	Flash Flood	Belmont Co.	26
Prison Riot – Lucasville	1993	Other (Prison Riot)	Scioto Co.	11
Floods (from snow runoff)	1996	Flood	Statewide	0
Severe Storms/Floods	1997	Flood	Southern Ohio	5

Name of Disaster	Year	Hazard/Event Type	Location	Casualties
Severe Storms/Floods	1998	Flash Flood	Central/east central & SE	12
Xenia Tornadoes	2000	Tornadoes	Greene Co.	1
Winter Storms	2004-05	Severe Winter Weather	Statewide	0
Severe Winter Weather	2005	Ice Storm	Statewide	0
Severe Storms	2007	Flooding	Statewide	0
Wind Storm	2008	High Wind Storm	Statewide	7
H1N1 – April	2009	Pandemic Influenza	Statewide	11
H1N1 – September	2009/10	Pandemic Influenza	Statewide	Between 245 and 562 deaths
Severe Weather & Tornadoes	2010	Tornadoes	Wood, Fulton, Ottawa & Lucas counties	6

Source: *Ohio Almanac/Contributing agencies/Ohio EMA (Plans)*

The previous figure shows some of the historically serious events (with hazards) occurring since 1849 by events and mortality statistics, but not property damages or other costs.

Since l964, many events have received a *Declaration of Disaster* by the President of the United States as shown in Figure 3. The figure on the following page provides a breakout of the types of federal assistance, funds provided, incident type, as well as date declared with federal disaster number.

These incidents have affected both people and property. Gubernatorial Declarations have often been used for a number of other events, not qualifying for federal assistance via Presidential Declarations, as "Emergencies" or "Disasters." This process serves to initiate coordinated state response efforts for areas requiring assistance beyond local capabilities.

Figure 3: Presidential Disaster and Emergency Declarations in Ohio with Costs, by County[6] (1964-08)

Disaster Number	Date Declared	Disaster Program	Incident Type	Counties Declare	Funds Provided
DR- 167	March 24, 1964	PA	Heavy rains and flooding	Adams, Athens, Auglaize Belmont, Brown, Butler, Carroll, Clermont, Clinton, Columbiana, Coshocton, Cuyahoga, Delaware, Fairfield, Franklin, Gallia, Geauga, Guernsey, Greene, Hamilton, Harrison, Hocking, Jackson, Jefferson, Lake, Lawrence, Licking, Medina, Meigs, Miami, Monroe, Morgan, Muskingum, Noble, Perry , Pickaway, Pike, Preble, Richland, Ross, Scioto, Summit, Trumbull, Tuscarawas, Vinton, Warren, Washington	$571,482 (P)
DR- 191	April 14, 1965	PA	Tornadoes and high winds	Allen, Cuyahoga, Delaware, Hancock, Harrison, Highland, Lorain, Lucas, Medina, Mercer, Morrow, Pickaway, Seneca, Shelby, Van Wert	$275,248 (P)
DR- 238	May 4, 1968	PA	Tornadoes	Brown, Clermont, Gallia, Licking, Scioto	$270,000 (P)
DR- 243	June 5, 1968	PA	Heavy rains and flooding	Adams, Athens, Brown, Butler, Clermont, Clinton, Fairfield, Franklin, Fayette, Gallia, Greene, Guernsey, Hamilton, Hocking, Jackson, Lawrence, Licking, Meigs, Monroe, Montgomery, Morgan, Noble, Perry, Pickaway, Pike, Ross, Scioto, Vinton, Warren, Washington	$600,000 (P)
DR- 266	July 15, 1969	PA	Heavy storms and floods	Ashland, Ashtabula, Coshocton, Cuyahoga, Erie, Harrison, Holmes, Huron, Lake, Lorain, Lucas, Medina, Morgan, Muskingum, Ottawa, Richland, Sandusky, Seneca, Stark, Trumbull, Tuscarawas, Wayne, Wood	$1,000,000 (P)
DR- 345	July 19, 1972	PA	Storms and flooding	Ashtabula, Belmont, Cuyahoga, Jefferson, Lake, Lorain, Monroe	$1,328,098 (P)
DR- 362	November 24, 1972	PA	Storms and flooding	Erie, Lake, Lorain, Lucas, Ottawa	$615,863 (P)
DR- 377	April 27, 1973	PA	Storms and flooding	Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky	$1,417.975 (P)

(M) – Hazard Mitigation Grant
(S) – State Match to Federal Hazard Mitigation funds
(P) – Public Assistance
(I) Individual Assistance includes FEMA Disaster Housing, SBA loans for homes, personal property and businesses and FEMA/State Other Needs Assistance grants for families and individuals
(NRCS)*+ - Natural Resources Conservation Service
* Indicates the disaster is not officially closed.

HMGP first available with disaster declared after 1987.
(SCB)** - State Controlling Board funds
(SDRP)**State Disaster Relief Program
(CDBG)+ - Community Block Grant funds provided by the Ohio Department of Development
EM 3187 is an Emergency Declaration for Public Assistance

Disaster Number	Date Declared	Disaster Program	Incident Type	Counties Declare	Funds Provided
DR- 390	June 4, 1973	PA	Mudslides	Hamilton, Washington	$1,434,684 (P)
DR- 421	April 4, 1974	PA/IFG	Tornadoes and high winds	Adams, Butler, Clark, Delaware, Fayette, Franklin, Greene, Hamilton, Madison, Paulding, Pickaway, Putnam, Summit, Warren,	$10,250,454 (P) $1,945,833 (I)
DR- 436	May 31, 1974	PA	Heavy rains and flooding	Lucas, Ottawa, Sandusky	$858,824 (P)
DR- 445	July 11, 1974	PA	Heavy rains and flooding	Warren	$507,364 (P)
DR- 480	September 11, 1975	PA	Floods	Belmont, Cuyahoga, Jefferson, Lake,	$3,320,493 (P)
DR-3055-EM	January 26, 1978	PA	Severe blizzard conditions	All 88 counties	$3,546,669 (P)
DR- 630	August 23, 1980	PA/IFG	Heavy rains and flooding	Belmont, Columbiana, Guernsey, Jefferson, Monroe, Muskingum, Noble	$1,653,327 (P) $669,820 (I)
DR- 642	June 16, 1981	PA/IFG	Tornado, high winds and flooding	Hancock, Morrow, Putnam, Wyandot (IA) Morrow (PA)	$346,950 (P) $47,382 (SCB)** $515,593 (I)
DR- 653	March 26, 1982	PA/IFG	Flood	Defiance, Fulton, Henry, City of Toledo (Lucas), Paulding, Wood County (IA) Defiance, Paulding, Village of Grand Rapids (Wood only) (PA)	$157,390 (P) $268,187 (I)
DR- 738	June 3, 1985	PA/IFG	Tornadoes	Ashtabula, Columbiana, Coshocton, Licking, Portage, Trumbull (IA) Trumbull (PA)	$1,556,950 (P) $419,751 (SCB)** $424,893 (I)
DR-796	1987	IFG	Floods	Crawford, Marion, Morrow, Richland	$1,066,258 (I) $266,564 (SCB)**
DR- 831	June 10, 1989	IFG	Severe storms and flooding	Butler, Coshocton, Cuyahoga, Franklin, Geauga, Greene, Lake, Licking, Lorain, Mercer, Montgomery, Preble, Warren	$2,363,868 (I) $590,967 (SCB)**

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DR- 870	June 6, 1990	PA/IFG/ HMGP *	Severe storm, tornadoes, and flooding	Athens, Belmont, Butler, Columbiana, Fairfield, Hamilton, Harrison, Hocking, Jackson, Jefferson, Lawrence, Licking, Monroe, Muskingum, Perry, Pike, Richland, Vinton (PA/IA) Clermont, Franklin, Mahoning, Morrow, Madison, Ross, Trumbull (IA only)	$10,847,075 (P) $4,331,497 (I) $3,849,783 (SCB)** $630,000 (M) $630,000 (S)
DR- 951	August 4, 1992 (IA) August 14, 1992 (PA/HMGP)	PA/IFG/ HMGP *	Severe storms, tornadoes, flooding	Cuyahoga, Franklin, Logan, Mahoning, Medina, Mercer, Ross, Shelby, Summit, Trumbull, Van Wert (PA/IA) Auglaize, Belmont, Columbiana, Erie, Fairfield, Fulton, Geauga, Jefferson, Lorain, Lucas, Ottawa, Portage, Wood (PA only)	$8,308,334 (P) $2,081,117 (I) $2,474,083 (SCB)** $250,000 (M) $350,000 (CDBG)+
DR-1065	August 25, 1995	IFG/HMG P	Severe storms and flooding	Champaign, Erie, Logan, Lorain, Licking, Marion, Mercer, Miami, Scioto, Shelby, Washington	$3,493,319 (I) $81,731 (SCB)** $721,500 (M)
DR-1097	January 27, 1996	PA/IFG/ HMGP	Ohio River flooding	Adams, Belmont, Columbiana, Gallia, Jefferson, Lawrence, Meigs, Monroe, Scioto, Washington (PA/IA) Brown, Clermont, Hamilton (IA)	$4,335,000 (P) $1,822,056 (I) $1,617,991 (SCB)** $1,721,655 (M)
DR-1122	June 24, 1996	PA/HMGP	Severe storms and flooding	Adams, Belmont, Brown, Butler, Clermont, Gallia, Hamilton, Hocking, Jefferson, Lawrence, Meigs, Monroe, Paulding, Scioto, Vinton, Williams	$10,811,838 (P) $2,702,960 (S) $1,137,951 (M)
DR-1164	March 4, 1997	IA/PA/HM GP	Flash flooding on inland rivers/streams and Ohio River flooding	Adams, Athens, Brown, Clermont, Gallia, Hamilton, Highland, Hocking, Jackson, Lawrence, Meigs, Monroe, Pike, Ross, Scioto, Vinton, Washington (IA/PA/HMGP) and Morgan (PA/HMGP)	$29,666,825 (P) $22,196,350 (I) $9,821,524 (M) $9,821,524 (S) $9,740,294 (NRCS)*+

