

# Countywide All Natural Hazards Mitigation Plan



**Cuyahoga County**  
Executive Ed FitzGerald

## TABLE OF CONTENTS

<b>1.0 FORWARD</b> .....	<b>1</b>
1.1 PARTICIPATING JURISDICTIONS .....	2
1.2 CUYAHOGA COUNTY NATURAL DISASTER BACKGROUND .....	3
<b>2.0 COUNTY INFORMATION</b> .....	<b>4</b>
2.1 CUYAHOGA COUNTY PROFILE AND COMMUNITY INFORMATION.....	4
2.1.1 CLEVELAND METROPARKS.....	5
2.1.2 WATERSHED ORGANIZATIONS .....	5
2.2 CENSUS INFORMATION .....	8
2.3 CUYAHOGA COUNTY LAND USE AND FUTURE LAND USE .....	11
2.4 OTHER EXISTING PLANS .....	14
<b>3.0 ALL NATURAL HAZARDS MITIGATION PLANNING PROCESS</b> .....	<b>14</b>
3.1 MISSION STATEMENT.....	15
3.2 MITIGATION CORE GROUP .....	15
3.3.1 ADJACENT COUNTY NOTIFICATION.....	17
3.3.2 PUBLIC NOTIFICATION PROCESS AND INVOLVEMENT .....	17
3.4 MEETINGS .....	18
3.4.1 MEETING 1- INTRODUCTION TO THE 2011 PLAN UPDATE.....	18
3.4.2 MEETING 2 - REVIEW OF PLAN'S ORIGINAL AND UPDATED INFORMATION .....	18
3.4.3 MEETING 3 - HAZARD RANKING AND ACTION PRIORITIZATION .....	18
3.5 FINALIZATION AND ADOPTION.....	19
3.6 HAZARD AND VULNERABILITY ASSESSMENT MATRIX DEVELOPMENT.....	20
3.6.1 HAZARD AND VULNERABILITY ASSESSMENT MATRIX .....	21
3.7 HAZARD PROBLEM STATEMENTS AND OVERALL GOALS .....	22
<b>4.0 STATE OF NATURAL DISASTERS AND HAZARD ASSESSMENT FOR CUYAHOGA COUNTY</b> .....	<b>26</b>
4.1 INITIAL HAZARD DETERMINATION FOR CUYAHOGA COUNTY .....	26
4.2 SEVERE STORMS.....	27
4.2.1 SEVERE THUNDERSTORM WARNINGS AND WATCHES .....	28
4.2.2 SIGNIFICANT EVENTS .....	28
4.2.3 CUYAHOGA SEVERE WEATHER MITIGATION EFFORTS.....	30
4.2.4 CRITICAL FACILITIES AND INFRASTRUCTURE.....	30
4.2.5 CURRENT DEVELOPMENT TRENDS .....	31
4.2.6 HAZARD ASSESSMENT AND VULNERABILITY ANALYSES / POTENTIAL DOLLARS LOST.....	31
<i>Actions for Severe Storms</i> .....	31
4.3 FLOODING.....	33
4.3.1 FLOODING WARNINGS AND WATCHES.....	33
4.3.2 SIGNIFICANT EVENTS .....	33
4.3.3 FLASH FLOODING .....	35

4.3.4 RIVER FLOODING.....	35
4.3.5 NON-FLOOD ZONE FLOODING.....	36
4.3.6 CRITICAL FACILITIES.....	38
4.3.7 INFRASTRUCTURE.....	40
4.3.8 REPETITIVE LOSS FLOODING.....	44
4.3.9 CUYAHOGA COUNTY FLOOD MITIGATION EFFORTS.....	47
4.3.10 CURRENT DEVELOPMENT TRENDS.....	47
4.3.11 HAZARD ASSESSMENT AND VULNERABILITY ANALYSES/ POTENTIAL DOLLARS LOST.....	48
4.3.12 ACTIONS FOR FLOODING.....	52
4.4 SEVERE WINTER WEATHER.....	55
4.4.1 SEVERE WINTER WEATHER WARNINGS AND WATCHES.....	55
4.4.2 SIGNIFICANT EVENTS.....	55
4.4.3 BLIZZARDS.....	57
4.4.4 ICE STORMS.....	57
4.4.5 WIND CHILL.....	57
4.4.6 CUYAHOGA COUNTY SEVERE WINTER WEATHER MITIGATION EFFORTS.....	58
4.4.7 CRITICAL FACILITIES AND INFRASTRUCTURE.....	58
4.4.8 CURRENT DEVELOPMENT TRENDS.....	58
4.4.9 HAZARD ASSESSMENT AND VULNERABILITY ANALYSES/ POTENTIAL DOLLARS LOST.....	58
4.4.10 ACTION FOR SEVERE WINTER WEATHER.....	59
4.5 TORNADOS.....	59
<i>The Enhanced Fujita Tornado Scale.....</i>	61
4.5.1 CUYAHOGA COUNTY EVENTS.....	62
4.5.2 TORNADO PATH MAP.....	62
4.5.3 TORNADO MITIGATION EFFORTS.....	65
4.5.4 CURRENT DEVELOPMENT TRENDS.....	65
4.5.5 HAZARD ASSESSMENT AND VULNERABILITY ANALYSES/ POTENTIAL DOLLARS LOST.....	65
4.5.6 ACTIONS FOR TORNADOES.....	65
4.6 TEMPERATURE EXTREMES.....	66
4.6.1 EXTREME HEAT.....	66
4.6.2 EXTREME COLD.....	67
4.6.3 CUYAHOGA COUNTY TEMPERATURE EXTREMES MITIGATION EFFORTS.....	67
4.6.4 CURRENT DEVELOPMENT TRENDS.....	68
4.6.5 CRITICAL FACILITIES AND INFRASTRUCTURE.....	68
4.6.6 HAZARD AND VULNERABILITY ASSESSMENT/ POTENTIAL DOLLARS LOST.....	68
4.6.7 ACTIONS FOR TEMPERATURE EXTREMES.....	68
4.7 EROSION AND LANDSLIDES.....	69
4.7.1 STREAMBANK EROSION.....	69
4.7.2 COASTAL EROSION.....	73
<i>Cuyahoga County Coastal Erosion Statistics.....</i>	73
4.7.3 MITIGATION EFFORTS.....	74
<i>Northeast Ohio Regional Sewer District Stormwater Management Program.....</i>	74
<i>Ohio Coastal Management Program.....</i>	75
<i>Coastal Erosion Area Program.....</i>	75

4.7.4 CURRENT DEVELOPMENT TRENDS .....	78
4.7.5 HAZARD ASSESSMENT AND VULNERABILITY ASSESSMENT/ POTENTIAL DOLLARS LOST: COASTAL EROSION .....	78
4.7.6 HAZARD ASSESSMENT AND VULNERABILITY ASSESSMENT/ POTENTIAL DOLLARS LOST: STREAMBANK EROSION .....	79
4.7.7 EROSION AND LANDSLIDES ACTIONS .....	80
4.8 DROUGHTS AND WILDLAND FIRES .....	81
4.8.1 DROUGHTS PRECURSOR TO OTHER DISASTERS .....	81
4.8.2 CUYAHOGA COUNTY DROUGHT AND WILDLAND FIRE MITIGATION EFFORTS .....	82
4.8.3 CURRENT DEVELOPMENT TRENDS .....	82
4.8.4 HAZARD AND VULNERABILITY ASSESSMENT.....	83
4.8.5 POTENTIAL DOLLARS LOST .....	83
4.8.6 ACTIONS FOR DROUGHTS AND WILDLAND FIRES.....	83
4.9 EARTHQUAKE HISTORY IN CUYAHOGA COUNTY.....	84
4.9.1 CUYAHOGA COUNTY RISK ZONE .....	84
4.9.2 MONITORING OF EARTHQUAKES.....	86
4.9.3 EARTHQUAKE OCCURRENCE IN CUYAHOGA COUNTY .....	89
4.9.4 CUYAHOGA COUNTY EARTHQUAKE MITIGATION EFFORTS .....	89
4.9.5 CURRENT DEVELOPMENT TRENDS .....	89
4.9.6 HAZARD ASSESSMENT AND VULNERABILITY ANALYSES .....	89
4.9.7 POTENTIAL DOLLARS LOST .....	89
4.9.8 ACTIONS FOR EARTHQUAKES .....	90
4.10 COASTAL FLOODING.....	90
4.10.1 SEICHE .....	90
4.10.2 STORM SURGE.....	91
4.10.3 CUYAHOGA COUNTY COASTAL FLOODING MITIGATION EFFORTS.....	91
4.10.4 CURRENT DEVELOPMENT TRENDS .....	91
4.10.5 HAZARD AND VULNERABILITY ASSESSMENT .....	91
4.10.6 POTENTIAL DOLLARS LOST .....	92
4.10.7 ACTION FOR COASTAL FLOODING.....	93
4.11 OTHER HAZARDS – DAMS.....	94
4.11.1 HAZARD ASSESSMENT AND VULNERABILITY ASSESSMENT.....	96
4.11.2 ACTION ITEM .....	96
<b>5.0 MITIGATION STRATEGY .....</b>	<b>98</b>
5.1 ACTION PRIORITIZATION METHODOLOGY.....	98
5.2 MITIGATION ACTION PLAN TABLE.....	100
<b>6.0 COUNTYWIDE ALL NATURAL HAZARDS MITIGATION PLAN MAINTENANCE ....</b>	<b>111</b>
6.1 INCORPORATION INTO EXISTING PLANNING MECHANISMS .....	111
<b>APPENDIX 1 – EXISTING PLANNING DOCUMENTS / ORGANIZED WATERSHED GROUPS / DESIGNATED FLOODPLAIN ADMINISTRATORS.....</b>	<b>113</b>
<b>APPENDIX 2 – 2011 COMMUNITY SURVEY.....</b>	<b>118</b>

<b>APPENDIX 3 – ORGANIZATIONS INVITED TO PARTICIPATE IN 2011 UPDATE.....</b>	<b>120</b>
<b>APPENDIX 4 – CORRESPONDENCES REGARDING THE 2011 UPDATE .....</b>	<b>121</b>
CORRESPONDENCE TO COMMUNITIES.....	121
CORRESPONDENCE TO MITIGATION CORE GROUP .....	123
CORRESPONDENCE TO ADJACENT COUNTIES .....	124
<b>APPENDIX 5 – PUBLIC NOTIFICATION .....</b>	<b>125</b>
CUYAHOGA COUNTY OFFICE OF EMERGENCY MANAGEMENT WEBSITE POSTING .....	125
CUYAHOGA COUNTY OFFICE OF EMERGENCY MANAGEMENT JANUARY 2011 NEWSLETTER ARTICLE .....	126
<b>APPENDIX 6 – HISTORICAL HAZARD IMPACTS REFERENCE DOCUMENT.....</b>	<b>127</b>
<b>APPENDIX 7 – PROBLEM STATEMENTS, OVERALL GOALS, AND MITIGATION ACTIONS .....</b>	<b>130</b>
PROBLEM STATEMENTS .....	130
<i>Severe Storms</i> .....	130
<i>Flooding</i> .....	131
<i>Severe Winter Weather</i> .....	132
<i>Tornadoes</i> .....	133
<i>Temperature Extremes</i> .....	133
<i>Erosion and Landslides</i> .....	133
<i>Drought and Wildland Fires</i> .....	134
<i>Earthquakes</i> .....	134
<i>Coastal Flooding (Storm Surge and Seiche)</i> .....	135
MITIGATION ACTIONS .....	135
<i>Severe Storms</i> .....	135
<i>Flooding</i> .....	136
<i>Severe Winter Weather</i> .....	137
<i>Tornadoes</i> .....	137
<i>Temperature Extremes</i> .....	137
<i>Erosion and Landslides</i> .....	137
<i>Droughts and Wildland Fires</i> .....	138
<i>Earthquakes</i> .....	138
<i>Coastal Flooding (Storm Surge and Seiche)</i> .....	138
<b>APPENDIX 8 – AT-RISK CRITICAL FACILITIES .....</b>	<b>139</b>
<b>APPENDIX 9 – VALLEY VIEW SUCCESS STORY .....</b>	<b>140</b>
<b>APPENDIX 10 – COMMUNITY MITIGATION ACTIVITIES .....</b>	<b>142</b>
<b>APPENDIX 11 – COMPREHENSIVE LISTING OF STREAMBANK EROSION AREAS.....</b>	<b>149</b>
<b>APPENDIX 12 – IDENTIFIABLE ACTION ITEMS SPECIFIC TO JURISDICTION .....</b>	<b>162</b>

**APPENDIX 13 – SUMMARY TABLE OF COMMUNITY PARTICIPATION FOR 2011  
UPDATE ..... 164**

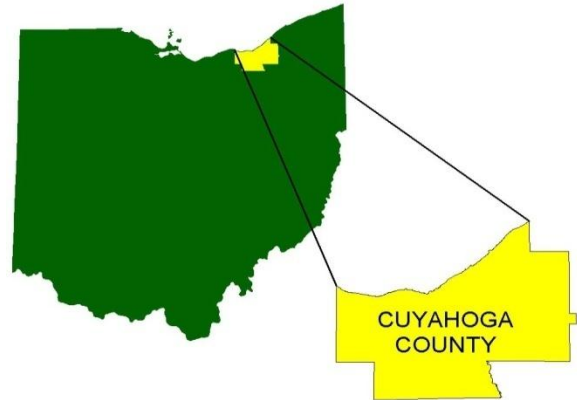
**APPENDIX 14 – ORIGINAL MITIGATION CORE GROUP MEMBERS..... 166**

**APPENDIX 15 – COMMUNITY NFIP PARTICIPATION ..... 168**

**APPENDIX 16 – COMMUNITY ADOPTION OF 2011 UPDATED PLAN ..... 170**

# 1.0 FORWARD

In November of 2002 Cuyahoga County received a grant from the Ohio Emergency Management Agency to support the development of a Countywide All Natural Hazards Mitigation Plan to include all 59 jurisdictions. Cuyahoga County was one of the first counties in the State of Ohio to undertake this planning process.



The All Natural Hazards Mitigation Plan allows Cuyahoga County to:

- Locate its areas of risk and assess the cost and magnitude of the risk;
- Develop strategies and priorities to mitigate risk from natural hazards and identify action steps or projects to reduce the risk;
- Guide the communities in their risk management activities and minimize conflicts between agencies responsible for mitigation; and
- Provide eligibility for future mitigation program funds.

The Disaster Mitigation Act (DMA) of 2000 requires all approved local hazard mitigation plans to be updated every 5 years. As such, the Cuyahoga Countywide All Natural Hazards Mitigation Plan ("Plan") must be updated by January 2012. Accordingly, in 2011 the Cuyahoga County Office of Emergency Management reassembled a Mitigation Core Group to coordinate an update to the Plan and fulfill this requirement.

The Mitigation Core Group responsible for the 2011 update reviewed and analyzed the Plan. During the course of this update, every effort was made to preserve the historical integrity of the Plan. A major component of the 2011 update was to reengage the 59 municipalities in the County and solicit information from each jurisdiction. To maintain eligibility to apply for federal Hazard Mitigation Assistance (HMA) programs, every community will be required to formally adopt the updated Plan once it is approved by FEMA.