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DR-1227	June 30, 1998	IA/PA/MIT	Flash flooding, flooding, high winds and tornadoes.	Athens, Belmont, Coshocton, Guernsey, Harrison, Jackson, Jefferson, Knox, Meigs, Monroe, Morgan, Morrow, Muskingum, Noble, Ottawa, Perry, Pickaway, Richland, Tuscarawas, Washington; (IA only) Franklin, Sandusky, (PA only) Holmes	$21,803,771 (P) $14,312,348 (I) $9,000,000 (M) $9,000,000 (S) $10,410,817 (NRCS)*+
DR-1321	March 7, 2000	IA/MIT	Flash flooding, flooding	Adams, Gallia, Jackson, Lawrence, Meigs, Pike, and Scioto	$1,914,189 (I) $297,310 (M) $297,310 (SDRP)**
DR-1339	August 25, 2000	IA/MIT	Flooding	Lucas	$7,898,840 (I) $873,931 (M) $873,931 (SDRP)**
DR-1343	September 26, 2000	IA/PA/MIT	High winds and tornadoes	Greene	$189,051 (I) $3,430,810 (P) $558,025 (M) $558,025 (S)
DR-1390	August 8, 2001	PA/MIT	Flooding	Brown, Butler, Clermont, and Hamilton	$ 7,712,456 (P) $ 876,439 (M) $ 876,439 (S)
DR-1444	November 18, 2002	IA/MIT	Tornados, Severe Storms	Ashland, Auglaize, Coshocton, Cuyahoga, Franklin, Hancock, Henry, Huron, Lorain, Medina, Ottawa, Paulding, Putnam, Sandusky, Seneca, Summit, Union, Van Wert, Wayne, and Wood	$ 11,668,849 (I) $ 139,068 (M) – $ 48,409 (S) $ 2,297,222 (SDRP)
DR-1453*	March 24, 2003	IA/PA/MIT	Ice/Snow Storm	Adams, Gallia, Jackson, Lawrence, Meigs, Pike and Scioto (IA/PA); Athens, Belmont, Darke, Delaware, Fayette, Franklin, Greene, Guernsey, Harrison, Hocking, Licking, Madison, Miami, Monroe, Morgan, Montgomery, Muskingum, Noble, Perry, Preble, Ross , Union, Vinton, and Washington (PA)	$ 4,530,045 (I) $ 39,621,605 (P) * $ 2,415,899 (M) – $ 2,415,899 (S) -

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Disaster Number	Date Declared	Disaster Program	Incident Type	Counties Declare	Funds Provided
DR-1478*	July 15, 2003	IA/MIT	Severe Storms and flooding	Auglaize, Columbiana, Crawford, Darke, Logan, Mahoning, Mercer, Pike, Shelby and Van Wert (IA/MIT); Adams, Auglaize, Darke, Logan, Mercer, Pike, Shelby, and Van Wert (SDRP)	$ 6,451,793 (I) $ 145,762 (M)* $ 13,721 (S) $ 2,976,949 (SDRP)
DR-1484*	August 1, 2003	IA/PA/MIT	Severe storms, tornadoes and flooding	Carroll, Columbiana, Cuyahoga, Franklin, Jefferson, Mahoning, Medina, Portage, Richland, Stark, Summit and Trumbull (IA/MIT); Adams, Columbiana, Carroll, Jefferson, Mahoning, Medina, Monroe, Portage, Stark, Summit, Trumbull, and Vinton (PA)	$ 135,723,395 (I) $ 13,160,834(P)* $ 6,016,488 (M) $ 162,790(S) -
EM-3187*	August 23, 2003	PA Only	Power Outage	Ashland, Ashtabula, Cuyahoga, Erie, Geauga, Huron, Knox, Lake, Lorain, Lucas, Portage, Summit, and Trumbull	$ 2,067,222 (P)*
DR-1507*	January 26, 2004	IA/PA/MIT	Landslide, severe storms and landslides	Belmont, Jefferson, Morgan, Ross, Tuscarawas and Washington (IA/PA/MIT); Franklin (IA/MIT); Athens, Guernsey, Harrison, Monroe, Noble, and Perry (PA/MIT)	$ 3,408,934 (I) $ 14,811,923(P*) $ 875,265 (M)* $ 164,804 (S) -
DR-1519*	June 3, 2004	IA/PA/MIT	Severe storms and flooding	Athens, Carroll, Columbiana, Cuyahoga, Delaware, Guernsey, Harrison, Hocking, Holmes, Medina, Noble, Perry, Portage, Summit, and Tuscarawas (IA/PA/MIT); Crawford, Geauga, Licking, Logan, Lorain, Mahoning, Richland, and Stark (IA/MIT) and Knox and Jefferson (PA/MIT)	$ 30,238,921 (I)* $ 14,060,750 (P) * $ 2,305,560 (M) $ 748,426 (S) -
DR-1556*	September 19, 2004	IA/PA/MIT	Severe storms and flooding	Athens, Belmont, Carroll, Columbiana, Gallia, Guernsey, Harrison, Jefferson, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Tuscarawas, Vinton and Washington (IA/PA/MIT); Lawrence, Mahoning, Stark, and Trumbull (IA/MIT)	$ 47,455,690 (I) $ 35,597,480 (P)* $ 3,948,349 estimate (M)* $ 2,300,000 (S)
EM-3198*	January 11, 2005	PA Only	Snow Removal and Response	Butler, Champaign, Clark, Crawford, Darke, Delaware, Erie, Franklin, Greene, Hamilton, Hardin, Huron, Logan, Madison, Marion, Miami, Montgomery, Morrow, Preble, Richland, Sandusky, Seneca, Shelby, Union, Warren, and Wyandot	$ 11,093,341 (P)*

(M) – Hazard Mitigation Grant
(S) – State Match to Federal Hazard Mitigation funds
(P) – Public Assistance
(I) Individual Assistance includes FEMA Disaster Housing, SBA loans for homes, personal property and businesses and FEMA/State Other Needs Assistance grants for families and individuals
(NRCS)*+ - Natural Resources Conservation Service
* Indicates the disaster is not officially closed.

HMGP first available with disaster declared after 1987.
(SCB)** - State Controlling Board funds
(SDRP)**State Disaster Relief Program
(CDBG)+ - Community Block Grant funds provided by the Ohio Department of Development
EM 3187 is an Emergency Declaration for Public Assistance

Disaster Number	Date Declared	Disaster Program	Incident Type	Counties Declare	Funds Provided
DR-1580*	February 15, 2005	IA/PA/MIT	Severe winter storms, ice and mudslides	Clark, Sandusky, Warren and Miami (IA/MIT); Ashland, Auglaize, Athens, Belmont, Coshocton, Crawford, Delaware, Fairfield, Franklin, Guernsey, Henry, Hocking, Holmes, Huron, Jefferson, Licking, Logan, Morgan, Muskingum, Pickaway, Pike, Richland, Ross, Scioto, Stark, Tuscarawas, Washington and Wyandot (IA/PA/MIT); Adams, Allen, Brown, Carroll, Champaign, Clermont, Columbiana, Darke, Fayette, Hancock, Hardin, Harrison, Highland, Knox, Lorain, Marion, Medina, Meigs, Mercer, Monroe, Montgomery, Morrow, Noble, Paulding, Perry, Putnam, Seneca, Shelby, Union, Van Wert, and Wayne (PA/MIT)	$ 13,823,757 (I)* $120,432,304 (P)* $7,534,746 (M)* $1,500,000 (S) -
EM-3250	September 13, 2005	PA Only	Hurricane Katrina Emergency Shelter Operations	All 88 counties were included in the federal declaration	$2,423,981 (P)*
DR-1651*	July 2, 2006	IA/MIT	Severe storms and flooding	Cuyahoga, Erie, Huron, Lucas, Sandusky, and Stark	$24,933,505 (I)* $1,789,019 (M) est.
DR-1656*	August 1, 2006	IA/PA/MIT	Severe storms and flooding	Ashtabula., Geauga, and Lake	$25,092,160 (I)* $13,940,453 (P)* est. $3,411,736 (M) est.*
DR-1720	August 28, 2007	IA/PA/MIT	Severe storms and flooding	Allen, Crawford, Hancock, Hardin, Putnam, Richland, Seneca (IA/MIT), and Wyandot	$45,452,363 (I)* $12,688,139 (P)* $6,630,799 (M)* $1,984,493 (S)*
EM-3286*	April 24, 2008	PA	Snow	Ashtabula, Brown, Clermont, Clinton, Crawford, Delaware, Fairfield, Franklin, Geauga, Greene, Hardin, Huron, Lake, Morrow, Richland, Union and Wyandot	$6,800,000 (P) est.
DR-1805*	October 24, 2008	PA/MIT	Wind Event	Ashland, Brown, Butler, Carroll, Champaign, Clark, Clermont, Clinton, Coshocton, Delaware, Fairfield, Franklin, Greene, Guernsey, Hamilton, Harrison, Highland, Hocking, Holmes, Knox, Licking, Madison, Miami, Montgomery, Morrow, Perry, Pickaway, Preble, Shelby, Summit, Tuscarawas, Union, and Warren	$48,124,981 (P)* $6,507,249 (M)*

(M) – Hazard Mitigation Grant
(S) – State Match to Federal Hazard Mitigation funds
(P) – Public Assistance
(I) Individual Assistance includes FEMA Disaster Housing, SBA loans for homes, personal property and businesses and FEMA/State Other Needs Assistance grants for families and individuals
(NRCS)*+ - Natural Resources Conservation Service
* Indicates the disaster is not officially closed.