# 1.1 Participating Jurisdictions

Listed below are the jurisdictions within Cuyahoga County that continued their participation in the Plan by contributing to the 2011 update. 100% participation was achieved. Note, Woodmere Village participated in the 2011 update and is now represented in the Plan.

- Bay Village
- Beachwood
- Bedford
- Bedford Hts.
- Bentleyville
- Berea
- Bratenahl
- Brecksville
- Broadview Hts.
- Brook Park
- Brooklyn
- Brooklyn Hts.
- Chagrin Falls
- Chagrin Falls Twp.
- Cleveland Hts.
- Cleveland
- Cuyahoga Hts.
- East Cleveland
- Euclid
- Fairview Park
- Garfield Hts.
- Gates Mills
- Glenwillow
- Highland Hills
- Highland Hts.
- Hunting Valley
- Independence
- Lakewood
- Linndale
- Lyndhurst
- Maple Hts.
- Mayfield Hts.
- Mayfield Village
- Middleburg Hts.
- Moreland Hills
- Newburgh Hts.
- North Olmsted
- North Randall
- North Royalton
- Oakwood
- Olmsted Falls
- Olmsted Twp.
- Orange Village
- Parma
- Parma Hts.
- Pepper Pike
- Richmond Hts.
- Rocky River
- Seven Hills
- Shaker Hts.
- Solon
- South Euclid
- Strongsville
- University Hts.
- Valley View
- Walton Hills
- Warrensville Hts.
- Westlake
- Woodmere (new)



# 1.2 Cuyahoga County Natural Disaster Background

Cuyahoga County is susceptible to several natural hazards, these include: severe storms, flash flooding, 100-year floodplain flooding, non-flood zone flooding, landslides, coastal and streambank erosion, tornadoes, earthquakes, drought, wildfires, coastal flooding, and temperature extremes. The primary natural hazard risk in Cuyahoga County is severe storms.

The following are historical Presidential Declarations of Disaster for Cuyahoga County:

Type of Incident	Date of Presidential Declaration
Heavy rain and floods	March 24, 1964
Tornado	April 14, 1965
Heavy rain and floods	July 15, 1969
Storms and flooding	July 1972
Storms and flooding	April 27, 1973
Floods	September 11, 1975
Severe blizzard conditions	January, 26, 1978
Heavy Rains and Floods	July 21, 2003
Regional Power Outage	August 14-15, 2003
Storms and Flooding	July 2, 2006
Storms and Flooding	April 4 – May 15, 2011

## 2.0 County Information

### 2.1 Cuyahoga County Profile and Community Information

Cuyahoga, from the Native American word for “crooked,” describes the Cuyahoga River near where many of these first residents lived. When the County was established by an Act in 1807, the population was approximately 1,400. By 1846 only a few Native American settlements remained. The population of Cuyahoga County peaked in 1970 at 1,721,300. Over the last ten years, the County experienced a decline in population from 1,393,978 in 2000, to 1,280,122 in 2010.

Employment statistics show that the service industry represents the largest segment of jobs at over 30%, followed by the trades, manufacturing, government, real estate financing, insurance and banking.

With 59 political subdivisions, Cuyahoga County is the most populated county in the State. Based on the 2010 census, the most populated cities within the County are:

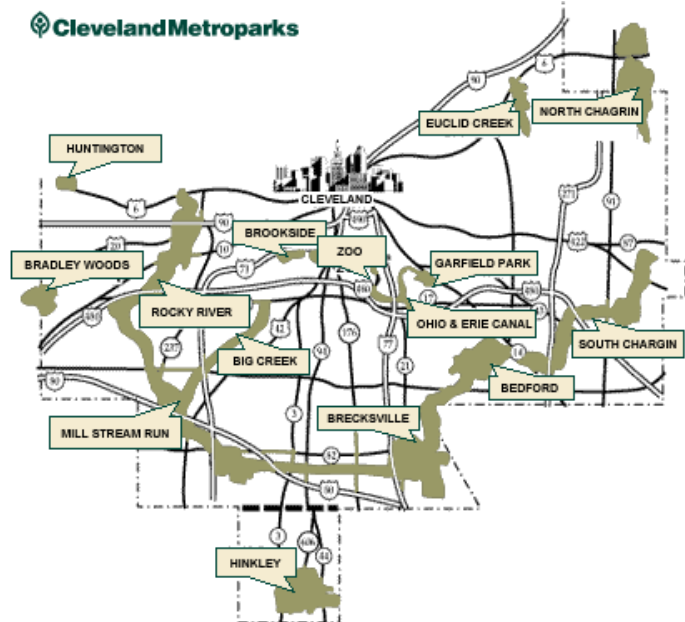
- Cleveland 396,815
- Parma 81,601
- Lakewood 52,131
- Euclid 48,920
- Cleveland Heights 56,121
- Strongsville 44,750
- North Olmsted 32,718
- Westlake 32,729
- Garfield Heights 28,849
- Shaker Heights 28,448

Coinciding with changing dynamics such as fewer children per family and declining population trends, regional growth dynamics have contributed to the decline in population of communities in Cuyahoga County. This factor, known as negative growth, began in the City of Cleveland and its inner-ring suburbs and has now continued to affect many of the suburbs in the southeastern region. These suburbs include: Bedford, Bedford Heights, Maple Heights, North Randall, Warrensville Heights, Oakwood, and Walton Hills. Suburban communities such as Solon and Orange Village as well as communities outside

of Cuyahoga County, experienced population growth from 1970 through the 1990's.

## 2.1.1 Cleveland Metroparks

The Cleveland Metroparks System in Cuyahoga County includes the Emerald Necklace Trail, Lake Erie and the public access to beaches at Edgewater State Park in Cleveland, and Huntington Park in Bay Village. The system features 16 woodland park reservations and the Cleveland Metroparks Zoo. This Park District comprises over 21,000 acres of various landscapes and attractions for park visitors to enjoy. Information regarding the natural recreational areas which include rivers, lakes, streams, and ravines has been included for the potential impact on surrounding communities and neighborhoods.



The park reservations include **Bedford, Big Creek, Bradley Woods, Brecksville, Brookside, Cleveland Metroparks Zoo, Euclid Creek, Garfield Park, Hinkley, Huntington, Mill Stream Run, North Chagrin, Ohio & Erie Canal, Rocky River, South Chagrin, Washington, and West Creek.**

For further information on the Cleveland Metroparks, visit:  
<http://www.clemetparks.com/>

Participating communities who are in **watershed protection or planning areas** are discussed in the relevant regional sections that follow.

## 2.1.2 Watershed Organizations

There are a number of active watershed organizations in Cuyahoga County. These organizations help communities comply with stormwater regulations and carry out stream restoration and protection projects that reduce flooding and erosion issues. The following sections provide historical information on the some watershed organizations within the County.

In 2000, the 10 municipalities in the **Euclid Creek Watershed** organized informally with the assistance of the Northeast Ohio Area Wide Coordinating Agency (NOACA). The **Euclid Creek Watershed Council** was formed in an effort to address common environmental, stormwater and development concerns in the area. In 2001, NOACA obtained a grant from the Ohio Lake Erie Protection Fund to develop a regional stormwater program model for the US Environmental Protection Agency's Phase II program. In addition, the grant undertook a demonstration of the use of this model with the Euclid Creek communities. Each of the communities agreed to provide matching funds for the effort. The Cuyahoga Soil and Water Conservation District (SWCD) is serving as the coordinating agency for this demonstration effort.

In 2002, the SWCD obtained a grant from the Ohio Department of Natural Resources to serve as a Watershed Coordinator for Euclid Creek, to facilitate development of a watershed plan for Euclid Creek and to assist member communities of the watershed in complying with the Phase II Stormwater Program.

The participating communities of this effort are:

- City of Beachwood
- City of Cleveland (Region V)
- City of Euclid
- City of Highland Heights
- City of Lyndhurst
- City of Mayfield Heights
- City of Richmond Heights
- City of South Euclid
- City of Willoughby Hills (Lake County)
- Village of Mayfield

For additional information regarding the Euclid Creek Watershed, visit:  
<http://www.cuyahogaswcd.org/Euclidcreekfiles/euclidcreekthepage.htm>

The **Chagrin River Watershed Partners, Inc.** is another non-profit organization that serves a coalition of community members in a four county area. The members share information and work collectively to solve local and watershed wide problems in a manner that ensures a sustainable future for the **Chagrin River Watershed**. Cuyahoga County communities that are members include:

- Beachwood
- Bentleyville
- Chagrin Falls Township
- Chagrin Falls Village
- Gates Mills
- Highland Heights
- Hunting Valley
- Lyndhurst
- Mayfield Village
- Mayfield Heights
- Moreland Hills
- Orange Village
- Pepper Pike
- Solon
- Woodmere

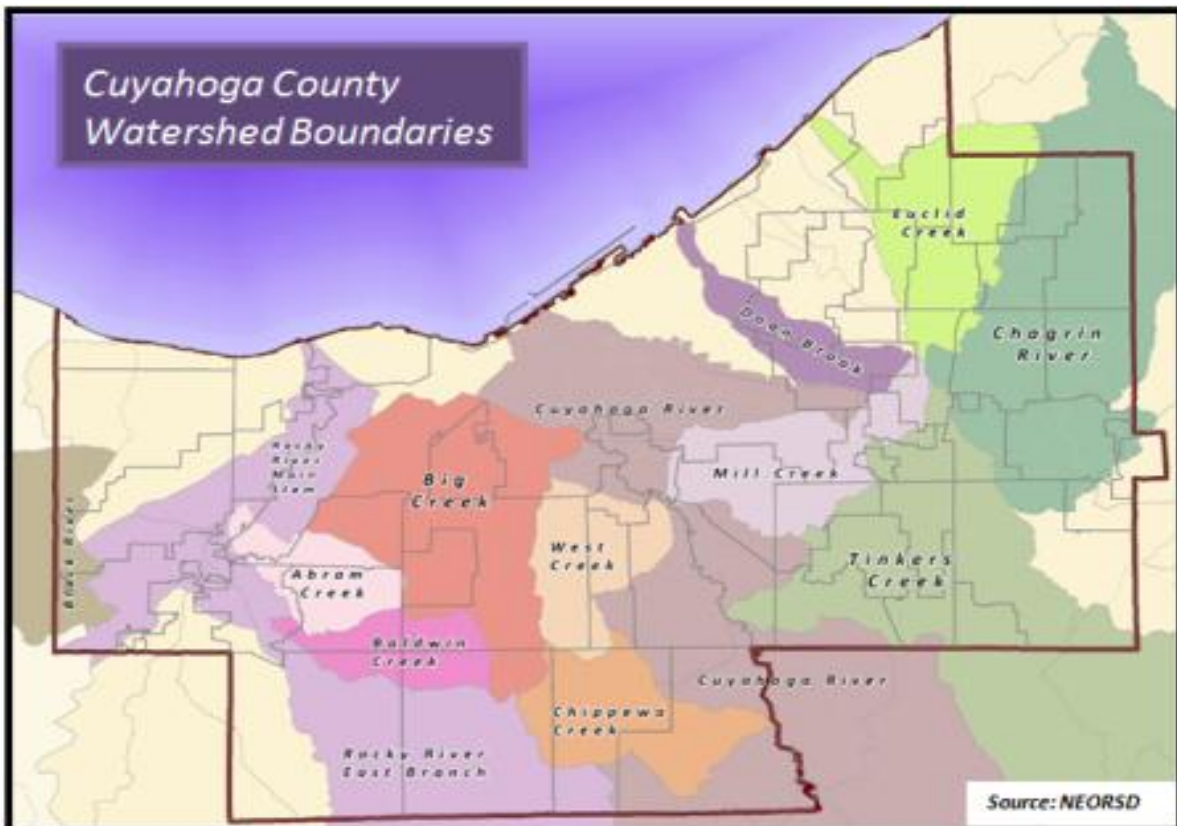
Additional information regarding Chagrin River Watershed Partners, Inc. can be found by visiting: <http://www.crowp.org/>

In 1974, the cities of Cleveland Heights, Shaker Heights and Cleveland formed the **Joint Committee on Doan Creek Watershed** to facilitate coordinated work to protect and preserve Doan Brook. In 2001, the Joint Committee on Doan Brook Watershed evolved into the **Doan Brook Watershed Partnership**, a 501(c) (3) nonprofit organization whose mission is to develop and implement a watershed management plan for the preservation of Doan Brook. Member communities in the Doan Brook Watershed Partnership include: Cleveland, Cleveland Hts., and Shaker Hts.

Visit: <http://doanbrookpartnership.org> for additional information on the Doan Brook Watershed Partnership.

Other watershed organizations within Cuyahoga County include:

- Friends of Big Creek: [www.firendsofbigcreek.org](http://www.firendsofbigcreek.org)
- Rocky River Watershed Council: [www.myrockyriver.org](http://www.myrockyriver.org)
- West Creek Preservation Committee: [www.westcreek.org](http://www.westcreek.org)
- Tinkers Creek Watershed Partners: [www.tinkerscreekwatershed.org](http://www.tinkerscreekwatershed.org)



## 2.2 Census Information

The following tables list demographic information for each of the 59 jurisdictions of the County:

Jurisdiction	Land Area (sq. mi.)	2010 Total Population
Cuyahoga County	458	1,280,122
Bay Village	4.6	15,651
Beachwood	5.3	11,953
Bedford	5.4	13,074
Bedford Heights	4.5	10,751
Bentleyville	2.6	864
Berea	5.3	19,093
Bratenahl	1.0	1,197
Brecksville	19.6	13,656
Broadview Heights	13.0	19,400
Brook Park	8.0	11,169
Brooklyn	4.3	11,543
Brooklyn Heights	1.7	19,212
Chagrin Falls	2.2	4,233
Chagrin Falls Township	2.6	Included with Chagrin Falls Population
Cleveland	77.0	396,815
Cleveland Heights	8.1	46,121
Cuyahoga Heights	3.2	638
East Cleveland	3.1	17,843
Euclid	10.8	48,920
Fairview Park	4.7	16,826
Garfield Heights	7.2	28,849
Gates Mills	9.1	2,270
Glenwillow	2.9	923
Highland Heights	7.0	8,345
Highland Hills	3.0	1,130
Hunting Valley	8.0	589
Independence	9.6	7,133
Lakewood	5.5	52,131
Linndale	0.9	179
Lyndhurst	4.4	14,001
Maple Heights	5.2	23,138

<b>Jurisdiction</b>	<b>Land Area (sq. mi.)</b>	<b>2010 Total Population</b>
Mayfield	3.9	3,460
Mayfield Heights	4.2	19,155
Middleburg Heights	8.0	15,946
Moreland Hills	7.2	3,320
Newburgh Heights	0.6	2,167
North Olmsted	11.6	32,718
North Randall	0.8	1,027
North Royalton	21.2	30,444
Oakwood Village	3.5	3,667
Olmsted Falls	4.0	13,513
Olmsted Township	10.0	9,024
Orange	3.6	3,323
Parma	20.9	81,601
Parma Heights	4.3	20,718
Pepper Pike	7.1	5,979
Richmond Heights	4.4	10,546
Rocky River	4.8	20,213
Seven Hills	5.0	11,804
Shaker Heights	6.3	28,448
Solon	20.4	23,348
South Euclid	4.7	22,295
Strongsville	24.4	44,750
University Heights	1.8	13,539
Valley View	5.6	2,034
Walton Hills	6.9	2,281
Warrensville Heights	4.0	13,542
Westlake	16.5	32,729
Woodmere	0.3	884