HMGP first available with disaster declared after 1987.
(SCB)** - State Controlling Board funds
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RISK ASSESSMENT, THE ANALYSIS PROCESS (METHODOLOGY, FACTORS, AND VALUES)

A hazard identification and risk analysis consists of two elements. The first is the identification of a hazard. The second element is an assessment of the vulnerability associated with that hazard. Research for this analysis involved the collection of both historical and statistical data, including review of available literature and interviews with professionals in various disciplines. Information was then systematically analyzed for potential risk value.

The risks associated with each hazard were further assessed using seven factors with numerical risk values. These seven factors are ***Frequency, Average Response Duration, Speed of Onset, Average Magnitude, Impact on Business, Impact on Human, and Impact on Property***. The Frequency, Duration, Speed of Onset and Magnitude comprise the profile of the hazard. Generally, these factors were considered for an average occurrence of the hazard, not incidence catastrophic occurrence.

Vulnerability profiles are based on impacts to business, people, and property. Numerical values were applied to provide a basis on which to compare hazards and to assign risk values. The resulting risk total values allow hazards to be compared against each other to obtain a prioritization of hazards.

While some specific environmental considerations have been included in the hazard description narratives, this HIRA does not consider environmental impacts as a separate factor in the vulnerability profile in and of themselves. Environmental impact is assessed through effects on people, property and business. Therefore, environmental impacts influence the scoring of a hazard insofar as they are manifested in the vulnerability profile.

Hazard Profile

Frequency. A key factor in the risk of a particular hazard is the frequency with which it occurs. Some hazards have been relatively frequent in this state while others were only sporadic. For this hazard analysis, the frequency with which an event occurs is based on the number of Gubernatorial Declarations associated with the hazard agent from 1991 through 2010. Using Gubernatorial Declarations provides a minimum threshold of damage as well as provides a wider variety of hazards than utilizing the presidential declarations. State declaration records from Ohio’s Secretary of State date back to 1991.

Frequency		
5	Excessive	Nine or more state declarations
4	High	Six to eight state declarations
3	Medium	Three to five state declarations
2	Low	One or two state declarations
1	None	No state declarations

It is important to note that frequency was considered a key factor in determining the hazard profile. To that end, an **Adjusted Frequency** score was added for this factor and multiplied by 1.5 to weight the score more importantly than other factors.

Average Response Duration may be defined as "time on the ground" or the time-period of response to a hazard or event. Transportation accidents may last a few hours whereas a tire fire may last a week and a flood several weeks. Duration, therefore, may not always be indicative of the degree of damage, but it remains an important planning factor.

Average Response Duration		
5	Excessive	Less than a year
4	Long	Less than a month
3	Medium	Less than a week
2	Short	Less than a day
1	Minimal	Less than a half day

Average Speed of Onset may affect all other factors due to lack of warning or time to prepare for impact. The lead-time required protecting lives and property varies greatly with each event. For instance, a slow-rising Ohio River flood may allow time to evacuate residents and begin flood fight measures, but flash floods can occur with little warning.

Average Speed of Onset		
4	Short-None	Minimal to no warning
3	Short	6 to 12 hours
2	Medium	12 to 24 hours
1	Extended	Over 24 hours

Average Magnitude is the geographic dispersion of the hazard. For instance, how many counties would be impacted by a flood on the Ohio River versus a transportation accident involving hazardous materials? Similar to Frequency, this hazard is deemed a more important contributor to risk and therefore received a weighted value of 1.25 above the raw score. This **Adjusted Magnitude** score is based on the number of counties potentially impacted by an event.

Average Magnitude		
4	Catastrophic	More than 50 counties impacted
3	Critical	25 to 50 counties impacted
2	Limited	10-25 counties impacted
1	Localized	Less than 10 counties impacted

The **Impact on Business** refers to enduring economic impact of the hazard on the community by an event. This factor was developed and in keeping with the hazard analysis in the Ohio Standard Mitigation Plan developed by the Ohio EMA Mitigation Branch.

Impact on Business	
4	Complete shutdown of critical facilities for 30 days or more
3	Complete shutdown of critical facilities for at least two weeks
2	Complete shutdown of critical facilities for one week
1	Shutdown of critical facilities for less than 24 hours

Impact on Humans. This factor relates to the number of lives potentially lost to a particular hazard. This factor was developed and in keeping with the hazard analysis in Ohio's Standard Mitigation Plan.

Impact on Humans		
4	High	Multiple deaths
3	Medium	Multiple severe injuries
2	Low	Some injuries
1	Minimum	Minor injuries

Impact on Property. This factor relates to the amount of property potentially lost to a particular hazard agent. This factor can vary between jurisdictions based on economics, geographic amount owned, and demographics of the particular populations. This factor, therefore, is generalized. This factor was developed and in keeping with the hazard analysis in Ohio's Standard Mitigation Plan.

Impact on Property		
4	High	More than 50% of property severely damaged
3	Medium	More than 25% of property severely damaged
2	Low	More than 10% of property severely damaged
1	Minimum	Less than 10% of property severely damaged

DETAILED HAZARD OVERVIEW

Natural Hazards - Meteorological

Flood, Flash Flood, Seiche

Ohio can experience four types of floods. *Riverine* (The overflow of rivers and streams from rains or melt water); *Flash* (A fast rising of streams or "dry-gulch" waters after heavy rain/snowmelt); *Urban and Small Stream* (An overflow of storm sewers and streams after a heavy rainfall); and *Coastal (Seiche)* (Floods along the Lake Erie shoreline, often associated with severe storms and/or seiche waves).

Flood/Riverine (Total Risk = 27.00), with the highest numerical rating, constitutes the primary threat to life and property in the state of Ohio. Riverine floods result from prolonged heavy rain over a large area. Riverine floods are more common in winter and spring when the soil is saturated or frozen. Large-scale weather systems producing heavy rain are most common during these seasons. The National Weather Service issues flood warnings several hours or days before riverine floods develop. Also, there may be two or more days of preparation before the flood crests on the major rivers in Ohio. Heavy rains in Ohio may cause floods on the rivers flowing into the Ohio River, such as the Muskingum, Scioto, and Miami Rivers, without causing a large flood on the Ohio. On the other hand, heavy rains in Pennsylvania and West Virginia may cause a flood on the Ohio River even if heavy rain has not fallen over Ohio.[7]

Flash Floods and Seiche (Total Risk = 23.75) are the result of intense local rainfall and usually last a few hours. Normally, little warning precedes flash flooding. One of the deadliest flash floods occurred in Shadyside, a community on the Ohio River in Belmont County, late on June 14, 1990. Twenty-six people lost their lives in a brief flash flood on Wegee Creek and Pipe Creek near Shadyside. Flash flooding began at 9:30 p.m. and was over in 30 minutes.

Lake Erie is particularly prone to short-term, wind-caused fluctuations because of its shallowness and elongation. These can lead to extreme seiche waves of up to 16 feet between the ends of the lake. The seiche effect can cause oscillation back and forth across the lake for some time until it settles down again. In May 1942, two seiche-related waves unexpectedly battered the Ohio shore between Bay Village and Conneaut. Madison-on-the-Lake received the brunt of the waves. The first wave ranged between 4 and 20 feet, and the second, following 15 minutes later, was 6 to 8 feet high. The seiche wave killed seven people.

Although often confined to specific drainage systems or geographic regions, floods can pose a threat to over 700 communities and potentially hundreds of thousands of residents in all 88 counties. Protective actions (evacuation/sheltering) may deplete both material and fiscal resources. Floodwaters have also damaged key infrastructure elements (roads, bridges and sanitary facilities). Infrastructure damages may also lead to an increase in infectious diseases in some affected areas. Other collateral problems include power outages and transportation delays. Mudslides, a component of the 1990 Shadyside event, are often a flood-related concern in the south-southeast areas of the state. The costs in labor, time and monies for flood-related mitigation and preparation actions may also be exceedingly high.

In the late 1990s, two major floods affected the state within a space of 16 months. The first, in February 1997, caused flash and riverine flooding in 18 southern counties. In June 1998, a varied weather pattern with tornadoes, severe storms, and flash flooding struck 23 counties on a northwest to southeast track. These events affected thousands of residents and caused millions of dollars in business and residential losses. The following chart provides a comparison of these events.

Figure 4: Flood Damage Comparison Chart for Ohio[8] (1997-98)

Critical Element	1997	1998
Overall Financial Impact	$180 Million	$184.3 Million
Federally Declared Counties	18	23
Casualties (Deaths)	5	12
Residents Evacuated	20,000	9,000

Windstorm, Tornadoes

Windstorms and Tornadoes (Total Risk = 26.25) are the second greatest threat to the state. These violent, rotary windstorms can attain wind-speeds up to 300+ mph and often accompany or follow severe thunderstorms. They may occur anywhere, at any time of the year with unpredictable, severe effects. In Ohio, tornadoes are more frequent in the spring and summer months of April, May, June, and July. Other severe storm associated winds, not classified as tornadoes, may be almost as violent and damaging. Tornadoes and windstorms have a high potential to cause loss of life, damage or destroy property, and overwhelm local response capabilities.

Tornado effects vary according to wind-speed, duration on the ground, and topography. From 1950 to 2009, the National Weather Service reported 876 tornado touchdowns in Ohio. Estimated losses over a 30-year period are in excess of $110+ million. The Lorain and Xenia storms cost more than 100 lives and caused millions of dollars in property damages. As in the case of floods, the costs and duration of recovery may extend over years.

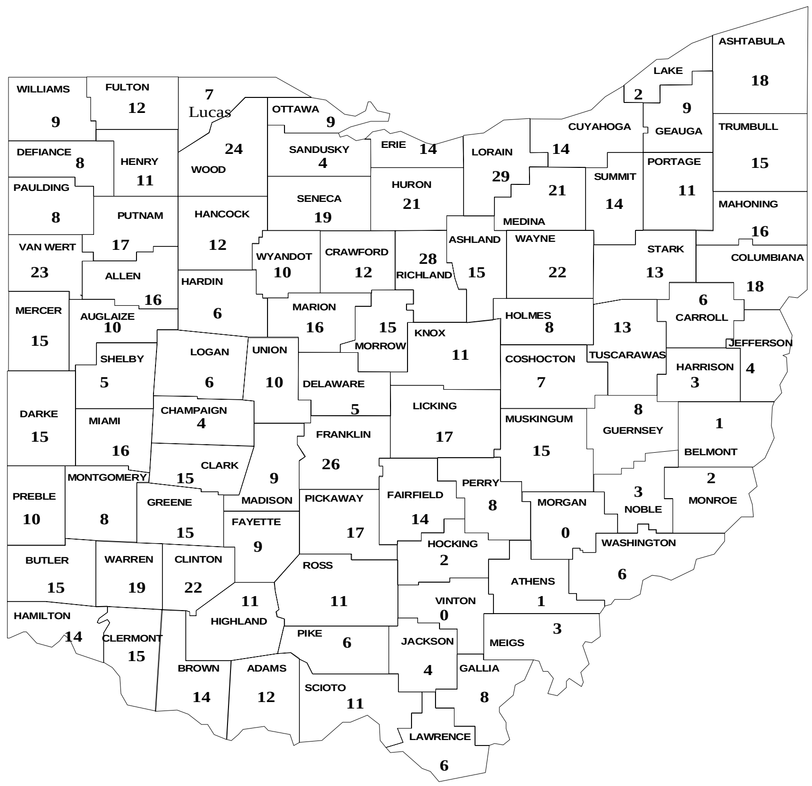
On April 9, 1999, a tornado in Clinton, Hamilton, and Warren counties killed four and injured 42 while destroying or damaging over 400 dwellings. Estimated financial losses were in the millions for the storm, which the National Weather Service termed as the most devastating in terms of casualties since the 1985 event, which killed 18 Ohioans.

One of the most destructive windstorms in the state's history hit Ohioans on September 14, 2008. Remnants from Hurricane Ike moved through Ohio with tropical storm force winds, leaving nearly two million homes and businesses without electricity during the height of the emergency. Eighty-four of Ohio's 88 counties reported some type of windstorm damage, fallen debris or power outages. Seven Ohioans died from injuries sustained from the windstorm. This event also resulted in a Presidential Declaration for 33 counties.

In 2010, three significant events severely impacted Ohio's communities. The first event occurred June 5-6, 2010, when a major tornado outbreak affected the Midwestern United States and Great Lakes Region. The event resulted in seven people dead in Wood County. The second event occurred when severe weather and tornadoes swept across the state in the afternoon of September 16, 2010. The National Weather Service confirmed 11 tornadoes in Athens, Delaware, Fairfield, Holmes, Meigs, Perry, Tuscarawas, and Wayne counties and in the Tarlton, Ohio area. No deaths were associated with the event.

The third event occurred October 27, 2010, when a very intense area of low pressure pushed east through the Great Lakes Region, with a strong cold front moving through the Ohio Valley. Wind gusts of 50-60 mph were recorded in some areas of the state. The National Weather Service confirmed eight tornadoes in Auglaize, Fayette, Franklin, Licking, Paulding, Pickaway and Van Wert counties. No deaths occurred with this event.

Figure 5: Ohio's Tornado History (1950-2010)



Source: Ohio Tornado Database
(National Weather Service and
Columbus Dispatch)
1950-2010

Snow, Ice, Hail and Sleet

Snow, Ice Hail and Sleet (Hazard Rating = 23.25) are the fourth leading weather-related threat to the state. These include heavy snowfall with extreme cold and ice, or a combination of the three.

A total of 504 Winter Storms from 1950 to present are reported by the National Weather Service. The storms of 1913, 1940, 1950, 1977, 1978, 1994, 1996, and 2004/2005 were especially damaging. Some winter storms have occurred in specific sectors of the state; south/southeast (1984); east/northeast (1993); and south/central (1994). However, the storms of 1950 and 1978 were statewide in nature and of a severity that required massive state/federal response and recovery efforts.

In addition to structural and power line damages, these storms have a potential for collateral effects; isolation and economic disruption (from roadway and business closings) along with ice dams and floods caused by the melting process.

Natural Hazards - Biological

Disease

Human Disease (Total Risk = 22.00) and Animal Disease (Total Risk = 21.50) are the two greatest biological threats to Ohio citizens.

Emerging diseases, such as plague, smallpox, anthrax, West Nile Virus, foot and mouth disease, Severe Acute Respiratory Syndrome (SARS), Pandemic Influenza, Bovine Spongiform Encephalopathy (BSE), commonly known as mad cow disease, are becoming increasingly prevalent on the world stage. This type of event would likely be regional, if not global, in nature. Pandemic Influenza has become a planning priority for the state of Ohio as well as at the federal level. Likewise, certain health conditions such as the Methicillin-resistant Staphylococcus aureus (MRSA) staph infection are coming to prevalence in the media.

A pandemic outbreak has the potential to infect large numbers of Ohio citizens, which could easily overwhelm the health care system in the state, and impact the personnel needed to respond and recover from such an event. A pandemic outbreak could also jeopardize essential functions by causing high levels of absenteeism in critical services areas. Large numbers of people would likely become ill or expire. Examples such as the 1918/19 Influenza Pandemic demonstrate the potential for loss of human life and significant impacts on society.

A continuous significant concern has been the emergence of a Pandemic Influenza or other human infectious disease, such as the recent Novel Influenza A (H1N1). The outbreak initially emerged in April 2009 for two months and then increased activity again in October 2009 for another four months. The H1N1 was not considered to have a high severity; however, it was considered extremely virulent in younger populations and pregnant women. From August 30 through January 30, 2010, the cumulative total for Ohio influenza confirmed hospitalizations is 3,194 individuals per Ohio Disease Reporting System (ODRS). At least 51 people hospitalized with H1N1 infection died in Ohio during that period. Fortunately there was not a significant impact to infrastructure or on personnel needed to respond and recover.

Diseases which cause widespread human deaths would have an impact on the environment in terms of the disposal of human remains and the handling of bio-hazardous waste. Environmental and regulatory factors would have to be evaluated in the disposal of both human remains and bio-hazardous waste.

Diseases which cause widespread deaths of animals, both captive and wild, would have an effect on the environment in terms of disposal of the carcasses. Whether the infected animals are buried, burned or left in place, a large quantity and concentration of carcasses may impact air, soil and groundwater.

Natural Hazards - Geological

Earthquakes

Earthquakes (Total Risk = 19.25) are defined as a rapid motion of the ground accompanied by shaking, faulting (surface and subsurface) and ground failure. Earthquakes from two points affect Ohio: events having epicenters within the state, and those occurring along the New Madrid, Missouri Fault Zone. Figure 6 shows a map of earthquake epicenters for Ohio and adjacent areas.

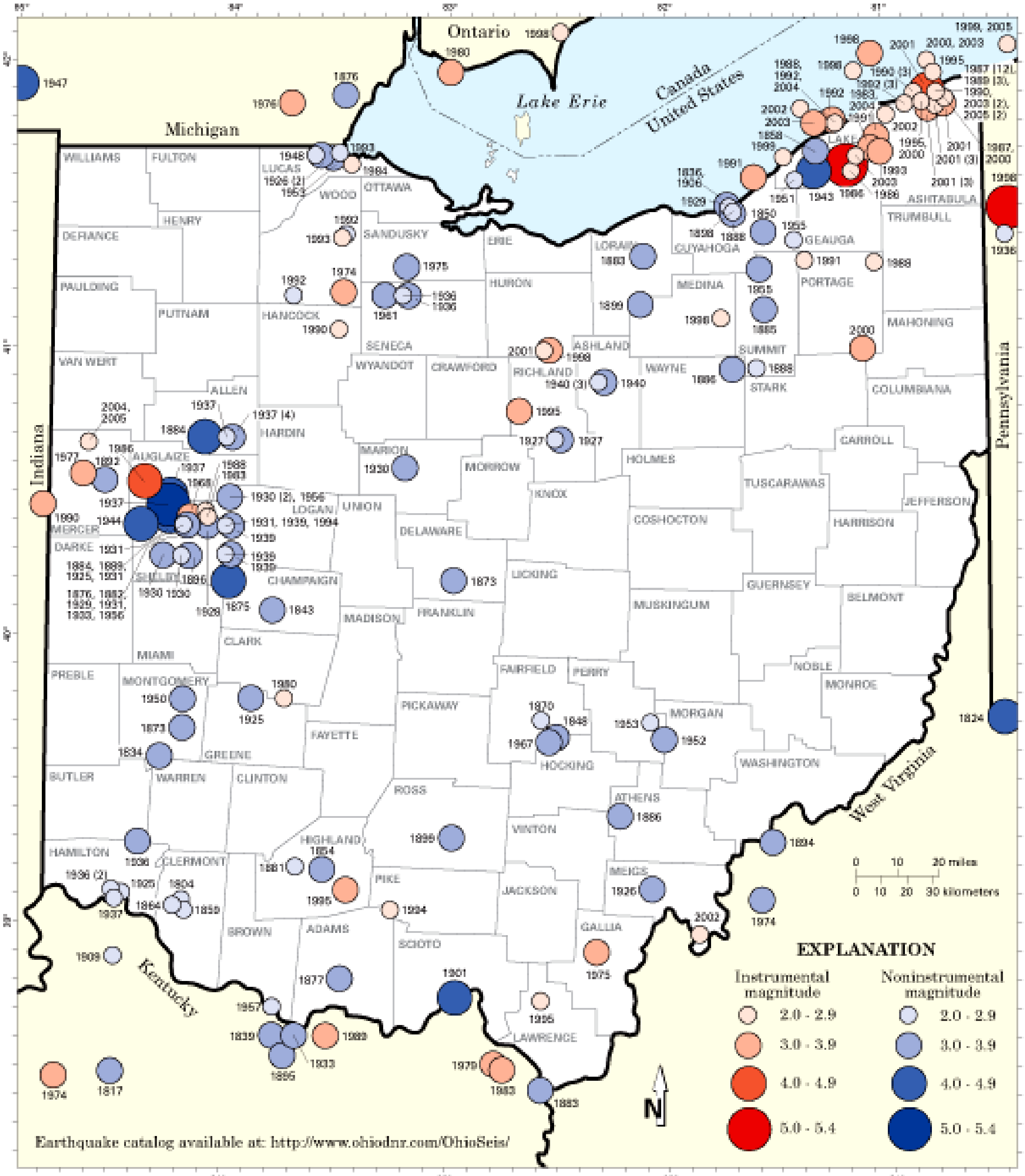
Over 120 earthquakes with Ohio epicenters have occurred since 1776. Fifteen of these events have caused minor to moderate damage with the largest earthquake registering 5.4 magnitudes in 1937. Fortunately, these events have not resulted in fatalities, only minor injuries.