Housing Units and Occupancy Status within Cuyahoga County:

<b>Community</b>	<b>2010 Total Units</b>	<b>2010 Occupied Units</b>
Bay Village city	6,436	6,198
Beachwood city	5,483	5,064
Bedford city	6,951	6,265
Bedford Heights city	5,750	5,111
Bentleyville village	318	303
Berea city	7,958	7,471

<b>Community</b>	<b>2010 Total Units</b>	<b>2010 Occupied Units</b>
Bratenahl village	811	679
Brecksville city	5,623	5,349
Broadview Heights city	8,237	7,698
Brooklyn city	5,506	5,153
Brooklyn Heights village	624	595
Brook Park city	8,171	7,799
Chagrin Falls*	2,085	1,913
Cleveland city	207,536	167,490
Cleveland Heights city	22,465	19,957
Cuyahoga Heights village	278	258
East Cleveland city	12,523	8,286
Euclid city	26,037	22,685
Fairview Park city	8,109	7,564
Garfield Heights city	13,125	11,691
Gates Mills village	992	919
Glenwillow village	383	316
Highland Heights city	3,405	3,205
Highland Hills village	315	268
Hunting Valley village	265	228
Independence city	2,868	2,770
Lakewood city	28,498	25,274
Linndale village	75	66
Lyndhurst city	6,890	6,447
Maple Heights city	10,894	9,515
Mayfield village	1,614	1,531
Mayfield Heights city	10,538	9,662
Middleburg Heights city	7,586	7,114
Moreland Hills village	1,376	1,262
Newburgh Heights village	1,145	958
North Olmsted city	14,500	13,645
North Randall village	571	462
North Royalton city	13,710	12,944
Oakwood village	1,648	1,544
Olmsted township	5,996	5,571
Olmsted Falls city	3,897	3,684
Orange village	1,374	1,277
Parma city	36,608	34,489



<b>Community</b>	<b>2010 Total Units</b>	<b>2010 Occupied Units</b>
Parma Heights city	10,295	9,534
Pepper Pike city	2,349	2,176
Richmond Heights city	5,370	4,766
Rocky River city	10,181	9,283
Seven Hills city	5,167	4,989
Shaker Heights city	13,318	11,840
Solon city	8,765	8,352
South Euclid city	9,607	8,913
Strongsville city	18,476	17,659
University Heights city	5,248	4,810
Valley View village	790	758
Walton Hills village	969	937
Warrensville Heights city	6,743	6,043
Westlake city	14,843	13,870
Woodmere village	468	446
<b>Cuyahoga County</b>	<b>621,763</b>	<b>545,056</b>

## 2.3 Cuyahoga County Land Use and Future Land Use

According to the Cuyahoga County Planning Commission, Cuyahoga County will soon become the first “built-out” county within the State of Ohio. In 1948, nearly 26% of the County’s land was developed. By 2002, nearly 90% had been developed.

For the past 50 years, the health of the County was based on economic growth and new housing options at the edge of the urbanized area. The future health of the County will be based on its environmental and economic vitality.

The ultimate goal for Cuyahoga County is a balanced pattern of development that accommodates both urbanization and land conservation. A Greenspace Plan is being developed to promote a broad comprehensive vision for greenspace protection and restoration within the County. Along with conservation, the plan will promote complimentary development. Through planning, creating, and managing greenspaces, Cuyahoga County will be a place where:

- Natural places are an integral part of daily life;
- Natural processes are visible and instructional; and
- Waterfronts are cared for and accessible.

The Cuyahoga County Planning Commission greenspace vision for the County seeks to:

- Build off of the County's unique geography and natural history;
- Emphasize the environmental, community and economic importance of greenspace;
- inspire decision makers to make greenspace a priority in the community;
- Promote connecting neighborhoods in the County to greenspace and the County's natural resources; and
- Encourage the "regreening" of the more urban portions of the County to make them more desirable places to live.

Source: <http://planning.co.cuyahoga.oh.us/>

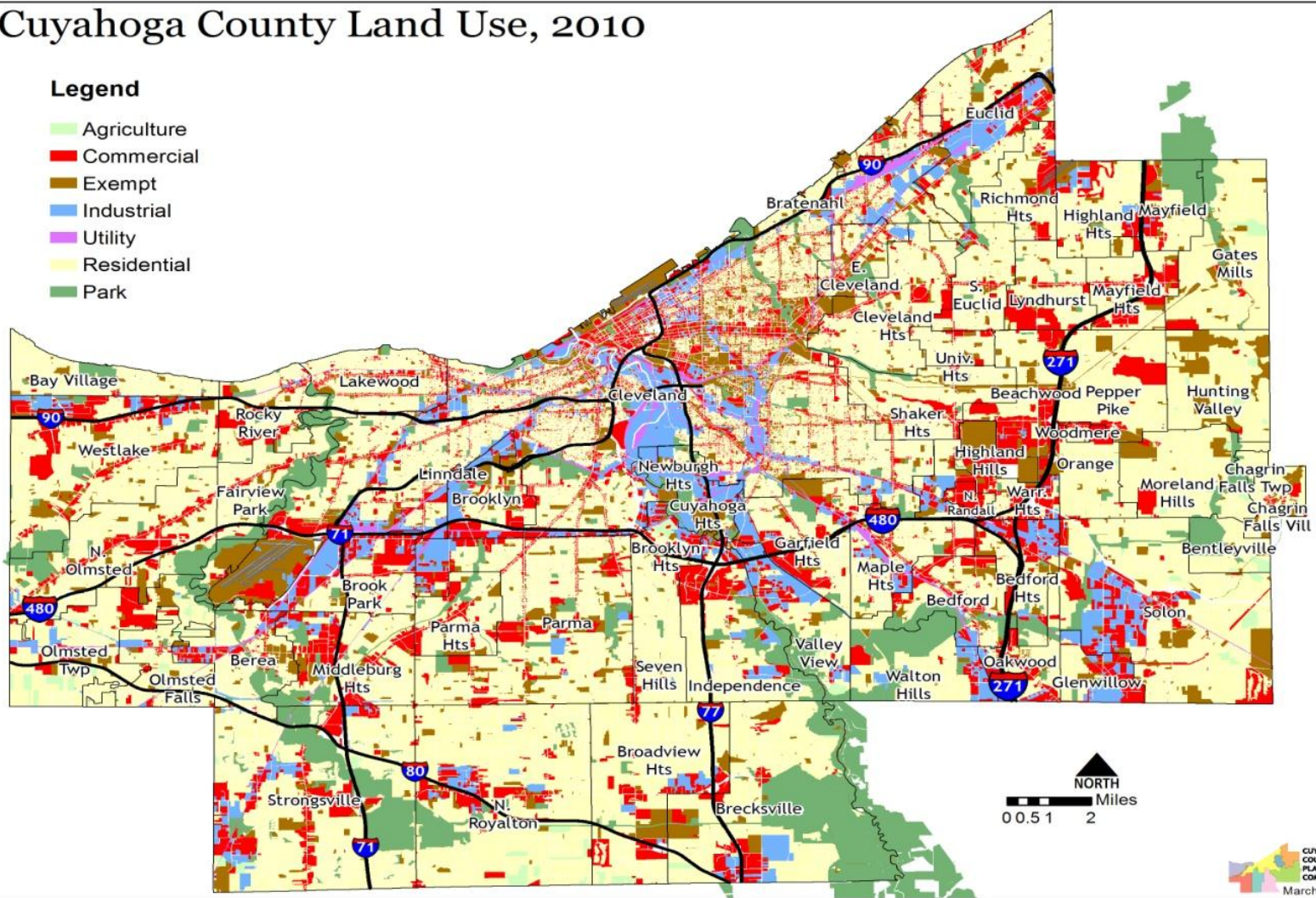
Basic elements of the plan include the creation of a system of natural corridors, a countywide trail system, the preservation of scenic views, and the protection and restoration of critical natural areas.

The map on the following page illustrates land use in Cuyahoga County as of 2010.

# Cuyahoga County Land Use, 2010

## Legend

- Agriculture
- Commercial
- Exempt
- Industrial
- Utility
- Residential
- Park



CUYAHOGA COUNTY PLANNING COMMISSION  
March 2011

## 2.4 Other Existing Plans

During the 2011 Plan update each community was asked to provide information regarding existing planning documents. Each jurisdiction was asked to indicate whether they had comprehensive plans, floodplain ordinances, land use ordinances, or organized watershed groups. A table of the results can be found in Appendix 1. The majority of these existing documents compliment mitigation efforts. For example, floodplain ordinances serve to guide development away from hazardous areas while stormwater management plans, as required in planning and zoning codes of many communities, reduce the effects of erosion due to increased runoff. Community master plans also compliment mitigation efforts by identifying environmentally sensitive areas, land use trends, etc., which is information that can be used in future mitigation planning.

## 3.0 All Natural Hazards Mitigation Planning Process

In an effort to meet the mission of protecting lives, property, economic viability, and quality of life for the people of the County, subject matter experts from the engineering firm Fuller, Mossbarger, Scott and May Engineers, Inc. were consulted to assist in the development of the original Plan.

As mentioned earlier, the Disaster Mitigation Act of 2000 requires all approved local hazard mitigation plans to be updated every 5 years. To meet this requirement in 2011, the Cuyahoga County Office of Emergency Management reassembled a Mitigation Core Group to review the Plan and identify necessary revisions and updates. Additionally, the 59 jurisdictions within the County and the general public were asked to provide input for the Plan's update.

For the 2011 update, communities were required to complete a survey that requested basic information regarding their jurisdiction as well as validation of historic, community-specific information within the Plan. A sample of this survey can be found in Appendix 2. Communities were also asked to participate in reevaluating the ranking of natural hazards within the Plan by completing the Hazard and Vulnerability Assessment Matrix. A copy of the Matrix is located on page 21.

The approach undertaken for both the creation and maintenance of the **Countywide All Natural Hazards Mitigation Plan** is comprehensive and collaborative. The Plan follows the interim final rule guidelines enacted under

the Disaster Mitigation Act of 2000 and the Federal Emergency Management Agency (FEMA) suggested guidelines for the development of an All Natural Hazards Mitigation Plan.

### 3.1 Mission Statement

The mission of the Mitigation Core Group is to develop and maintain a working document that serves the whole of Cuyahoga County while fulfilling the mandates of the Federal Disaster Mitigation Act of 2000, and satisfying the requirements of FEMA and the Ohio EMA, as well as meets the needs of all of Cuyahoga County.

By researching and planning for future natural hazards and implementing appropriate mitigation techniques, Cuyahoga County can save lives and protect property, reduce the cost of disasters, provide for a rapid and efficient recovery by coordinating response efforts, and increase the educational awareness of natural hazard events and their effects on the people, property and resources of the County.

### 3.2 Mitigation Core Group

Obtaining support from the whole community requires a comprehensive approach to developing and maintaining the Mitigation Plan. Identifying those persons, community leaders and government agencies with the knowledge and authority to help a community organize a plan is key to the planning effort.

For the 2011 Plan update, efforts were made to reconvene many of the individuals and organizations that had participated in the Plan's original development. Additionally, new organizations from within the academic, non-profit, and business sectors were also invited to participate. To view a comprehensive list of the organizations invited to participate on the 2011 Mitigation Core Group, reference Appendix 3.

Listed on the following page are the Mitigation Core Group members that participated in the 2011 Plan update. The table also indicates whether the individual and/or their respective organization were represented on the original Mitigation Core Group responsible for the Plan's creation.



**2011 Mitigation Core Group**

**Community Emergency Coordinators/Public Safety Personnel**

Chief Ken Ledford	returning	Bedford Hts. FD
Chief Ed Egut	returning	Brecksville FD
Chief Peter Nelson	returning	Independence FD
Chief Chris Flynn	returning	Rocky River FD
Chief Tom Hartman	new	Pepper Pike FD
Chief Timothy Pitts	new	Bentleyville PD
Chief Chris Kostura	returning	Orange PD
Lt. Alan Finklestein	returning	Strongsville FD

<b>Ohio Emergency Management Agency (Returning Organization)</b>	
Dean Irvin	new
<b>Cuyahoga County Office of Emergency Management (Returning Organization)</b>	
Mark Christie	new
William Belardo	new
<b>Cleveland Office of Emergency Management (New Organization)</b>	
Bob Horwatt	new

<b>Cuyahoga County Planning Commission (Returning Organization)</b>	
Rick Sicha	returning
Dan Meaney	returning

<b>Chagrin River Watershed Partners (Returning Organization)</b>	
Christina Znidarsic	new

<b>American Red Cross (New Organization)</b>	
Robert Allen	new

<b>Northeast Ohio Regional Sewer District (Returning Organization)</b>	
Frank Greenland	new
Betsy Yingling	new
Mark Link	new

<b>Valley View Mitigation Group (New Organization)</b>	
Dave Petras	new

<b>Cuyahoga County Dept. of Development (Returning Organization)</b>	
Harry Conard	returning

<b>City of Independence (Returning Organization)</b>	
Ron White (Economic Development)	returning
Don Ramm (Engineer)	new

<b>Cuyahoga County Soil and Water Conservation (New Organization)</b>	
Jan Rybka	returning
Todd Houser	new

<b>Cuyahoga County Board of Health (Returning Organization)</b>	
J. Meiring Borchers	new

### 3.3.1 Adjacent County Notification

Adjacent counties were notified of the hazard mitigation planning process taking place in Cuyahoga County. Neighboring county Emergency Management Agency Directors were sent a notice informing them of the 2011 Plan update and inviting their participation in the process. Please see Appendix 4 for a copy of the notification.

### 3.3.2 Public Notification Process and Involvement

Public input in the hazard mitigation planning process was solicited by posting Cuyahoga County's original All Natural Hazards Mitigation Plan on the County's website. The Plan was posted at the beginning of the 2011 update process. Once revised, the Plan was reposted for a two-week period at the conclusion of the update process. During each time the public was encouraged to review the Plan and submit any input or questions to the Cuyahoga County Office of Emergency Management. A copy of the website posting can be found in Appendix 5.

Additionally, the Cuyahoga County Office of Emergency Management publishes a quarterly newsletter for multidisciplinary distribution throughout the County. The January 2011 edition of the newsletter included an article concerning the County's 2011 All Natural Hazards Mitigation Plan update. The article directed readers to the Plan's website posting and encouraged them to provide input. A copy of this article can also be found in Appendix 5.

## **3.4 Meetings**

The 2011 Plan update entailed a comprehensive re-evaluation of all parts of the Plan, including hazard profiles, risk assessments, strategies, and priorities. To facilitate this review, the Mitigation Core Group convened 3 meetings. The updated information gathered was analyzed in contrast to the Plan's existing content. The Group revisited and discussed each hazard's original problem statements, goals, and actions. This ultimately served as the basis for the revisions and additions to the Plan's Mitigation Strategy.

### **3.4.1 Meeting 1 - Introduction to the 2011 Plan Update**

The primary purpose of this meeting was to initiate the 2011 update to the Mitigation Plan. Prior to this meeting, the Mitigation Core Group members were requested to review the original Plan. A presentation was provided to the Group on the utility of mitigation planning. The scope and process of the 2011 Plan update were discussed as well.

### **3.4.2 Meeting 2 - Review of Plan's Original and Updated Information**

During this meeting, the Mitigation Core Group compared the Plan's original content with the information gathered for the 2011 update. This comparison served as the basis for plan updates concerning the hazard analyses and also contributed to the identification of new mitigation actions. Lastly, the Group evaluated and discussed the original problem statements, goals, and actions of each hazard addressed within the Plan.

### **3.4.3 Meeting 3 - Hazard Ranking and Action Prioritization**

The focus of this meeting was to discuss the new methodologies used to reevaluate the ranking of natural hazards in the Plan and reprioritize their respective actions. The Mitigation Core Group reviewed and discussed the new



ranking of natural hazards based on the responses received from the Hazard and Vulnerability Assessment Matrix. As a result of the hazard re-ranking, the Core Group examined several natural hazards not comprehensively addressed in the original Plan. For planning purposes, the Core Group reviewed and established hazard pairings to facilitate efficient and logical analyses. For instance, severe winter weather was analyzed as one hazard in the Plan and is inclusive of snow storms, blizzards, and ice storms.

Furthermore, the Core Group reviewed the process used to reprioritize the actions in the updated Plan. The Group evaluated the priority descriptions and analyzed the new order of actions in the Mitigation Strategy. Each action's benefits and costs were reviewed to determine if the order of actions required further adjustment.

Lastly, the Core Group evaluated other significant revisions and additions to the Plan and discussed the finalization process.

### **3.5 Finalization and Adoption**

Upon the completion of the 2011 update, the Plan's review and approval process will begin. The Cuyahoga County Executive has the authority to adopt the Plan after it has been reviewed by the Ohio Emergency Management Agency and approved "pending local adoption" by FEMA.

The adoption process will take place after all of the agencies that need to evaluate the Plan have done so. Every community in Cuyahoga County participated in the 2011 update and will be required to adopt the updated Plan in order to maintain eligibility to apply for federal Hazard Mitigation Assistance (HMA) programs. Once the Plan has been adopted by the local jurisdictions, it will receive formal approval from FEMA.

### 3.6 Hazard and Vulnerability Assessment Matrix Development

For the 2011 update, a matrix originally created by Kaiser Permanente was modified to reevaluate the ranking of natural hazards within the original Plan. Using the matrix, Mitigation Core Group members and community representatives, were asked to rank the natural hazards which affect the County based on specific criteria (e.g. probability of occurrence, human impact, property impact, current preparedness levels, etc.). To increase objectivity, participants were provided with a reference document containing information on the historical impacts of hazards in the County. This document can be found in Appendix 6.

The benefit of this hazard ranking process was twofold. First, it provided a more objective method for assessing the hazards in the updated Plan. Second, it served as the first step in the re-prioritization of the mitigation actions within the Mitigation Strategy. Once the results of the matrices were totaled, actions were re-prioritized according to the ranking of their respective hazards. A sample of the Cuyahoga County Hazard and Vulnerability matrix can be found on the following page. The results are listed on the table below.

<b>2011 Hazard and Vulnerability Assessment Results</b>
Severe Thunderstorm
Flooding
Snow Storm
Tornado
Blizzard
Ice Storm
Temperature Extremes
Erosion/Landslide
Drought
Earthquake
Wildfire
Storm Surge
Seiche

### 3.6.1 Hazard and Vulnerability Assessment Matrix

HAZARD AND VULNERABILITY ASSESSMENT TOOL											
NATURALLY OCCURRING EVENTS											
EVENT	PROBABILITY	SEVERITY = (MAGNITUDE - MITIGATION)									RISK
		HUMAN IMPACT	PROPERTY IMPACT	BUSINESS IMPACT	AVERAGE RESPONSE DURATION	SPEED OF ONSET	EXPOSURE	PREPAREDNESS	INTERNAL RESPONSE	EXTERNAL RESPONSE	
	<i>Likelihood this will occur</i>	<i>Possibility of death or injury</i>	<i>Physical losses and damages</i>	<i>Monetary losses associated with interruption of services</i>	<i>Time period of response to hazard</i>	<i>Length of warning time that can be expected</i>	<i>How much of the County is likely to be impacted</i>	<i>Community Preplanning</i>	<i>Internal Resources and Supplies Available</i>	<i>Mutual Aid - Resources and Supplies Available</i>	<i>Relative threat*</i>
SCORE	1= N/A 2= Low 3= Mod 4= High 5= Extreme	1= N/A 2= Low 3= Mod 4= High 5= Extreme	1 = \$0-\$250k 2 = \$250k-\$500k 3 = \$500k-\$750k 4=\$750k-\$1million 5= >\$1million	1 = \$0-\$250k 2 = \$250k-\$500k 3 = \$500k-\$750k 4=\$750k-\$1million 5 = > \$1million	1= < 6 hours 2= 6-12 hours 3= 12-24 hours 4= 2-7 days 5= > 1 week	1= > 24 hours 2= 12-24 hours 3= 6-12 hours 4= 1-6 hours 5= No Warning	1= 1 Neighborhood 2= 1 Jurisdiction 3= Multi-jurisdictions 4= 1/2 County 5= Entire County	1 = Extremely Prepared 2 = High 3 = Mod 4 = Low 5 = None	1 = Extremely Prepared 2 = High 3 = Mod 4 = Low 5 = None	1 = Extremely Prepared 2 = High 3 = Mod 4 = Low 5 = None	0 - 100%
Severe Thunderstorm											0%
Tornado											0%
Snow Storm											0%
Blizzard											0%
Ice Storm											0%
Earthquake											0%
Temperature											0%
Drought											0%
Flooding											0%
Wild Fire											0%
Landslide (Coastal & Streambank Erosion)											0%
Storm Surge											0%
Seiche											0%
<b>AVERAGE SCORE</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%
<i>*Threat increases with percentage.</i>											
RISK = PROBABILITY * SEVERITY											
0.00    0.00    0.00											

## 3.7 Hazard Problem Statements and Overall Goals

Below are some examples of problem statements for the hazards associated with Cuyahoga County. Also included are the overall goals set for each hazard. Goals are defined as general guidelines that explain what a community wants to achieve in the future. Goals should be realistic and explain what a community intends to accomplish concerning mitigation. A comprehensive listing of problem statements and goals can be found in Appendix 7.

### **Severe Storms**

Severe storms are the number one natural hazard in Cuyahoga County based on frequency of occurrence. Severe storms occur throughout the year and historically have had dramatic, repetitive effects on the communities in the County.

- Due to the location and elevation of Cuyahoga County, susceptibility to severe weather can differ dramatically based on location within the County. This makes it difficult to release appropriate warnings and notices of severe events.
- Due to the unpredictability of storm events, reaction time, and relay of information to the general public is lacking.
- All communities located in Cuyahoga County may not be able to communicate with each other based on the type of communication systems and equipment used within a particular community.

Overall goal: To reduce the effects of severe storms on Cuyahoga County through better preparation for each severe storm event.

### **Flooding**

Flooding is the second highest ranked hazard. This hazard was subdivided into three categories for assessment: flash flooding, 100-year floodplain flooding, and non-flood zone flooding.

#### *Flash Flooding*

- The undersized infrastructure is unable to handle the stormwater in some areas of Cuyahoga County.
- Youth play in highly hazardous areas in relation to flash floods. There needs to be further education focused on youth about the potential for danger.
- There is insufficient warning time for flash flooding in some areas of Cuyahoga County.

Overall goal: To make the general public more aware of flash flood events and those areas of high hazard potential.

#### *100-Year Floodplain Flooding*

- Most communities in Cuyahoga County follow the minimum NFIP and still allow new structures to be built in the 100-year floodplain.
- There are 59 individual jurisdictions in Cuyahoga County, which can result in varying interpretations of NFIP regulations. Despite community efforts to coordinate interpretations, continuity issues among the jurisdictions continue to exist.

Overall goal: To coordinate efforts regulating the 100-year floodplains and to learn from each other how each community applies and enforces their regulations.

#### *Non-Flood Zone Flooding*

- There is generally a lack of awareness as it relates to non-flood zone flooding in the County. There are currently no initiatives to educate residents on the potential for flooding outside a traditional flood zone.

Overall goal: To save lives and property, reduce flood damage, and increase educational awareness of flooding in the communities within Cuyahoga County.

### **Severe Winter Weather**

The leading cause of death during severe winter weather is transportation accidents. Cuyahoga County experiences severe winter weather frequently.

- Heavy ice and/or snow loads can cause fallen trees and limbs, roof collapses, damage to telephone poles and power outages.
- Severe winter weather causes dangerous driving conditions and an increased amount of traffic accidents.

Overall goal: To mitigate the effects of severe winter weather by increasing awareness of the dangers associated with winter storms.

### **Tornadoes**

Tornadoes are a natural hazard that have had historically dramatic effects on the communities of Cuyahoga County.

- There is a lack of a countywide public notification/warning system in Cuyahoga County.
- There are no tornado shelters in public areas or parks within Cuyahoga County.

Overall goal: To increase public educational awareness about the effects of tornadoes on the community, and how to respond to warning sirens.

### ***Temperature Extremes***

Hot and cold Temperature Extremes have affected Cuyahoga County 15 times since 1993.

- There is a lack of awareness regarding the effect hot and cold temperature extremes can have on human health.
- Many citizens in the County may be unaware of resources and shelters that are made available during occurrences of temperature extremes.

Overall goal: Increase public awareness of the dangers of temperature extremes as well as the measures that can be taken to ensure safety.

### ***Erosion and Landslides***

Both coastal and streambank erosion are exacerbated by other natural hazards occurring in the County, namely flooding and severe storms. Further, coastal and streambank erosion can cause landslides.

- Existing structures and the construction of new homes on the coastline are a potential disaster waiting to happen.
- There is a lack of consistent riparian area regulations in Cuyahoga County.
- Natural areas around some of the waterways been affected by stormwater and streambank erosion in recent years.

Overall goal: To increase educational awareness of coastal and streambank erosion in the communities affected, as well as to learn about different techniques communities are using to control erosion.

### ***Droughts and Wildfires***

Droughts are one of the lesser-known hazards for Cuyahoga County. Due to the drying effects of a drought, the potential for wildland fires is often increased during and after a drought event.

- There are concerns over the effects drought and heat stress can have on sensitive populations, such as the elderly and children.
- Fire departments in Cuyahoga County lack the appropriate equipment to fight wildfires.

Overall goal: To reduce potential damage of droughts and wildfires by increasing public awareness and better equipping fire departments to respond to wildfires.

### ***Earthquakes***

Because of the low frequency of occurrence of this hazard, earthquakes are not one of the higher ranked hazards in the County.

- There are no building standards that address earthquake resistance.

Overall goal: To reduce potential damage of earthquakes and to increase public awareness.

### ***Coastal Flooding (Storm Surge and Seiche)***

Due to its location on the shore of Lake Erie, Cuyahoga County is susceptible to coastal flooding resultant of storm surges and seiches.

- Properties on the coastline could be damaged by storm surges and seiches.
- There is a general lack of awareness of storm surges and seiches in the County.

Overall goal: Increase public awareness of the potential dangers of coastal flooding.

# 4.0 State of Natural Disasters and Hazard Assessment for Cuyahoga County

## 4.1 Initial Hazard Determination for Cuyahoga County

Listed below is the approach taken in the original Plan to generate the initial Hazard Identification and Risk Assessment (HIRA) for Cuyahoga County. To ensure continuity within the 2011 Plan update, effort was made to mirror the historic methodology utilized in the development of the hazard assessments, vulnerability analyses, and potential dollars lost for each hazard. Areas where the methodology differs between the original and updated plans are noted and explained.

Step 1 - FEMA's database was researched to determine which hazards had been documented as possible natural hazards, including future threats, for the State of Ohio. Several hazards that are listed on FEMA's website include Flooding, Severe Storms, Tornadoes and Winter Storms.

Step 2 – The National Climatic Data Center (NCDC) website was referenced for updated information pertaining to storm events that have occurred in Cuyahoga County since the Plan was initially drafted. The NCDC website presents each type of hazard and the historic information associated with it for each County, offering several hazard search parameters. These parameters include: droughts, dust storm, flooding, fog, hail, hurricanes, lightning, tornadoes, wild/forest fires, ocean/lake surf, precipitation, snow and ice, temperature extremes and thunderstorms and high

Ohio Disaster History According to FEMA 2005-2011	
02/15/2005	Severe Winter Storms, Flooding
07/02/2006	Severe Storms, Tornadoes, Flooding
08/01/2006	Severe Storms and Flooding
08/27/2007	Severe Storms and Flooding
10/24/2008	Severe Wind Storm
07/13/2011	Severe Storms and Flooding

Initial Hazard Assessment for Cuyahoga County	No. of Events	*Cost in Millions
Severe Storms (1950-2010)	562	67.08
Thunderstorms	324	14.29
High Wind / Lightening	72	47.34
Hail	166	5.45
Winter Storms (1993 – 2010)	76	252.11
Floods (1993-2010)	70	98.93
Flash Floods	42	55.78
100-Year/Non-Floodzone Floods	28	43.16
Tornadoes (1950-2010)	29	67.75
Temperature Extremes	15	5.53
Earthquakes (1836,1850, 1868, 1888, 1955, 1991)	7 epicenters	
Droughts (1995-2011)	6	200

\*Cost includes damages incurred by other counties as well



winds. Of those parameters, dust storms, severe fog, hurricanes/tropical storms, wild/forest fires and ocean/lake surf have either never been documented in Cuyahoga County, or have not occurred since 1950. This left droughts, flooding, hail, lightning, tornadoes, snow and ice, severe precipitation, temperature extremes, thunderstorms, and high winds to further assess. Note that earthquakes and coastal/streambank erosion are not part of the NCDC database.

The information pertaining to earthquake susceptibility was obtained from the United States Geological Survey (USGS). The information pertaining to coastal and streambank erosion was gathered from several sources which include: the Army Corps of Engineers, the Cuyahoga County Planning Commission, the Chagrin River Watershed Partners, Euclid Watershed Coordinator, Doan Brook Watershed Coordinator, Rocky River Watershed Coordinator, Lake Erie Direct and the Cuyahoga Watershed Coordinator. Updated information regarding coastal and streambank erosion was obtained from the Northeast Ohio Regional Sewer District (NEORS) and the Ohio Department of Natural Resources (ODNR), Division of Geological Survey.

## 4.2 Severe Storms

Cuyahoga County, like most communities in Ohio, is susceptible to severe weather. The severe storm category is a "catch all" to include thunderstorms, high winds, lightning, and hail. A specific criterion of severe weather, as it relates to thunderstorms, is a wind classification of 58 mph and above. Severe storms can produce damage, but also are often the precursor for much more severe weather to follow.