Seismic activity is concentrated in, but not confined to, three areas of the state. Historically, the most active area, with at least 40 earthquake events since 1875, is the Anna Seismogenic Zone centered in Shelby County, (western Ohio). Many other events have occurred in the Lake County area, or in the southeast, and have caused minor to moderate damage.

Other counties with documented earthquake epicenters include Adams, Allen, Ashland, Ashtabula, Athens, Auglaize, Brown, Butler, Champaign, Clermont, Cuyahoga, Gallia, Geauga, Greene, Hamilton, Hancock, Hardin, Highland, Hocking, Jackson, Lake, Lucas, Marion, Meigs, Mercer, Montgomery, Muskingum, Perry, Pike, Portage, Preble, Putnam, Richland, Ross, Sandusky, Scioto, Seneca, Shelby, Summit, Washington, Williams, Wood, and Wyandot.

The state would also be affected by events generated by the New Madrid Fault Zone, extending from Arkansas to Indiana along the Mississippi and Ohio River Valleys. This fault generated the most powerful earthquakes ever documented in the Continental U.S. in a four-month period during 1811 and 1812. If earthquakes of this intensity occur again, devastating damages in our southwestern counties could be expected. Figure 7 lists the counties potentially impacted, and effects from a major New Madrid earthquake in Ohio.

Figure 6: Earthquake Epicenters in Ohio and Adjacent Areas



Source: Ohio Department of Natural Resources, Ohio Division of Geological Survey, 2007, Earthquake epicenters in Ohio and adjacent areas

Figure 7: Effects of a Major New Madrid Earthquake in Ohio

Mercalli Intensity	Effects	Counties Potentially Affected
VI	Felt by all, indoors & outdoors. Many people frightened and excited. Liquids set in strong motion. With slight damage in poorly built structures. Fallen & cracked plaster with a considerable quantity of broken dishes & glassware.	Allen, Ashland, Auglaize, Crawford, Cuyahoga, Defiance, Erie, Geauga, Hancock, Hardin, Henry, Huron, Lake, Logan, Lorain, Mahoning, Marion, Medina, Mercer, Morrow, Ottawa, Paulding, Portage, Putnam, Richland, Sandusky, Seneca, Shelby, Stark, Summit, Trumbull, Van Wert, Wayne, Wood, & Wyandot. (Approx. 4 million people in 36 counties)
VII	Many people find it difficult to stand. Slight damage in ordinary buildings., Considerable amounts of fallen plaster & numerous broken windows & fallen cornices	Athens, Belmont, Carroll, Champaign, Clark, Columbiana, Coshocton, Darke, Delaware, Franklin, Fulton, Gallia, Guernsey, Harrison, Holmes, Jackson, Jefferson, Knox, Lawrence, Licking, Lucas, Madison, Meigs, Miami, Monroe, Morgan, Noble, Tuscarawas, Union, Washington, and Williams (Approx. 3 million people in 31 counties)
VIII	Alarm approaches panic. Branches of trees broken. Changes in the flow of well & spring water. Considerable damage in ordinary substantial buildings. Fallen walls, factory stacks, towers, & monuments. Heavy furniture overturned.	Adams, Brown, Butler, Clermont, Clinton, Fairfield, Fayette, Greene, Hamilton, Highland, Hocking, Montgomery, Muskingum, Pickaway, Perry, Pike, Preble, Ross, Scioto, Vinton, & Warren (Approx. 3 million people in 21 counties)

Source: *U. S. Geological Survey, Maximum Seismic Interactions Map for New Madrid Seismic Zone; Algermission & Hopper*

Collateral effects from an earthquake could be extensive and may include hazardous material spills, landslides, subsidence, dam failures, fires, groundwater contamination, pipeline breaks, infrastructure disruptions, epidemics, floods, along with theft/looting.

Landslide, Mudslide, Subsidence

Landslide, Mudslide and Subsidence (Total Risk = 18.75) are the second major geological threat. *Subsidence* is defined as a drop in the earth's surface due to a collapse in bedrock or other underlying material (coal pillars, rock, etc) into underground mines or other open space.

Land or Mudslides are defined as downward and outward movements of slopes due to rains or melting snow with accompanying damage and debris deposition. They may also include sudden collapses of mines, tunnel walls, or supports with resulting damage to surface structures or features (buildings and highways).

Landslides include three types. A *Rotational Slump* occurs when weak rock or sediment moves as a mass in a slow or imperceptible movement. A more common event, *Earthflow*, involves rock, sediment, or weathered surface materials moving down slope in a mass. *Rock fall* is seen as the most common and dangerous form of movement. Rock from a cliff or cut will fall onto roadways or structures. This action is common during periods of late winter or early spring thawing. Traffic vibration, undercut slopes, increased weight on slopes, or the removal of vegetation and ensuing erosion may also contribute to these events. Events have been traced back to 1923 at various sites. They occur mainly through the Ohio or Scioto River Valleys, or elsewhere in the eastern portion of the state with some occurring along the eastern Lake Erie Shoreline (Figure 8).

During and after WWII, when the demand for mineral resources was high, the state had over 700 active coal mines. As the supply of coal in many mines was exhausted, the mines were abandoned with little or no preparation. Supporting pillars of coal in shaft mines were mined away prior to closings. In the mid-1990s, over 6,000 closed underground mines were estimated to exist in 37 counties with over 61,000 acres of land affected by closings or site abandonment.

Abandoned mines have also occasionally collapsed with damage to surface structures or costly infrastructure damage. On March 5, 1995, a twelve foot section of Interstate 70 in Guernsey County collapsed due to an abandoned underground mine subsidence. In addition, landslides and mudslides affecting roadways have led to costly repair actions by state and local governments. It is estimated that repair or replacement costs could reach $9 million or more if a major highway is involved. The ODNR Division of Geological Survey has detailed maps for approximately 4,200 abandoned mines in Ohio and estimate there are approximately an additional 2,000 abandoned mines not detailed on maps.

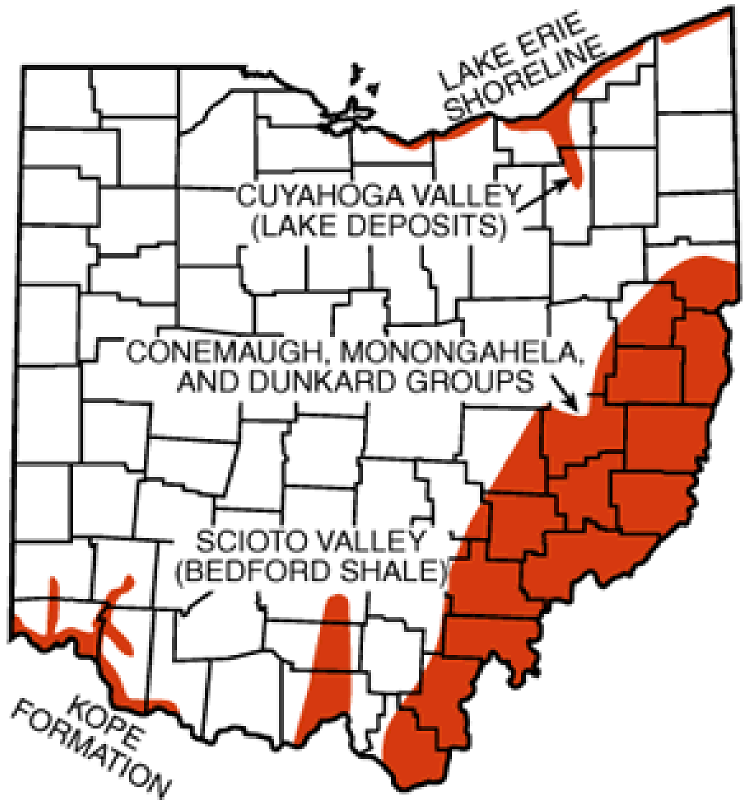
Subsidence and landslides, particularly during the l997-98 floods, have also led to the temporary relocation of farmsteads, housing units, or businesses.