Tornadoes and flash flooding are spawned by thunderstorms. When a "severe thunderstorm warning" is issued, citizens should review what actions to take under a "tornado warning" or a "flash flood warning." When thunderstorms produce heavy rains (which can cause flash flooding), strong winds, hail, lightning and tornadoes, people should seek shelter and stay tuned to a battery-operated radio for weather information.

Lightning is also a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed each year by lightning. The myth that lightning never strikes twice in the same place needs to be replaced by the fact that lightning can strike several times in the same place in the course of a single discharge

## 4.2.1 Severe Thunderstorm Warnings and Watches

A severe thunderstorm **watch** is issued by the National Weather Service when the weather conditions are such that damaging winds of 58 mph or more, or hail three-fourths of an inch in diameter or greater, is likely to develop. Citizens should locate a safe place in the home and tell family members to watch the sky and listen to the radio or television for more information. A severe thunderstorm **warning** is issued when a severe thunderstorm has been sighted or indicated by weather radar. At this point, danger is immediate, citizens should move to a safe place, turn on a battery-operated radio or television, and wait for the "all clear" by the authorities.

The following paragraphs describe some of the specific severe storm hazards that have affected Cuyahoga County.

## 4.2.2 Significant Events

**September 25, 1994 - Hail - \$5.0 Million.** Lightning and large hail, driven by strong winds, occurred at a number of locations including Bedford and Oakwood where hail covered the ground like snow and stripped foliage from trees. Numerous homes and businesses reported damage to siding, roofs, windows, and vehicles. A MetroParks ranger at Brookside Park was injured when lightning struck a nearby light pole, then jumped to the tree that he was standing under, striking him.

**October 30, 1996 - High Winds - \$7.6 Million.** A deep low pressure moving east across Ontario Canada brought winds of 60 to 70 miles per hour, with higher gusts, to Northern Ohio. Trees, limbs and power lines were downed, some across roads, and others on cars and buildings causing considerable damage. In Cuyahoga County, at Cleveland Hopkins Airport, a stewardess was blown off the steps of a commuter plane but was not injured. At least 2 cars, a truck and a house were struck by falling trees in Bay Village and shingles were blown from roofs in Berea. A 16 ton concrete wall at a Revco drugstore under construction in Akron in Summit County was toppled and, in Springfield Township, a storage facility under construction was destroyed. A wind gust of 67 miles per hour was reported at Kent in Portage County. A wind gust of 79 miles per hour was reported at Fairport Harbor in Lake County. A 71 mile per hour wind gust was reported in Ashtabula County.

**July 26, 2005 - Thunderstorm - \$750,000.** A line of severe thunderstorms raced southeast onshore from Lake Erie during the late afternoon hours of the 26th. At Burke Lakefront Airport, seven aircrafts received either major damage or were totally destroyed as a result of the 75 mph winds. Three airplanes were ripped

from their tiedown straps and thrown across the airport by the severe winds. The planes crashed into each other as they were thrown across the airfield and at least two of the three landed up against the airport fence. There was a report of an office building in the downtown area of Cleveland that had several windows blown out. The glass from the windows landed on several cars causing major damage to them. Across the remainder of the County, numerous trees, large limbs, and power lines were downed.

**August 10, 2009 -Thunderstorm - \$150,000.** A cold front was located northwest of the region during the afternoon and evening hours of the 10th. A warm and unstable airmass caused showers and thunderstorms to develop shortly after noon and persist through the afternoon and evening hours. Some of the thunderstorms became severe producing severe winds and hail. Dozens of trees were reported down throughout Shaker Heights. Power lines were also downed causing thousands of people in the area to lose power. Several streets were closed by downed trees and power lines.

**April 28, 2011 - High Winds - \$200,000.** An area of very strong low pressure moved northeast across the Great Lakes during the evening hours of April 27th and the morning hours of the 28th. A strong cold front swept east across northern Ohio prior to daybreak on the 28th. Following the passage of the cold front, strong northwesterly winds developed over northern Ohio. Peak winds at most locations occurred during the predawn hours of the 28th. Winds gusted to as much as 70 mph in some areas and damage was reported. Most of the damage was from downed trees, power lines and utility poles. Hundreds of homes also sustained damage, mainly from lost roofing or siding. A semi truck was blown over in Marion County. Scattered power outages were also reported across the area with over 100,000 homes and businesses affected. The peak wind gusts measured at Burke Lakefront Airport in Cuyahoga County was 67 mph.

### Ohio Disaster History

Year	Disaster Type
2011	Severe Storms and Flooding
2008	Severe Wind Storm associated with Tropical Depression Ike
2007	Severe Storms, Flooding, and Tornadoes
2006	Severe Storms, Straight Line Winds, and Flooding
2006	Severe Storms, Tornadoes, Straight Line Winds, and Flooding
2005	Severe Winter Storms, Flooding and Mudslides
2004	Severe Storms and Flooding
2004	Severe Storms and Flooding
2004	Severe Storms, Flooding, Mudslides, and Landslides

### 4.2.3 Cuyahoga Severe Weather Mitigation Efforts

During the 2011 update to the Plan, Cuyahoga Heights and Valley View reported that they had installed warning/tornado sirens. Additionally, the County continues efforts to map critical facilities and develop first responder interoperability; both of which were activities identified in the original Plan as mitigation actions for severe storms.

### 4.2.4 Critical Facilities and Infrastructure

Due to the non-site specific nature of severe storms, the impact on particular critical facilities and infrastructure cannot be determined. However, severe weather events can result in power failures and unsafe, impassable roadways. Critical facilities can be most directly impacted by severe storms through power failures. Those critical facilities for which electricity is crucial (i.e. hospitals, nursing homes, etc.), must plan for the provision of emergency generators, or other measures that will ensure continuity of their operations. Further, thunderstorms may cause effects similar to flooding on infrastructure. Please see the flooding section that follows for additional details.

## 4.2.5 Current Development Trends

Since severe storms are a non-site specific hazard, current development trends have no effect other than the knowledge that in regard to mitigation for severe storms, any strategy should be considered Countywide.

## 4.2.6 Hazard Assessment and Vulnerability Analyses / Potential Dollars Lost

Historic events were referenced to determine Cuyahoga County's susceptibility to severe storms. According to the National Climatic Data Center (NCDC) website, from 1950-2010, Cuyahoga County experienced **562** severe storm events (includes thunderstorms, high winds, lightning, and hail) totaling over **\$67 million** in damages.

### **Actions for Severe Storms**

- **Seek funding to develop a countywide public notification/warning system. Identify most appropriate type of system, whether in the form of siren, reverse 9-1-1, social media, or other mode.**

This activity stresses the importance of having a notification / warning system that can warn citizens throughout the County of dangerous weather conditions.

- **Develop detailed PSAs on the countywide public notification/ warning system.**

This activity addresses the fact that the residents will have to be educated about the new system to facilitate their understanding of its functions. Public service announcements will serve to familiarize the residents with the system.

- **Evaluate countywide communications interoperability. Seek funding to make communities' first responders interoperable.**

This activity is in response to the fact that not all communities located in Cuyahoga County can communicate with one another based on the type of communication system or equipment utilized within a particular community.

- **Map all of the critical facilities of every community within the County.**  
 This activity will allow for increased knowledge about each critical facility, where they are located, and the most direct routes to take to get to a critical facility in case of an emergency.
- **Develop a plan for participation to coordinate cleanup efforts into the mitigation process.**  
 This activity addresses the fact that local communities bear “sole financial burden” when cleaning up after a severe storm which can become a financial strain on many communities. By coordinating cleanup efforts among communities, this allows for costs to be better distributed among communities.
- **Develop strategic outreach to promote a program for regional NWS Sky Warn classes to educate identified community/volunteer organizations (e.g. Neighborhood Watch, CERT, etc.)**  
 This activity will educate members of identified community/volunteer organizations about how to recognize severe weather. The ability to accurately identify and describe severe weather conditions will promote citizen preparedness in Cuyahoga County.
- **Develop Social Media programs to provide weather information to the public.**  
 This activity will promote severe weather safety by providing the public with easy access to valuable information pertaining to hazards and preparedness.
- **Develop outreach educating citizens on the responsibility of tree maintenance and removal with regard to power outages caused by severe weather.**  
 Most property owners are unaware that they may be held responsible for trees/limbs that fall on their property and damage power lines. Property owners can incur the cost of the clean-up as well as the expense of repairs to the power lines. By providing information to property owners about this matter, this activity will encourage proper tree maintenance, reducing power outages caused by severe weather.

## 4.3 Flooding

The history of flooding in Cuyahoga County is extensive. According to the National Climatic Data Center (NCDC) the County has been impacted by 72 flooding events between 1993 and 2011.

### 4.3.1 Flooding Warnings and Watches

The National Weather Service (NWS) issues Flood Watches and Warnings for large-scale river flooding. Warnings are issued when flooding is expected to develop over a large area and cause damage and threaten life. Watches are issued when flooding is possible within 12 - 48 hours. When rapid flooding resultant from heavy rain or a dam failure is expected, Flash Flood Watches and Warnings are issued.

Provided below are descriptions of some of the significant flooding events that have occurred in the County.

### 4.3.2 Significant Events

**August 13, 1994 - Flood - \$5.0 Million.** The Cuyahoga River raged over its banks at Independence and surrounding areas in the valley, exceeding flood stage of 16.0 feet and cresting at 22.9 feet. Nearby tributaries backed up and flooded. Roads, businesses and some homes were flooded and evacuations were necessary.

**July 15, 1995 - Flash Flood - \$800,000.** Thunderstorm rains of two to three inches fell on saturated ground in less than an hour and a half producing widespread flooding of streets, poor drainage areas, and basements. The Cain Park Amphitheater was flooded and had to be evacuated. A popular nightclub in Cleveland located in a basement became flooded and patrons had to leave through knee-deep water. About 500 basements were flooded in North Olmsted and numerous basements were reported flooded in South Euclid.

**September 7, 1996 - Flash Flood -\$100,000.** Four to six inches of heavy rain from the remnants of Hurricane Fran caused flooding of streets, basements and low lying areas in several locations including, Cleveland, Parma, Strongsville, and Olmsted Falls. Monkey Island, at the Cleveland Zoo, was inundated, and picnic tables, asphalt and fences were damaged, but no animals were injured. There was up to one foot of water on some streets in Parma.



**June 1, 1997 - Flood - \$400,000.** The Cuyahoga River at Valley View overflowed its banks. A number of businesses and numerous basements and roads were flooded, cars were submerged and some schools were closed on June 2, 1997 because of impassable roads. Thirty-five people were evacuated. The Cuyahoga Valley National Recreation Area and Cleveland Metroparks closed the federal park and the Brecksville Reservation because of Cuyahoga River flooding.

**August 10, 1998 - Flood - \$275,000.** Heavy thunderstorm rain caused widespread flooding of roads and low lying areas in Cleveland and surrounding suburbs. In Newburgh Heights, Interstate 77 was flooded with three to four feet of water and an elderly couple had to be rescued from their floating car. Over five inches of rain was measured in some southern and eastern sections as storms repeatedly crossed the area for several hours.

**July 21, 2003 - Flood - \$15 Million.** Runoff from very heavy thunderstorm rains caused the Cuyahoga River to leave its banks late on the 21st. The river crested at 12.64 feet at Old Portage around 10 p.m. on the 21st. The river fell back below its flood stage of 9 feet just after midnight on the 24th. At Independence, the Cuyahoga River went into flood stage around 6 a.m. on the 22nd and crested at 21.12 feet around 6 p.m. on the 22nd. The river fell back below flood stage early in the afternoon of 23rd. Considerable damage was caused by the flooding in both Cuyahoga and Summit Counties. Over 20 miles of foot trails, several miles of railroad tracks and eight bridges were washed out in the Cuyahoga Valley National Recreation Area. Damage in the park topped \$1 million. Significant flooding occurred along Canal and Tinkers Creek Roads in Valley View. Many homes on the east side of the river along Gleeson, Charles, Frances and Stone Streets sustained major damage. Flooding also occurred along the river in Cuyahoga Falls and Monroe Falls near Kennedy Park. Over 20 businesses along the river also suffered flood related losses.

**June 22, 2006 - Flash Flood - 35 Million.** Thunderstorms dumped torrential rainfall on much of Cuyahoga County during the late afternoon and early evening hours of June 22nd. With the ground already saturated from heavy rains the previous 24 hours, flash flooding quickly developed. The eastern and southern portions of the county were especially hard hit with significant damage reported in Brecksville, Broadview Heights, Parma, North Royalton and Solon. In Independence, 21 passengers had to be rescued from a scenic railway train after the railroad's tracks became flooded. In Brecksville, Chippewa Creek turned into a raging torrent and caused extensive damage in the city. A lumberyard near the creek saw much of its inventory washed away and around 450 homes in the area were damaged with 50 sustaining major damage. As much as two to three feet of water was reported on the ground floors of homes in Independence. In Parma, a sink hole 10 feet wide and 13 feet deep



developed on State Road (State Route 94). The City of Parma spent over \$1 million for emergency response, street repairs, materials and personnel. Around 200 homes, most of them east of State Road were damaged in the city. Several hundred homes and six school buildings were damaged by flooding in North Royalton. The damage was even more widespread in Broadview Heights and Solon. In Broadview Heights, around 1800 homes were affected by flooding with over 200 sustaining major damage. Most of this damage was north of State Route 82. Another 2000 homes were damaged in Solon. Numerous roads and culverts in these areas were washed out. At the peak of the flooding, nearly two dozen streets were impassable in Solon alone. In Walton Hills, flood waters were reported flowing over guard rails lining streets. Flooding in Cuyahoga County during this event was unprecedented. Nearly 4,000 homes, 475 businesses and 21 public buildings in the county were damaged by flooding.

**February 28, 2011 - Flood - \$700,000.** Heavy rain and rapid snow melt led to widespread flooding across Cuyahoga County. Rainfall totals across the County averaged 2 inches. Up to ten inches of heavy snow was on the ground at the onset of the rain. This snow rapidly melted as temperatures warmed into the 50s on the 28th. Up to an additional inch of water equivalent rainfall was released from the melted snow. Dozens of homes in the County sustained damage, mainly from basement flooding. Many roads had to be closed because of the flooding. Several schools in North Royalton received considerable damage.

### 4.3.3 Flash Flooding

Flash flooding is the leading cause of weather-related deaths in the U.S. - approximately 200 deaths per year. Over 50% of flood-related drownings are vehicle-related. Flash Floods can happen anywhere at any time. Cuyahoga County's concern for flash flooding is two-fold. One, the lack of warning time and two, undersized infrastructure.

### 4.3.4 River Flooding

The following areas have been listed as flood prone areas due to close proximity to a river or creek. The source of the flood is given, followed by the area affected:

**Rocky River:** Areas along Rocky River from North Royalton's Bennett Road northwest to Berea. In Berea, from the 800 block of Prospect Road northeast to Eastland and Sheldon Roads. Rocky River Reservation north to Lake Erie.

**Rocky River Tributary:** From Berea east to Zona Lane in Parma. In Middleburg Heights, center of Webster Road to northeast portion of Alan and Ragall Parkways.