Figure 8: Ohio Landslides

ODOT District No.	**District Counties**	**Average Annual Slides**
8	Butler, Clermont, Clinton, Greene, Hamilton, Preble, & Warren	15
9	Adams, Brown, Highland, Jackson, Lawrence, Pike, Ross, & Scioto	12
10	Athens, Gallia, Hocking, Meigs, Monroe, Morgan, Noble, Vinton & Washington	180-200
11	Belmont, Carroll, Columbiana, Harrison, Holmes, Jefferson & Tuscarawas	20

Source: *ODOT (Div. of Engineering Policy)*

Figure 9: Ohio Subsidence and Landslides



Subsidence and landslide zones shown in red

Human-caused - Accidental

Radiological Incidents (Nuclear Power Generating Sites)

Radiological Incidents (Nuclear Power Generating Sites) (Total Risk =22.25) are the greatest human-caused hazard and ranked as the 5th hazard in the state overall. The release (or potential for release) of radioactive materials could initiate protective actions (evacuation or sheltering) for populations residing within a 10-mile Emergency Planning Zone (EPZ), and affect the ingestion pathway within a 50-mile EPZ of a site. Ohio residents could potentially be affected by three nuclear power generating facilities operating in or near the state:

- Davis-Besse Nuclear Power Station located in Port Clinton (Ottawa County)
- Perry Nuclear Power Plant located in North Perry (Lake County)
- Beaver Valley Power Station located in Shippingport, Pa. (Beaver County)

In an emergency involving a single power plant, over 95,000 residents could be affected by accidental emissions. Response and recovery actions could cost millions of public and private sector dollars. Ohio has experienced 34 events from 1986-2010.

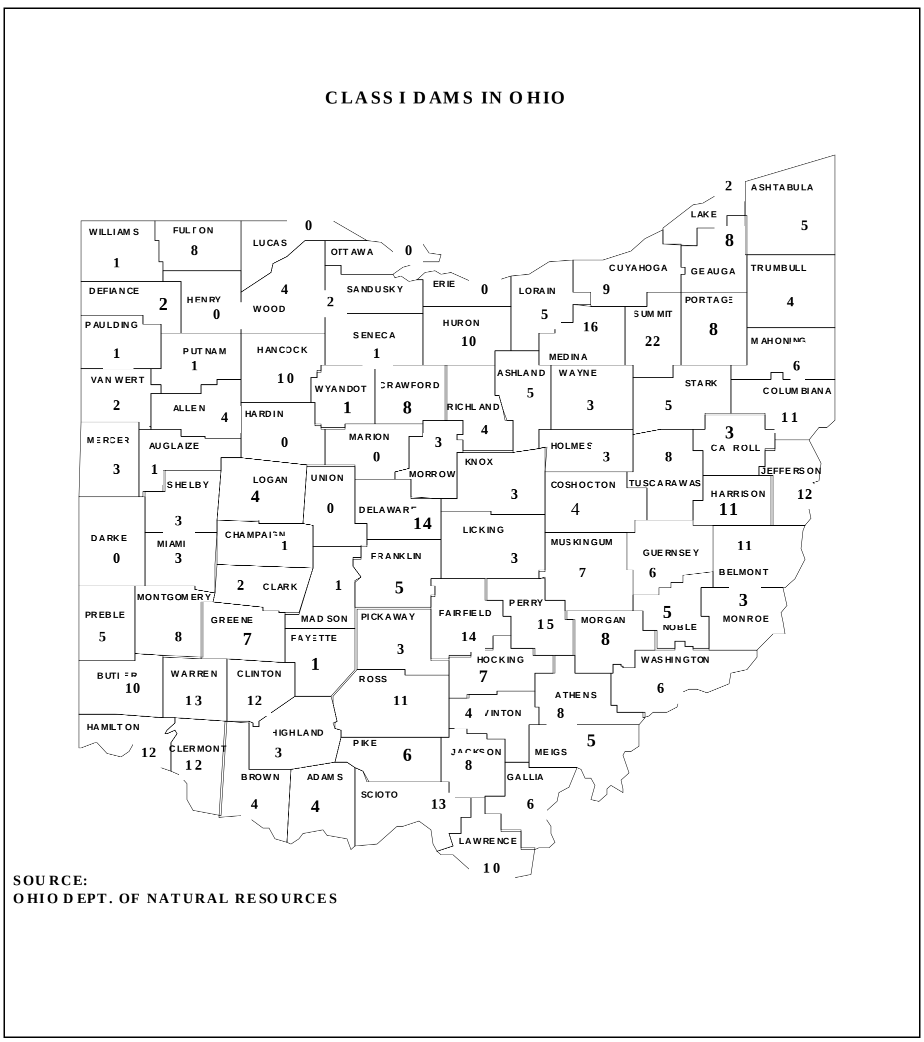
Water Control Structure (Dam/Levee Failure)

Water Control Structure (Dam/Levee Failure) (Total Risk = 22.00) is the second greatest human-caused hazard and ranked sixth in the state. It is defined as a gradual or immediate collapse or failure of water impounding systems or structures, resulting in downstream damages.

Dams in Ohio have been divided into four classes; I, II, III, IV, based upon a downstream threat potential. Figure 10 shows the number of Class I dams by county. The failure of a Class I dam would result in the probable loss of life or pose a serious hazard to health, property and high-value industrial or commercial properties or public utilities in the below-dam inundation plain. A Class I dam is one with a volume capacity of over 5,000 acre-feet or a height greater than 60 feet. Although damages to Class I dams pose the greatest threat to human life, Class II and III units could also pose a similar threat if affected.

The state does not currently have a means of determining downstream populations and/or potential monetary losses in case of failure. A review of similar events in other states illustrates the possible consequences: Buffalo Creek, W.Va. suffered 125 casualties and $400 million in property damages; Lawn Lake, Colorado incurred three casualties and $21 million in property damages; and the town of Toccoa, Georgia, suffered 39 casualties and $30 million in property damages.

Figure 10: Class I Dams in Ohio



Building/Structure Collapse

Building/Structure Collapse (Total Risk = 20.75) is the third ranked human-caused accidental hazard impacting Ohio. Bridges are the most common type of collapse in the state. There are over 42,000 bridges in the state of Ohio. The Ohio Department of Transportation (ODOT) is responsible for nearly 15,000 bridges on the state highway system. Our state has the second largest number of bridges in the country. Ohio law requires all bridges to be inspected on an annual basis. This applies to all bridges maintained by ODOT as well as county and city bridges.

The 2007 Interstate 35W bridge collapse in Minneapolis, Minnesota, brought to light challenges states face with structurally deficient bridges. Like Minnesota, Ohio has over a dozen highway deck truss bridges that share the same design structure as the I-35W Bridge. In 2009, Lake County replaced a similarly-designed bridge with twin bridges on Interstate 90 over the Grand River. The bridge partially collapsed in 1996 due to deteriorating corroded steel plates. No injuries were reported, but the bridge was closed for months for repairs. In another comparable case, the city of Cleveland's Inner belt Bridge is undergoing more than $150 million in repairs.

In 1983 a bridge collapsed in Antwerp (Paulding County) killing five people. The 30-foot stone and asphalt structure caved-in and four cars plunged into a dry creek bed. Another notable bridge collapse occurred in Ohio on December 15, 1967. The Silver Bridge over the Ohio River collapsed killing 46 people. The bridge connected the towns of Point Pleasant, West Virginia, and Managua, Ohio.

More recently, Ohio resources have been used to respond to building structural collapse rescues. On July 7, 2010, the Ohio Regional Urban Search and Rescue and the northwest area's Regional Structural Collapse Response Unit responded to a significant structural collapse in Fremont. Support columns inside a food processing plant partially collapsed the roof structure. Area-wide assistance was requested for two workers trapped under the debris. One person was killed and the other was trapped for hours beneath the rubble.

Structural/building collapse will remain a primary human-caused hazard in Ohio, primarily due to the threats faced in this state. Significant threat concerns include the impact from tornadoes, earthquakes, snow loads, landslides, gas explosions, acts of terrorism, and environment.

The collapse of a building or other structure may lead to environmental damages through hazardous materials releases, the atmospheric release of asbestos or other harmful substances, and the contamination of the water table through sewage release or other chemicals. Contaminated debris may pose special challenges for waste disposition or recycling.

Using this documentation, risk to the environment can be assessed in terms of magnitude and of impact on plant, animal and human life as well as the eco-systems in which they interact. In accordance with the Magnitude factor used throughout the Hazard Identification and Risk Analysis Update 2011, magnitude of risk to the environment due to structural collapse is rated as “Localized” meaning it is expected to be small in geographical scale with less than 10 of 88 counties impacted.

Vulnerability of the environment can be assessed in the same fashion using the Impact on Humans factor from the HIRA Update 2011. Impact on plants, animals and humans and associated eco-systems is rated at “High” because of the strong possibility they will be in immediate proximity to the collapse. Multiple deaths are expected as well as long-term consequences to the eco-system in the immediate area. Depending on the purpose of the structure and its date of construction lead and asbestos may be present and their contamination could readily be spread through water and wind movement.

Explosion/Fire

Explosion/Fire (Total Risk = 19.75) ranks fairly high as a human-caused hazard, primarily due to its impact on people. Cleveland is noted by fire historians for the Collinwood School Fire in 1908 that killed 172, as well as the Cleveland Clinic Fire in 1929 that killed 123.

Structural fires pose many of the same environmental challenges of building collapse with an added immediate impact to the atmosphere. Depending on what materials are in the structure, it is possible that air quality could deteriorate for an unknown length of time and pose an immediate threat to life and long term threat to well-being.

Hazardous Materials

Hazardous Materials (Total Risk = 18.25) ranks as the sixth human-caused accidental hazard. Hazardous materials incidents remain the most common form of accidental threat to Ohio, occurring almost daily. A hazardous materials spill can be the result of human negligence, an intentional act, or a natural hazard. Human negligence occurs predominantly during the manufacture, transport, or storage of the hazardous material. An intentional act would be considered either a terrorist act, criminal act, or act of vandalism. A hazardous materials spill can be a secondary effect of a natural hazard (e.g., flooding, earthquake, or severe weather).

Although major chemical accidents and spills seem most threatening, it is the smaller, more routine accidents and spills that have a greater impact on humans, wildlife, economy, and environment. Some of the most common spills involve tanker trucks and railroad tankers containing gasoline, chlorine, or other industrial chemicals. The National Environmental Law Center reported that 34,500 accidents involving toxic chemicals were reported to the EPA's Emergency Response and Notification System between 1988 and 1992, meaning that on average, a toxic chemical accident was reported nineteen times a day in the United States, or nearly once every hour. [9]

Human Caused Hazards - Intentional

Terrorism (CBRNE)

Terrorism incidents (Total Risk = 20.00), involving Chemical, Biological, Radiological, Nuclear, & Explosive (CBRNE), are ranked as the highest human-caused intentional hazard. The Federal Bureau of Investigation (FBI) defines terrorism incidents as the "…unlawful use of force or violence against persons or property to intimidate, or coerce a government, civilian population, or any segment thereof in the furtherance of political and social objectives." The victims of terrorism may not always, however, be the intended, or most concerned, elements of society.

Although events such as the World Trade Center Bombing/Destruction (1993 & 2001) and Oklahoma City bombing (1995) did not occur in Ohio, the threat, real or implied, to employ terrorism in this state, remains. Threats often involved the employment of Weapons of Mass Destruction (WMD), to include bombs and pathogens, and can be directed at targets in both rural and urban-industrial settings.

In 1995, an Ohio resident with ties to unorganized militias was able to order, via mail, samples of Plague bacilli. Although that attempt was thwarted, the events of 2001 show that the bio-terrorist threat remains viable.

One of the most dangerous emerging threats to our country is the criminal and terrorist use of Improvised Explosive Devices (IEDs). IEDs have the potential to make a lethal impact, with relatively low-tech skills needed to produce them. IEDs have been the weapon of choice for foreign terrorists since the first World Trade Center attack in 1993 and for domestic terrorists since the Oklahoma City bombing in 1995. This threat has expanded to include both Vehicle-born Improvised Explosive Devices (VBIEDs) and small arms attacks.

IEDs have an enormous potential for influencing public perception and for creating an atmosphere of fear and uncertainty. A car bomb exploding in the middle of a busy urban setting can quickly undermine emergency response efforts to protect the public.

An act of terrorism's impact on the environment can be very large and can be felt by the environment in several different ways.

Chemical incidents are unlikely to have a significant effect on electric utilities, natural gas utilities, pipelines nor water courses. Such incidents would create some debris, though not an unmanageable amount. Chemical terrorism would however have a large impact on both the short-term quality of the air, and long-term quality of waste water systems, aquatic ecosystems and soils that sustain wildlife.

A biological incident probably would not compromise utilities, displace waterways, create large amounts of debris, nor have a large-scale effect on air quality, but could certainly effect sewage systems, septic systems, waterway ecosystems, soil usability - and subsequently the plant life and wild life that depend on them.

A radiological incident has the potential to make a large impact on air quality due to fallout from the device; contamination of water utilities, storm sewers, sewage and septic systems; contamination of water eco-systems; and soil contamination from both the device itself and from radioactive water leeching into the soil. Such an incident has less likelihood of effecting electric, natural gas, pipelines, utilities; watercourses; or of creating an immediate debris problem.

A nuclear incident would have a huge impact on the environment. All utilities and wastewater systems would be compromised. Air quality would be hampered by smoke, lead, and asbestos from damaged older structures. Water courses could be displaced thereby altering their ecosystems. Soil would be contaminated not only from fallout/debris, but also by released hazardous material and raw sewage. The harm to wildlife habitat would be catastrophic and long-lasting.

Explosive incidents have the potential to impact electric, water, natural gas, pipelines, and utilities. These types of incidents would pollute the air with smoke, lead fumes and asbestos. Explosive incidents would alter water ecosystems by rerouting, damming or displacing waterways. Explosive incidents would potentially contaminate soil with not only hazardous materials, but also debris. All of which in turn effect wildlife habitat and the environment. Such an incident has less likelihood of affecting storm sewers, sewage and septic systems, or of creating overwhelming amounts of debris.

Primary sources of data for determining the likelihood or probability of occurrence for human-caused, intentional acts of terrorism are risk assessments by the Ohio Department of Natural Resources and Ohio Homeland Security's Ohio Strategic Analysis Information Center (SAIC). Other sources of data include weekly Ohio SAIC intelligence summaries, U.S. Coast Guard risk assessments on intentional pollution in both ports and in rivers, U.S. Forest Service intelligence summaries, and classified federal intelligence reports containing vulnerability information.

From that, risk to the environment can be assessed not in terms of percentage, but in terms of magnitude and of impact on plant, animal, and human life as well as the eco-systems in which they interact. In accordance with the Magnitude factor used throughout the Hazard Identification and Risk Analysis Update 2011, magnitude of risk to the environment due to terrorism of all types is overall rated as "Localized." This term does not mean that resulting damage would be unimportant, but rather when all the possible types are considered collectively, the average is projected to be small in geographical scope with less than 10 of 88 counties expected to be impacted.

Vulnerability of the environment can be assessed similarly using the Impact on Humans factor used in the HIRA Update 2011. Impact on plants, animals and associated eco-systems is rated at "High" because they will be either the focus of such an attack, or will be in immediate proximity to an attack without means of evacuation. The movement of wind and water could easily spread the damage. Multiple deaths are expected as well as long-term consequences.

EXPLANATION OF HAZARD AND VULNERABILITY PROFILE SCORING

The analysis process discussed in the previous section was applied to the entire state employing the historical data described in Figure 2, Figure 3, and other related sources. A numerical rating value was developed for each factor. Since the analysis incorporates data applicable to the entire state, the data for any specific (county) jurisdiction may differ.

Attachment 1 provides the numerical score, the hazard profile, vulnerability, and overall risk total for each hazard. The hazards are categorized primarily by NFPA 1600 typing and FEMA's Comprehensive Preparedness Guide 101.

Attachment 2 provides a rank order of the hazards from greatest to least in terms of total risk. This document also provides the hazard profile and vulnerability information.

Hazard Profile Factor/Value

Frequency (Based on Past Gubernatorial Declarations from 1991 through 2010 data): 1 = none; 2 = 1-2; 3 = 3-5; 4 = 6-8; 5 = 9 or more

Adjusted Frequency: Same scoring as above, however score is weighted for importance by factor of 1.5

Average Response Duration: 1 = Less than one-half day; 2 = Less than one day; 3 = Less than one week; 4 = Less than one month; 5 = Less than one year

Average Speed of Onset: 1 = more than 24 hrs warning; 2 = 12 to 24 hrs warning; 3 = 6 to 12 hrs; 4 = minimal or no warning

Average Magnitude (Average number of counties impacted): 1 = Localized (Less than 10); 2 = Limited (10 to 25); 3=Critical (25 to 50); 4 = Catastrophic (More than 50)

Adjusted Average Magnitude: Same scoring as above, however score is weighted for importance by factor of 1.25

Adjusted Total Score: Total of the Adjusted Frequency, Average Response Duration, Average Speed of Onset, and Adjusted Average Magnitude

Vulnerability Profile Factor/Value

Business: 1 = Low (Shutdown of critical facilities for less than 24 hours); 2 = Medium (complete shutdown of critical facilities for one week); 3 = High (complete shutdown of critical facilities for at least two weeks); 4 = Excessive (complete shutdown of critical facilities for 30 days or more)

Human: 1 = Low (Minor injuries); 2 = Medium (Some injuries); 3 = High (Multiple severe injuries; 4 = Excessive (Multiple deaths)

Property: 1 = Low (Less than 10% of property severely damaged); 2 = Medium (More than 10% of property severely damaged); 3 = High (More than 25% of property damaged); 4 = Excessive (More than 50% of property severely damaged)

HAZARD GROUPING

						HAZARD PROFILE				VULNERABILITY		
NATURAL - BIOLOGICAL												
Hazard	**Total Risk**	**Hazard Total**	**Vulnerability Total**	**Hazard Grouping**	**Hazard Type**	**Adjusted Frequency**	**Duration**	**Speed of Onset**	**Adjusted Magnitude**	**Business**	**Human**	**Property**
Disease - Human	22.00	15.00	7.00	Natural	Biological	3.00	5	2	5.00	2	4	1
Disease - Animal	21.50	12.50	9.00	Natural	Biological	1.50	5	1	5.00	4	1	4
Animal or Insect Infestation or Damage	13.00	9.00	4.00	Natural	Biological	1.50	4	1	2.50	1	2	1
NATURAL - GEOLOGICAL												
Hazard	**Total Risk**	**Hazard Total**	**Vulnerability Total**	**Hazard Grouping**	**Hazard Type**	**Adjusted Frequency**	**Duration**	**Speed of Onset**	**Adjusted Magnitude**	**Business**	**Human**	**Property**
Earthquake (5.4 magnitude)	19.25	13.25	6.00	Natural	Geological	1.50	4	4	3.75	2	2	2
Landslide, Mudslide, Subsidence	18.75	12.75	6.00	Natural	Geological	4.50	3	4	1.25	2	2	2
NATURAL - METEROLOGICAL												
Hazard	**Total Risk**	**Hazard Total**	**Vulnerability Total**	**Hazard Grouping**	**Hazard Type**	**Adjusted Frequency**	**Duration**	**Speed of Onset**	**Adjusted Magnitude**	**Business**	**Human**	**Property**
Flood (Areal and Riverine)	27.00	15.00	12.00	Natural	Meteorological	7.50	3	2	2.50	4	4	4
Windstorm, Tornado	26.25	17.25	9.00	Natural	Meteorological	7.50	3	3	3.75	2	4	3
Flash Flood, Seiche	23.75	11.75	12.00	Natural	Meteorological	4.50	2	4	1.25	4	4	4
Snow, Ice, Hail Sleet	23.25	15.25	8.00	Natural	Meteorological	7.50	3	1	3.75	2	4	2
Extreme Temperatures (heat, cold)	18.25	11.25	7.00	Natural	Meteorological	1.50	4	2	3.75	2	4	1
Drought	17.25	11.25	6.00	Natural	Meteorological	1.50	5	1	3.75	1	1	4
Fire (forest, range, urban, wildland)	16.75	9.75	7.00	Natural	Meteorological	1.50	3	4	1.25	2	3	2
Geomagnetic Storm	15.50	10.50	5.00	Natural	Meteorological	1.50	3	1	5.00	3	1	1
Lightning Strikes	10.75	7.75	3.00	Natural	Meteorological	1.50	1	4	1.25	1	1	1