**Tinker's Creek:** From just east of Dunham Road in Walton Hills, then east, northeast to Oakwood.

**Chagrin River:** In Gates Mills, along Chagrin River Road from Berkshire Road north to Rogers Road.

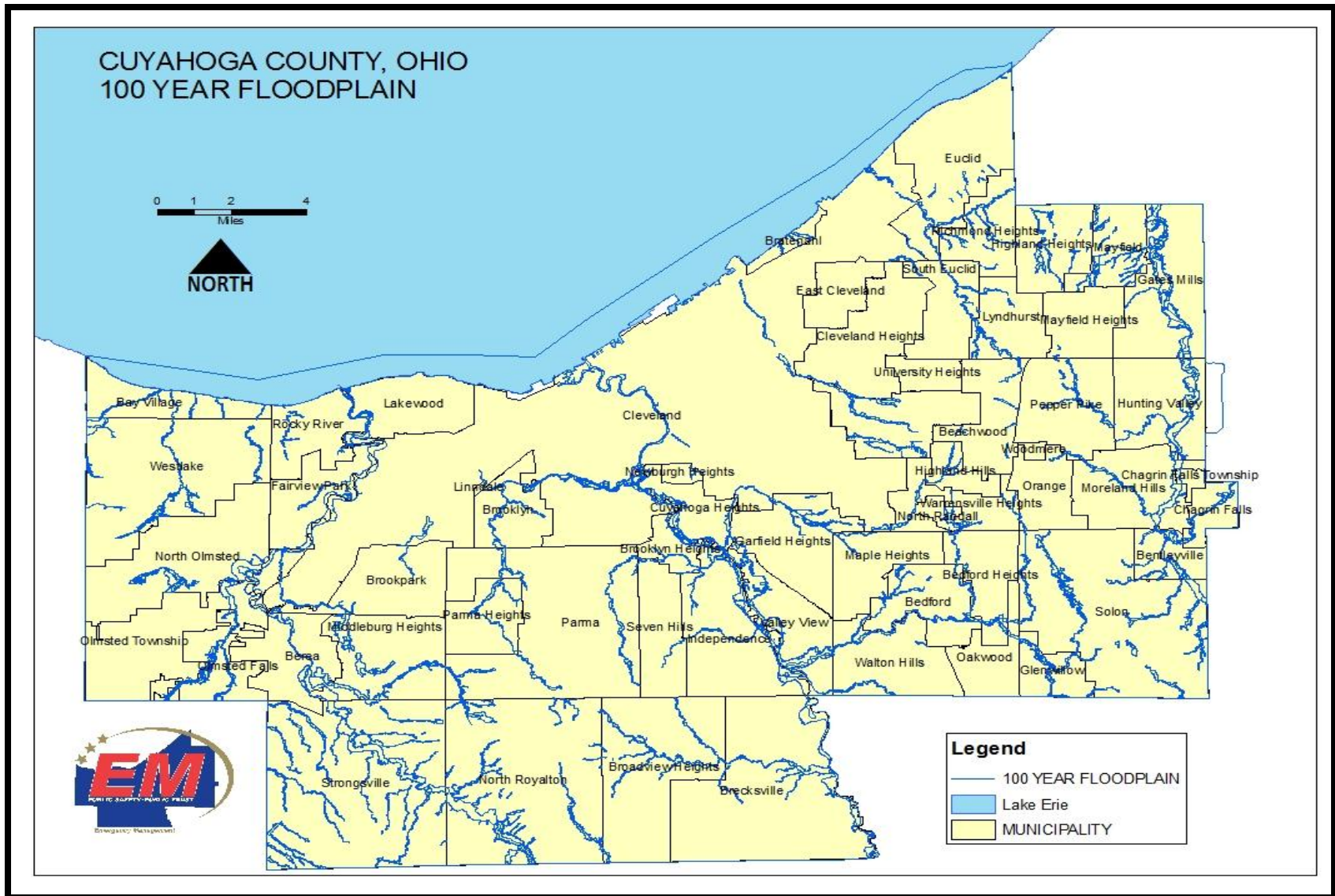
**Big Creek:** From just northeast of Tobik Road northwest to the intersection of Big Creek and Stumph Roads, then northeast to Linndale.

**Euclid Creek:** In Lyndhurst, from Cedar Road to Mayfield Road. In South Euclid, from Mayfield Road to Anderson Road. From Anderson Road east/southeast to Ridgebury Road. In Richmond Heights, from Anderson Road northwest along Glenridge Road to Euclid Cemetery then northwest to Lake Erie.

**Cuyahoga River:** In Brecksville, areas near the intersection of Riverview, Vaughn and Snowville Roads. In Cuyahoga Valley, East Valley, Brookside Road and Rockside Road to Warner Road.

### 4.3.5 Non-Flood Zone Flooding

Non-flood zone flooding can be defined as flooding that occurs in areas not defined as floodplains, usually in areas that have been developed at a fast rate. Non-flood zone flooding is an issue that occurs in communities throughout the County. Many of the flooding issues identified by communities within the Infrastructure Concerns table on page 40 are related to non-flood flooding.



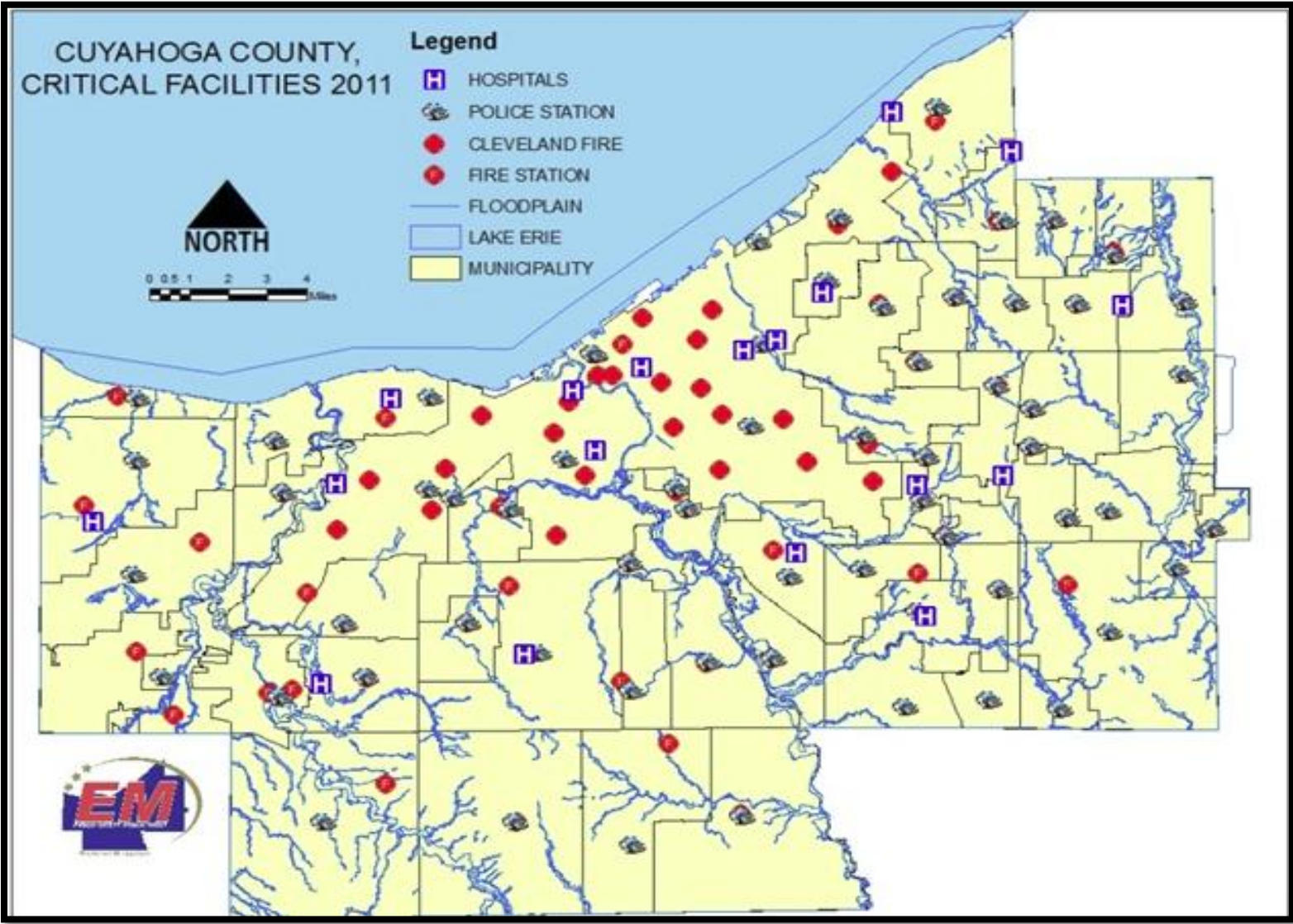
Note: Individual community floodplain maps can be viewed by visiting FEMA's Map Service Center at: [www.msc.fema.gov/](http://www.msc.fema.gov/)

### 4.3.6 Critical Facilities

According to FEMA, typical critical facilities include hospitals, fire stations, police stations, storage of critical records, and similar facilities. These types of facilities should be given special consideration when formulating regulatory alternatives and floodplain management plans.

The locations of critical facilities within Cuyahoga County in relation to the 100-year floodplains are shown on the map on the following page. Due to the large number of critical facilities within Cuyahoga County, only the fire departments, police stations and hospitals are depicted on the map. There are **6 critical facilities** in Cuyahoga County identified to be within 100-year floodplains, with a total potential loss of **\$28,431,900**. Refer to Appendix 8 for additional detail on these locations.





## 4.3.7 Infrastructure

During the planning process for the original Plan, communities were asked to identify infrastructure concerns in regard to flooding. This question was posed to communities once again during the 2011 update. Specifically, communities were asked to review their originally identified infrastructure concerns and provide updates. These updates included identifying problems listed in the original Plan that have now been remedied, as well as documenting new areas of concern.

The question was as follows:

*“What infrastructure concerns does your community have as it relates to flooding? (For example, please list any intersections, culverts, and/or bridges that have systemic flooding issues.)”*

Community	Description of Problem/Updated Status (where relevant)
Bay Village	<ul style="list-style-type: none"> <li>Porter Creek – Ashton Lane culvert/bridge</li> <li>Wischmoyer Creek – Lake Road culvert</li> </ul>
Beachwood	Intersection of Richmond and South Woodland: Remedied
Bedford	<ul style="list-style-type: none"> <li>Cresswell Avenue <ul style="list-style-type: none"> <li>Wood Creek under Broadway: Culvert under construction. Will be replaced in 2011</li> </ul> </li> </ul>
Bedford Heights	<ul style="list-style-type: none"> <li>Areas along Bear Creek, properties along Aurora Rd.</li> <li>Consistent flooding: railroad right-of-way north and south of Fargo Ave; at the termination of approx. 102" stormwater drain at 5626 Richmond Rd</li> <li>Culvert running under Rockside Road</li> </ul>
Bratenahl	<ul style="list-style-type: none"> <li>Nine Mile Creek</li> <li>Dugway Creek</li> </ul>
Brecksville*	<ul style="list-style-type: none"> <li>Riverview Rd. between Snowville Rd. and the County line</li> <li>Valley Parkway Ford</li> <li>Riverview Road/Vaughn Road culvert</li> <li>Vaughn Road</li> <li>Riverview Road at NPS Maintenance Garage</li> <li>Riverview Road at Wiese Road</li> </ul>
Brook Park	<ul style="list-style-type: none"> <li>West 130<sup>th</sup> at I-480</li> <li>West 130<sup>th</sup> south of Brook Park Rd.</li> <li>Sheldon Road at Abrams Creek</li> <li>Smith Rd - south of Brookpark Rd.</li> <li>Brookpark Rd. – west of Smith Rd.</li> </ul>
Brooklyn Heights	Lancaster culvert, Van Epps Road hill
Chagrin Falls	Flooding at Solon Rd and Monticello

Community	Description of Problem/Updated Status (where relevant)
Cleveland	<p>Problem area underpasses:  Berea Rd. &amp; Detroit Ave.  Broadway Ave. &amp; Harvard Ave.  Canal Rd.  Cedar Ave. &amp; Ashland Ave.  East 32 St. &amp; Lakeside Ave.  East 36 St. &amp; St. Clair Ave.  East 37 St. (north of Woodland Ave.)  East 38 St. &amp; Superior Ave.  East 40 St. &amp; Payne Ave.  East 55 St. (tracks)  East 65 St. &amp; Carnegie Ave.  East 65 St. &amp; Central Ave.  East 71 St. &amp; Hastings Ave.  East 71 St. &amp; Quincy Ave.  East 75 St. &amp; Colfax Ave.  East 79 St. &amp; Bessemer Ave.  East 79 St. (RTA bridge)  East 79 St. &amp; Woodland Ave.  East 93 St. &amp; Buckeye Ave.  East 105 St. &amp; Quincy Ave.  East 131 St. &amp; St. Clair Ave.  East 140 St. (Aspinwall to Lakeshore)  East 152 St.  East 185 St. (St. Clair to Waterloo)  Holmden Ave.  Ivanhoe Ave.  Puritas between Enterprise and W. 168<sup>th</sup>  West Clinton &amp; West Blvd.  West 117 St. between Detroit &amp; Berea  West 112 St. &amp; Berea Ave.  West 130<sup>th</sup> St. from Gilmore to Brook Park  West 143 St. &amp; Lorain Ave.  West 150 St. between Industrial and Brook Park</p> <p>Low spots:  East 167/Harvard  East 93/Richmond/Meech  East 147/Edgewood  East 110 behind Glenville  East 123 &amp; 121/Superior  Arlington/East 123 between Thornhill  Bellflower Ave. (Charles Harris Park)  3645 Seymour  3628 East 61  5928 Ackley  East 71/Worley  Hamlet/Adolpha  2500 West 3<sup>rd</sup>  Canal/Commercial</p>

Community	Description of Problem/Updated Status (where relevant)
	12414 Emery 12501 Hirst 12409 Ervin 12601 Milligan Gilmore/West 132 Harold/West 130
Cuyahoga Heights	<ul style="list-style-type: none"> <li>• I-77 North and South, North of Grant Ave.</li> <li>• Grant Avenue under Railroad Bridge</li> <li>• Nicky Blvd. landfill storm sewer improvements</li> <li>• Burke Brooke storm sewer improvements</li> <li>• Sediment buildup mouth of Mill Creek at the Cuyahoga River</li> </ul>
Garfield Heights	<ul style="list-style-type: none"> <li>• Broadway – Millcreek Project Sewers</li> <li>• Hydro breaks in street sewers</li> <li>• Catch basin repair 2011</li> </ul>
Gates Mills	<ul style="list-style-type: none"> <li>• The intersection of Mayfield Rd. and Chagrin River Rd.</li> <li>• Chagrin River Rd. between Old Mill Rd. and Berkshire Rd.</li> <li>• Chagrin River Rd. north of Mayfield Rd. to Rogers Rd.</li> </ul>
Glenwillow	<ul style="list-style-type: none"> <li>• 7272 Austin Powder</li> </ul>
Highland Hills	Severe erosion of Millcreek and occasional localized flooding. Erosion is most severe between Harvard Rd. and Warrensville Center Road where streambank erosion has threatened to destabilize adjacent slopes and structures.
Hunting Valley	<ul style="list-style-type: none"> <li>• Flooding along Chagrin River Road within the Village between SR 87 (South Woodland Rd.) and Fairmount Blvd.</li> <li>• Fairmount Blvd. floods occasionally just east of Chagrin River: Remedied</li> </ul>
Independence	<ul style="list-style-type: none"> <li>• Lower Brookside Road, west of Riverview Rd.</li> <li>• Cuyahoga River Valley</li> <li>• Schaaf/Fuhrmeyer Roads at West Creek</li> <li>• Elmwood sewer back-ups</li> </ul>
Lakewood	<ul style="list-style-type: none"> <li>• Clifton Lagoon – residential</li> <li>• Sweetwater Landing/Metroparks</li> <li>• Wastewater treatment plant</li> </ul>
Maple Heights	<ul style="list-style-type: none"> <li>• Streets experiencing flooding: Waterbury, Franklin, Clare</li> <li>• Maple Hts. Blvd./Oakwood</li> <li>• Maple Hts. Blvd./Beechwood</li> <li>• Maple Hts. Blvd./ Elmwood</li> <li>• Maple Hts. Blvd./Hollywood</li> </ul>
Mayfield Heights	Low spot along Mayfield Rd. between SOM Center Road and the East Corporation Line of the City: Remedied
Newburgh Heights	<ul style="list-style-type: none"> <li>• East 49<sup>th</sup> and Harvard</li> <li>• East 38<sup>th</sup> St.: remedied</li> <li>• East 27/29<sup>th</sup> Streets</li> <li>• Brow Avenue and East 53<sup>rd</sup> Street: remedied</li> <li>• East 42<sup>nd</sup> and McGregor</li> </ul>



Community	Description of Problem/Updated Status (where relevant)
	<ul style="list-style-type: none"> <li>• East 26<sup>th</sup> Street</li> <li>• East 52<sup>nd</sup> and 53<sup>rd</sup> – sink holes</li> <li>• I-77 South (between Harvard and Grant in Cuyahoga Heights)</li> <li>• I-77 North bound exit ramp at Harvard</li> <li>• Harvard Ave. (between Washington Park Blvd. and East 27<sup>th</sup>) – directly across from Harvard Heat Treat Operation</li> <li>• Bridgeview and Washington Park Blvd.: remedied</li> </ul>
North Olmsted	<ul style="list-style-type: none"> <li>• City is built on a ridge defined by Lorain Rd. Water falling north of Lorain Road is problematic. Sewage is pumped up and over the ridge by many pumping stations located throughout the north half of the city. Due to infiltration, the city has had a severe flooding problem in the northeast quadrant of the city. Many areas in need of mitigation.</li> <li>• Root ditch flooding and erosion</li> <li>• Hall ditch flooding and erosion</li> <li>• Dover ditch flooding and erosion</li> </ul>
North Randall	<ul style="list-style-type: none"> <li>• Flooding on Northfield Rd. near Miles Rd.</li> <li>• Flooding on Northfield Rd. at I-480 overpass</li> <li>• Frequent flooding on Derbyshire Rd. and North Randall Drive</li> </ul>
North Royalton	<ul style="list-style-type: none"> <li>• Bridge at Ridge Road and the east branch of the Rocky River</li> <li>• Bennett Road and the east branch of the Rocky River: Remedied</li> <li>• Bridge at Sprage over Baldwin Creek</li> <li>• Culvert at Sprague east of Thornhurst Dr.</li> </ul>
Oakwood Village	<ul style="list-style-type: none"> <li>• Tinker's Creek by the Metropark entrances on Richmond Rd.</li> <li>• Macedonia Road about 7647</li> </ul>
Olmsted Falls	<ul style="list-style-type: none"> <li>• Bugsby Ditch: Flooding of Bagley Rd. east of Fitch Rd.</li> <li>• Plum Creek: culvert/bridge over Plum Creek</li> <li>• Storm sewers in the Cook Rd, Mapleway, Cranage and Clark Streets have been recently internally inspected and found to be in varying states of deterioration</li> <li>• Storm sewer along the north side of Sprague Rd (east of SR 252) has been recently found to be in poor conditions</li> <li>• Culvert crossing Sprague Rd. ( east of Lindbergh Boulevard) has been found to be severely deteriorated and in need of replacement. One half of the culvert is in Lorain County.</li> </ul>
Parma	<ul style="list-style-type: none"> <li>• West Ridgewood Drive@ West 54<sup>th</sup> Street</li> <li>• Laverne Ave./Luelda Ave./Velma Ave. @ from Pearl Rd. to Ridge Rd.</li> <li>• Abraham Ave. @ Gabriella Ave.</li> <li>• Pearl Rd. @ Laverne Ave.</li> <li>• West Creek near Pleasant Valley Rd.</li> <li>• East Branch of Big Creek @ Linden Lane</li> <li>• Big Creek @ Brookpark Rd.</li> <li>• Cecilia Dr @ Brian Dr.</li> <li>• Coventry Dr. @ West Creek</li> <li>• Added a twin storm sewer on W. List Lane @ W. 130<sup>th</sup> :</li> </ul>

Community	Description of Problem/Updated Status (where relevant)
	Remedied <ul style="list-style-type: none"> <li>• Increased size of storm sewer on W. Linden lane: Remedied</li> <li>• A 72" storm sewer detention pipe was installed on Manhattan Ave.: Remedied</li> <li>• The overall cleaning and maintenance of the Municipal sewer system has been increased: Remedied</li> </ul>
Solon	<ul style="list-style-type: none"> <li>• SR 91 at Norfolk and Southern overpass</li> <li>• Solon Blvd. storm sewer</li> <li>• Beaver Meadow Parkway at the entrance to treatment plant</li> <li>• Area of Cannon Rd. and Richmond Rd. (Hawthorne Creek flooding)</li> <li>• Overland flooding on the north side of Pettibone Rd near the entrance to the Rollingbrook Subdivision. The road has flooded and caused closures in the past</li> <li>• Beaver Meadow Parway- New culvert,</li> <li>• Area of Cannon Rd. and Richmond Rd. - County replaced culvert #140, Lowered the normal water level by adjusting the structures in the 500 yr floodplain and therefore adding an additional 15 acre-feet of water storage.: Remedied</li> </ul>
University Heights	Basement flooding problem along Meadowbrook Blvd. from approx. Warrensville Center Road to Cleveland Heights line
Valley View	<ul style="list-style-type: none"> <li>• 96" storm sewer along I-480 is filled with silt</li> <li>• Canal Road storm sewer system between I-480 and Fosdick Road overwhelmed by rain</li> <li>• Strathmore Subdivision Stream Bank Stabilization, Mill Creek sediment buildup at the Cuyahoga River, Sagamore Creek sediment buildup at culvert under Canal Road</li> </ul>
Walton Hills	Periodic flooding along Tinkers Creek
Warrensville Heights	<ul style="list-style-type: none"> <li>• Northfield Road underpass under the Erie Railroad bridge</li> <li>• Miles Road – 23000 block</li> </ul>

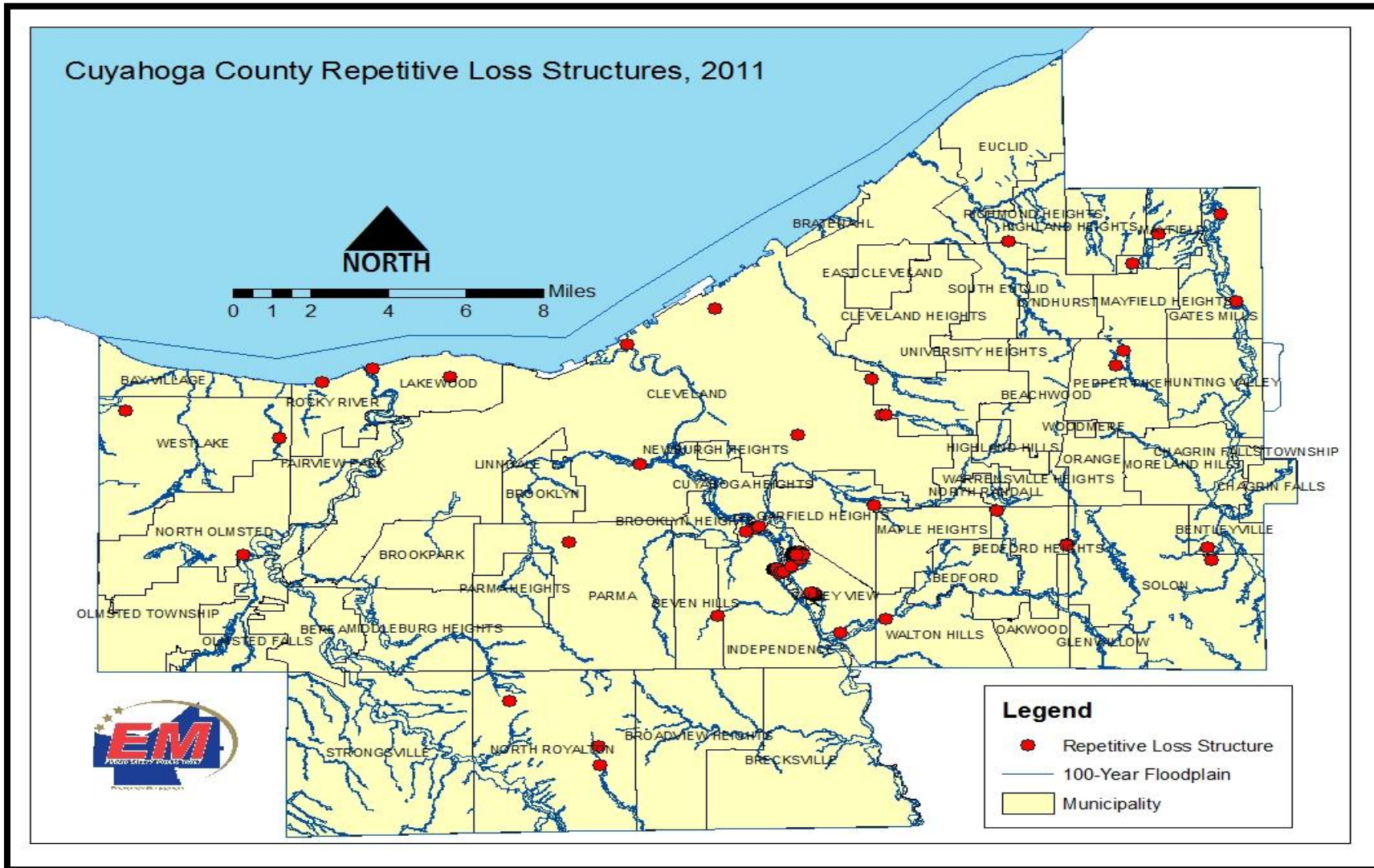
### 4.3.8 Repetitive Loss Flooding

Repetitive loss structure is a term that is associated with the National Flood Insurance Program (NFIP). For Flood Mitigation Assistance (FMA) program purposes, a repetitive loss structure is any insurable building for which two or more claims of more than \$1,000 were paid by the NFIP within any rolling 10-year period since 1978. At least two of the claims must be more than 10 days apart but within 10 years of each other. A repetitive loss structure is important to the NFIP, since structures that flood frequently put a strain on the flood insurance fund. It should also be important to a community because of the disruption and threat to residents' lives by the continual flooding.

According to FEMA records, as of April 2011, Cuyahoga County has 104 repetitive loss structures. It is important to note that this figure also represents mitigated properties that are no longer considered repetitive. Therefore, although the number of repetitive loss properties has increased in recent years, mitigation projects have been completed in the County since the original Plan was drafted. These projects include the elevation and acquisition/demolition of repetitive loss properties. To read about one such project, reference the Valley View Success Story in Appendix 9.

The table below provides information regarding the associated losses of the repetitive loss structures in the County. A map identifying their general locations can be found on the following page.

<b>Cuyahoga County Repetitive Loss Property Summary</b>				
<b>Community Name</b>	<b>Residential Properties</b>	<b>Commercial/Industrial Properties</b>	<b>Losses</b>	<b>Total Paid</b>
Bay Village	1	0	3	\$32,036.02
Bedford Heights	2	1	24	\$684,256.82
Bentleyville	1	0	3	\$11,217.19
Cleveland	4	5	21	\$524,858.52
Garfield Heights	1	1	5	\$50,405.19
Gates Mills	2	0	4	\$38,691.07
Independence	3	14	91	\$8,457,019.77
Lakewood	4	0	15	\$201,224.76
Mayfield Village	1	1	6	\$142,444.51
Middleburg Heights	1	1	5	\$35,806.98
North Olmsted	1	0	2	\$29,071.88
North Royalton	3	0	14	\$171,237.83
Parma	1	0	2	\$5,384.25
Pepper Pike	2	0	4	\$22,673.23
Richmond Heights	1	0	3	\$19,111.82
Rocky River	1	0	5	\$32,596.89
Seven Hills	1	0	2	\$24,673.63
Solon	1	0	2	\$195,325.31
South Euclid	1	0	2	\$46,693.60
Valley View	45	1	201	\$4,186,638.30
Walton Hills	1	0	2	\$26,940.55
Westlake	2	0	2	\$267,176.81
<b>Totals:</b>	<b>80</b>	<b>24</b>	<b>418</b>	<b>\$15,205,484.93</b>



Note: In certain areas, several repetitive loss structures are in close proximity to one another. Therefore, plots on the map may represent more than one structure.

### 4.3.9 Cuyahoga County Flood Mitigation Efforts

There are several countywide flood mitigation efforts underway in Cuyahoga County. Detail on these projects can be found in the Plan's Mitigation Action Table beginning on page 100. Also, as part of the 2011 update process, communities were asked to provide information on their past, current, and future mitigation efforts. As the majority of the mitigation activities were related to flooding, the responses were organized into a table which can be found in Appendix 10.

Additionally, several communities, including Parma, Independence, and Westlake, submitted letters of intent for FY2012 Hazard Mitigation Assistance (HMA) programs. All of the proposed projects are related to flood mitigation.

Lastly, the US Army Corps of Engineers is conducting a Section 205 Flood Study in Cuyahoga County which will evaluate and recommend a Flood Risk Management Project. This study will identify the magnitude and frequency of flooding on the Cuyahoga River within flood prone areas of Independence and Valley View. Moreover, the Study will develop alternative measures and plans for flood damage reduction while considering downstream impacts, environmental impacts, and economic costs. Ultimately, the goal of the study aims to reduce the impacts of future flood events.

### 4.3.10 Current Development Trends

The current development trends in Cuyahoga County are relatively static. Cuyahoga County is considered a built-out community and has very little "new" development occurring.

As part of the planning process, communities were asked if they had existing planning documents, including floodplain ordinances; which can serve to control the movement of development into hazardous areas. Communities were also asked to identify their designated floodplain administrators responsible for managing the floodplains within their jurisdictions. The responses to both inquiries are represented in the table located in Appendix 1.