HAZARD GROUPING

						HAZARD PROFILE				VULNERABILITY		
HUMAN-CAUSED ACCIDENTAL												
Hazard	Total Risk	Hazard Total	Vulnerability Total	Hazard Grouping	Hazard Type	Adjusted Frequency	Duration	Speed of Onset	Adjusted Magnitude	Business	Human	Property
Radiological Incidents (Nuclear Power Generating Sites)	22.25	13.25	9.00	Human-Caused	Accidental	1.50	5	3	3.75	4	2	3
Water Control Structure (dam/levee failure)	22.00	10.00	12.00	Human-Caused	Accidental	1.50	3	3	2.50	4	4	4
Building/Structure Collapse	20.75	13.75	7.00	Human-Caused	Accidental	4.50	4	4	1.25	1	2	4
Explosion/Fire	19.75	11.75	8.00	Human-Caused	Accidental	4.50	2	4	1.25	2	4	2
Fuel/Resource Shortage	19.50	14.50	5.00	Human-Caused	Accidental	4.50	4	1	5.00	3	1	1
Hazardous Material	18.25	10.25	8.00	Human-Caused	Accidental	3.00	2	4	1.25	2	3	3
Product Defect/Contamination	17.50	11.50	6.00	Human-Caused	Accidental	1.50	4	1	5.00	2	2	2
Mine Collapse	16.75	10.75	6.00	Human-Caused	Accidental	1.50	4	4	1.25	1	4	1
Energy/Power/Utility failure	15.00	11.00	4.00	Human-Caused	Accidental	4.50	2	2	2.50	2	1	1
Air/Water Pollution, Contamination	13.00	10.00	3.00	Human-Caused	Accidental	1.50	5	1	2.50	1	1	1
Communications Systems Interruptions	12.75	8.75	4.00	Human-Caused	Accidental	1.50	2	4	1.25	2	1	1
Transportation Accident	12.75	7.75	5.00	Human-Caused	Accidental	1.50	1	4	1.25	1	3	1
Space Debris	10.75	7.75	3.00	Human-Caused	Accidental	1.50	2	3	1.25	1	1	1
HUMAN-CAUSED INTENTIONAL												
Hazard	Total Risk	Hazard Total	Vulnerability Total	Hazard Grouping	Hazard Type	Adjusted Frequency	Duration	Speed of Onset	Adjusted Magnitude	Business	Human	Property
Terrorism (CBRNE)	20.00	12.00	8.00	Human-Caused	Intentional	1.50	4	4	2.50	2	4	2
Civil Disturbance, Public Unrest, Riot	17.25	9.25	8.00	Human-Caused	Intentional	3.00	3	2	1.25	1	4	3
Cyber Attack	15.00	11.00	4.00	Human-Caused	Intentional	1.50	4	3	2.50	2	1	1
Criminal Activity	12.75	9.75	3.00	Human-Caused	Intentional	1.50	3	4	1.25	1	1	1
TECHNOLOGICAL												
Hazard	Total Risk	Hazard Total	Vulnerability Total	Hazard Grouping	Hazard Type	Adjusted Frequency	Duration	Speed of Onset	Adjusted Magnitude	Business	Human	Property
Energy/Power/Utility failure	15.00	11.00	4.00	Technological	Accidental/Intentional	4.50	2	2	2.50	2	1	1
Communications Systems Interruptions	12.75	8.75	4.00	Technological	Accidental/Intentional	1.50	2	4	1.25	2	1	1

HAZARD RANKING

								HAZARD PROFILE				VULNERABILITY		
Rank	Hazard	Total Risk	Hazard Total	Vulnerability Total	Hazard Grouping	Hazard Type	Cata-strophic	Adjusted Frequency	Duration	Speed of Onset	Adjusted Magnitude	Business	Human	Property
1	Flood (Areal and Riverine)	27.00	15.00	12.00	Natural	Meteorological	X	7.50	3	2	2.50	4	4	4
2	Windstorm, Tornado	26.25	17.25	9.00	Natural	Meteorological	X	7.50	3	3	3.75	2	4	3
3	Flash Flood, Seiche	23.75	11.75	12.00	Natural	Meteorological	X	4.50	2	4	1.25	4	4	4
4	Snow, Ice, Hail Sleet	23.25	15.25	8.00	Natural	Meteorological	X	7.50	3	1	3.75	2	4	2
5	Radiological Incidents (Nuclear Power Generating Site)	22.25	13.25	9.00	Human-Caused	Accidental	X	1.50	5	3	3.75	4	2	3
6	Disease - Human	22.00	15.00	7.00	Natural	Biological	X	3.00	5	2	5.00	2	4	1
7	Water Control Structure (dam/levee failure)	22.00	10.00	12.00	Human-Caused	Accidental	X	1.50	3	3	2.50	4	4	4
8	Disease - Animal	21.50	12.50	9.00	Natural	Biological		1.50	5	1	5.00	4	1	4
9	Building/Structure Collapse	20.75	13.75	7.00	Human-Caused	Accidental		4.50	4	4	1.25	1	2	4
10	Terrorism (CBRNE)	20.00	12.00	8.00	Human-Caused	Intentional	X	1.50	4	4	2.50	2	4	2
11	Explosion/Fire	19.75	11.75	8.00	Human-Caused	Accidental		4.50	2	4	1.25	2	4	2
12	Fuel/Resource Shortage	19.50	14.50	5.00	Human-Caused	Accidental		4.50	4	1	5.00	3	1	1
13	Earthquake (5.4 magnitude)	19.25	13.25	6.00	Natural	Geological	X	1.50	4	4	3.75	2	2	2
14	Landslide, Mudslide, Subsidence	18.75	12.75	6.00	Natural	Geological		4.50	3	4	1.25	2	2	2
15	Extreme Temperatures (heat, cold)	18.25	11.25	7.00	Natural	Meteorological	X	1.50	4	2	3.75	2	4	1
16	Hazardous Material	18.25	10.25	8.00	Human-Caused	Accidental	X	3.00	2	4	1.25	2	3	3
17	Product Defect/Contamination	17.50	11.50	6.00	Human-Caused	Accidental		1.50	4	1	5.00	2	2	2
18	Civil Disturbance, Public Unrest, Riot	17.25	9.25	8.00	Human-Caused	Intentional		3.00	3	2	1.25	1	4	3
19	Drought	17.25	11.25	6.00	Natural	Meteorological	X	1.50	5	1	3.75	1	1	4
20	Mine Collapse	16.75	10.75	6.00	Human-Caused	Accidental		1.50	4	4	1.25	1	4	1
21	Fire (forest, range, urban, wildland)	16.75	9.75	7.00	Natural	Meteorological		1.50	3	4	1.25	2	3	2
22	Geomagnetic Storm	15.50	10.50	5.00	Natural	Meteorological		1.50	3	1	5.00	3	1	1
23	Energy/Power/Utility failure	15.00	11.00	4.00	Human-Caused/ Technological	Accidental/Intentional	X	4.50	2	2	2.50	2	1	1
24	Cyber Attack	15.00	11.00	4.00	Human-Caused	Intentional	X	1.50	4	3	2.50	2	1	1
25	Animal or Insect Infestation or Damage	13.00	9.00	4.00	Natural	Biological		1.50	4	1	2.50	1	2	1
26	Air/Water Pollution, Contamination	13.00	10.00	3.00	Human-Caused	Accidental		1.50	5	1	2.50	1	1	1
27	Communications Systems Interruptions	12.75	8.75	4.00	Human-Caused/ Technological	Accidental/Intentional		1.50	2	4	1.25	2	1	1
28	Transportation Accident	12.75	7.75	5.00	Human-Caused	Accidental		1.50	1	4	1.25	1	3	1
29	Criminal Activity	12.75	9.75	3.00	Human-Caused	Intentional		1.50	3	4	1.25	1	1	1
30	Lightning Strikes	10.75	7.75	3.00	Natural	Meteorological		1.50	1	4	1.25	1	1	1
31	Space Debris	10.75	7.75	3.00	Human-Caused	Accidental		1.50	2	3	1.25	1	1	1

RECORD OF CHANGES

RECORD OF CHANGES			
Change Number	**Description of Change (with page number)**	**Date**	**Authorized by**
001	Section added on Assessing Risk and Vulnerability to the Environment for Building Collapse and Terrorism...	July 2008	Ted Filer
002	Added Record of Changes	July 2008	Patrick Sheehan
003	HIRA Update	December 2011	Portia Pulsifer

[1] See Ohio Revised Code 5502.22 accessed at http://onlinedocs.andersonpublishing.com/oh/lpExt.dll/PORC/245eb/24748/2478c/24792?fn=document-

[2] See Ohio Revised Code 5502.21 (I) accessed at http://onlinedocs.andersonpublishing.com/oh/lpExt.dll/PORC/245eb/24748/2478c/2478d?

[3] See Ohio Revised Code 5502.21 (J) accessed at http://onlinedocs.andersonpublishing.com/oh/lpExt.dll/PORC/245eb/24748/2478c/2478d?

[4] See National Fire Protection Association. NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs, 2010 Edition, Pp. 1600-18

[5] Taken from the US Census Bureau information on August 2010

[6] As reported by the Ohio EMA Disaster Recovery Branch, information accurate as of August 2010

[7] *Thunder in the Heartland, A Chronicle of Outstanding Weather Events in Ohio*, 1996

[8] Ohio EMA Disaster Recovery Branch materials

[9] Pollution Issues, http://www.pollutionissues.com/