### 4.3.11 Hazard Assessment and Vulnerability Analyses/ Potential Dollars Lost

For the 2011 update, a more precise methodology was used to identify and obtain information regarding the at-risk structures in the County (structures within 100-year floodplains). This improved approach revealed that there were fewer at-risk structures within the County than listed in the original Plan.

The at-risk structure data was generated via analyses of the 2010 FEMA Flood Zones for 100-year risk that contain structure points. The structure points represent all “addressable structures” from the 2006 Location Based Response System (LBRS) for Cuyahoga County. Furthermore, 2010 certified property appraisal data was referenced for median home and commercial/industrial values to account for *total loss* calculations.

According to the results, Cuyahoga County has a total of **1,606** at-risk structures. The potential dollar loss within the 100-year floodplains is **\$563,671,300**. A table of the results is shown on the following pages.

**Cuyahoga County At-Risk Structure Inventory**

Community/Land use	Parcel Count	Building Value
<b>BAY VILLAGE</b>	<b>24</b>	<b>3,037,000</b>
Residential	24	3,037,000
<b>BEACHWOOD</b>	<b>20</b>	<b>49,517,600</b>
Commercial	1	35,488,200
Residential	19	14,029,400
<b>BEDFORD</b>	<b>63</b>	<b>4,236,300</b>
Exempt	2	265,700
Residential	61	3,970,600
<b>BEDFORD HEIGHTS</b>	<b>4</b>	<b>2,375,800</b>
Commercial	1	560,500
Exempt	2	361,400
Industrial	1	1,453,900
<b>BENTLEYVILLE</b>	<b>2</b>	<b>412,400</b>
Residential	2	412,400



<b>Community/Land use</b>	<b>Parcel Count</b>	<b>Building Value</b>
<b>BEREA</b>	<b>3</b>	<b>189,300</b>
Exempt	2	-
Residential	1	189,300
<b>BRATENAHL</b>	<b>2</b>	<b>1,577,700</b>
Residential	2	1,577,700
<b>BRECKSVILLE</b>	<b>8</b>	<b>819,500</b>
Residential	8	819,500
<b>BROADVIEW HEIGHTS</b>	<b>13</b>	<b>1,855,300</b>
Exempt	2	-
Residential	11	1,855,300
<b>BROOK PARK</b>	<b>2</b>	<b>177,500</b>
Industrial	1	86,200
Residential	1	91,300
<b>BROOKLYN</b>	<b>5</b>	<b>13,392,800</b>
Commercial	4	7,479,800
Residential	1	5,913,000
<b>CHAGRIN FALLS</b>	<b>3</b>	<b>1,234,800</b>
Residential	3	1,234,800
<b>CLEVELAND</b>	<b>59</b>	<b>112,258,200</b>
Commercial	10	1,155,100
Exempt	9	95,727,800
Industrial	25	12,644,600
Residential	15	2,730,700
<b>CLEVELAND HEIGHTS</b>	<b>2</b>	<b>933,100</b>
Residential	2	933,100
<b>EUCLID</b>	<b>1</b>	<b>33,900</b>
Residential	1	33,900
<b>GARFIELD HEIGHTS</b>	<b>30</b>	<b>6,154,600</b>
Commercial	8	971,100
Industrial	17	4,908,000
Residential	5	275,500
<b>GATES MILLS</b>	<b>64</b>	<b>22,200,500</b>
Commercial	4	3,844,000
Exempt	5	2,294,300

Community/Land use	Parcel Count	Building Value
Residential	55	16,062,200
<b>HIGHLAND HEIGHTS</b>	<b>45</b>	<b>8,773,300</b>
Residential	45	8,773,300
<b>HUNTING VALLEY</b>	<b>1</b>	<b>133,200</b>
Commercial	1	133,200
<b>INDEPENDENCE</b>	<b>47</b>	<b>17,827,100</b>
Commercial	5	1,113,900
Exempt	5	2,389,200
Industrial	27	12,895,300
Residential	10	1,428,700
<b>LAKESWOOD</b>	<b>20</b>	<b>5,649,300</b>
Exempt	1	-
Residential	19	5,649,300
<b>LYNDHURST</b>	<b>11</b>	<b>1,013,500</b>
Residential	10	1,013,500
<b>MAPLE HEIGHTS</b>	<b>2</b>	<b>148,700</b>
Residential	2	148,700
<b>MAYFIELD</b>	<b>18</b>	<b>3,154,500</b>
Commercial	1	317,400
Residential	17	2,837,100
<b>MIDDLEBURG HEIGHTS</b>	<b>6</b>	<b>683,600</b>
Residential	6	683,600
<b>MORELAND HILLS</b>	<b>4</b>	<b>1,722,200</b>
Exempt	1	-
Residential	3	1,722,200
<b>NORTH OLMSTED</b>	<b>215</b>	<b>41,397,900</b>
Commercial	3	3,172,900
Exempt	2	17,550,800
Residential	210	20,674,200
<b>NORTH RANDALL</b>	<b>37</b>	<b>6,587,700</b>
Commercial	9	4,162,500
Residential	28	2,425,200
<b>NORTH ROYALTON</b>	<b>151</b>	<b>21,945,400</b>
Commercial	3	728,500



<b>Community/Land use</b>	<b>Parcel Count</b>	<b>Building Value</b>
Exempt	6	-
Industrial	1	335,200
Residential	140	20,881,700
<b>OLMSTED FALLS</b>	<b>51</b>	<b>5,807,600</b>
Commercial	7	1,067,900
Exempt	1	355,800
Residential	43	4,383,900
<b>OLMSTED TWP</b>	<b>25</b>	<b>7,775,400</b>
Commercial	1	5,199,400
Residential	24	2,576,000
<b>PARMA</b>	<b>22</b>	<b>2,587,500</b>
Commercial	3	890,000
Exempt	1	-
Residential	18	1,697,500
<b>PEPPER PIKE</b>	<b>5</b>	<b>2,041,600</b>
Exempt	1	45,000
Residential	4	1,996,600
<b>RICHMOND HEIGHTS</b>	<b>1</b>	<b>107,200</b>
Residential	1	107,200
<b>ROCKY RIVER</b>	<b>5</b>	<b>2,689,700</b>
Commercial	1	1,824,200
Residential	4	865,500
<b>SHAKER HEIGHTS</b>	<b>70</b>	<b>11,911,700</b>
Commercial	6	3,271,500
Residential	64	8,640,200
<b>OLON</b>	<b>60</b>	<b>55,822,900</b>
Commercial	3	14,084,800
Exempt	1	5,110,000
Industrial	10	26,401,900
Residential	45	10,226,200
<b>SOUTH EUCLID</b>	<b>11</b>	<b>802,700</b>
Residential	11	802,700
<b>STRONGSVILLE</b>	<b>60</b>	<b>19,269,500</b>
Commercial	2	511,700

Community/Land use	Parcel Count	Building Value
Exempt	4	10,877,400
Residential	54	7,880,400
<b>VALLEY VIEW</b>	<b>257</b>	<b>86,716,700</b>
Agr	2	240,800
Commercial	46	31,691,600
Exempt	4	3,277,800
Industrial	36	30,397,100
Residential	165	18,292,100
Utl	3	2,817,300
<b>WALTON HILLS</b>	<b>3</b>	<b>1,592,100</b>
Commercial	2	1,481,400
Residential	1	110,700
<b>WARRENSVILLE HEIGHTS</b>	<b>25</b>	<b>2,135,400</b>
Commercial	2	411,100
Residential	23	1,724,300
<b>WESTLAKE</b>	<b>154</b>	<b>34,968,600</b>
Commercial	1	-
Exempt	1	486,700
Industrial	4	8,231,700
Residential	147	26,250,200
<b>Grand Total</b>	<b>1,606</b>	<b>\$563,671,300</b>

## 4.3.12 Actions for Flooding

### Flash Flooding

- **Seek funding to install diversion devices on roadways prone to flash flooding in the County.**

This activity seeks to dissuade people from driving through flooded roadways. Originally, the installation of elevation markers in flood-prone areas was identified for this project. For the 2011 Plan update, the action was altered to incorporate other types of diversion/detour devices, including the NWS's "Turn Around Don't Drown" (TADD) signs as well as gates that could be lowered when flooding has rendered roadways impassable.

- **Develop partnerships with other communities within the watershed to enhance stormwater regulations countywide.**

This activity addresses the problems associated with the runoff that are generated by communities who are unable to handle their stormwater, which as a result, negatively affects neighboring communities located in Cuyahoga County.

- **Develop outreach for school aged children in the form of public service announcements (PSAs) or other innovative connection.**

By educating residents, primarily the youth of the community, the dangers facing youth who play in highly hazardous areas in relation to flash floods can be eliminated.

- **Seek funding to replace inadequate, undersized infrastructure in defined areas.**

This activity addresses the fact that the undersized infrastructure in some areas of Cuyahoga County is unable to handle the stormwater generated during a storm event, causing flooding problems and creating hazardous areas throughout the County.

- **Seek funding to acquire NOAA weather radios for critical facilities.**

There is insufficient warning time as for flash flooding in some areas of Cuyahoga County. NOAA weather radios provide valuable information regarding dangerous weather conditions. By providing NOAA weather radios to critical facilities such as schools, vulnerable populations would be given timely warnings and information regarding severe weather conditions.

- **Develop outreach to educate citizens on the importance of having a NOAA weather radio at home and work.**

NOAA weather radios are inexpensive and can provide valuable information about dangerous weather conditions. By developing outreach to promote the purchase and access to NOAA weather radios, citizens in the County will be able to better prepare for impending severe weather, such as flash flooding.

### **100-Year Floodplain Flooding**

- **Secure funding to update FEMA Flood Insurance Rate Maps (FIRM).**

The Flood Insurance Rate Maps for most of Cuyahoga County are outdated, some as much as 20-30 years old. By ensuring that the maps are up-to-date, the most accurate mitigation and prevention efforts can be planned.

- **Modify infrastructure to handle bigger storm events. Evaluate and rank infrastructure problems. Determine areas of vulnerability for both utilities and roadways and seek funding to permanently mitigate.**

This activity addresses the problem of undersized utilities and roadways that are directly affected by flood events, causing hazardous conditions for the residents of the County.

- **Coordinate and facilitate outreach to all participating NFIP communities within Cuyahoga County and evaluate higher standards that could be implemented in the County.**

There are 59 individual communities within the County and each one has its own interpretation of NFIP regulations. Communication among and between communities is lacking in terms of what other districts are doing and how there can be more continuity across the County. This activity will resolve these complications.

- **Develop and implement an outreach strategy targeting communities in the County that have repetitive loss properties.**

In an effort to reduce the number of and repetitive loss properties throughout the County, the program would aim to educate the applicable communities and citizens on mitigation techniques and funding opportunities available through FEMA's Hazard Mitigation Assistance (HMA) Programs. The outreach will stimulate more mitigation projects such as, acquisition/demolition, elevation, relocation etc., and thereby decrease the number of repetitive loss properties in the County.

- **Evaluate and implement USGS program that incorporates additional stream gauges and historical data to develop web based interactive flood-inundation maps.**

The Cuyahoga County Office of Emergency Management is evaluating a similar program created in Findley, Ohio to implement on the Cuyahoga River in the Valley View/ Independence area. The program would help project the severity of flooding as water reaches defined levels.

### **Non-Flood Zone Flooding**

- **Seek funding to map non-flood zone areas within the County.**

This activity addresses the concern that there are currently areas within the County that experience flooding, but are not included on NFIP maps.

- **PSA about non-flood zone flooding awareness.**

This activity addresses the general lack of awareness of residents as it relates to non-flood zone flooding in the County. There are currently no initiatives to educate residents of non-flood zone flooding occurrences.

- **Evaluate a program to install stream gauges in creeks and tributaries that cause flooding in areas not considered to be in the 100-year flood zone.** Some areas throughout the County that are adjacent to creeks and tributaries repetitively flood, but are not considered to be within 100-year flood zones. Installing stream gauges in these areas would help inform impacted communities and residents

## 4.4 Severe Winter Weather

Severe winter weather in Ohio consists of freezing temperatures paired with heavy precipitation. Cuyahoga County is susceptible to severe winter weather in the form of winter storms, blizzards and ice storms. Due to its position on Lake Erie, the County often experiences what is known as “lake effect snow.” Lake effect snow occurs when the cold air of a winter weather system passes over relatively warm lake water and absorbs moisture. Ultimately, the winter weather system releases extra moisture in the form of snow.

The leading cause of death during winter storms is transportation accidents. Preparing your vehicle for the winter season, and knowing how to react if stranded or lost on the road are vital to safe winter driving. Moreover, heavy ice and/or snow loads can cause fallen trees and limbs, roof collapses, damage to telephone poles, and power outages.

### 4.4.1 Severe Winter Weather Warnings and Watches

A winter storm **watch** indicates that severe winter weather may affect your area. A winter storm **warning** indicates that severe winter weather conditions are definitely on the way. A blizzard warning signifies that large amounts of falling or blowing snow, and sustained winds of at least 35 mph are expected for several hours.

The following paragraphs describe several winter weather events that have affected Cuyahoga County.

### 4.4.2 Significant Events

**December 13, 2000 - Winter Storm - \$2.5 Million.** Low pressure moved up the Ohio Valley and across central Ohio late on December 13<sup>th</sup>. Light precipitation began during the afternoon hours and increased in intensity during the evening. Freezing rain fell south of a line from Marion County northeast to Trumbull County. Significant ice accumulation was reported in this area by early on the 14<sup>th</sup>. Further north, most of the precipitation fell in the form of snow. The

heaviest snow fell along and just south of Lake Erie. Accumulations of 7 inches were reported from Lucas County east to Huron County. Around 6 inches of snow fell from the Cleveland Metro area northeast to Ashtabula County. Locations just south of the heavy snow band saw a mixture of freezing rain and snow. Scattered power outages resulted from the freezing rain accumulation. Numerous accidents were also reported.

**December 24, 2002 - Heavy Snow - \$3.1 Million.** An area of low pressure developed along the Gulf Coast early on December 24<sup>th</sup> and then moved rapidly northeast. This low moved across eastern Ohio and western Pennsylvania during the morning hours of the 25<sup>th</sup>. Snow developed well north of the low and spread into northern Ohio during the evening of the 24<sup>th</sup>. The snow intensified during the early morning hours and again in the afternoon. The snow finally tapered off from west to east during the evening of the 25<sup>th</sup>. Heavy snow fell in northern Ohio along and north of U.S. Highway 30. Generally, 6 to 10 inches of snow fell in this area with a maximum of 11.2 inches of snow recorded at Cleveland Hopkins International Airport. Snow totals at other locations include: 7.1 inches at Toledo Express Airport; 5.8 inches at Mansfield Lahm Airport; 5.2 inches at the Akron-Canton Regional Airport and 5.5 inches at the Youngstown-Warren Regional Airport. Northwest winds increased to 15 to 25 mph during the storm and caused considerable blowing and drifting with whiteout conditions at times. Travel was severely hampered by this storm and dozens of accidents occurred as a result of the treacherous driving conditions caused by the snow.

**January 26, 2003 - Heavy Snow - \$325,000.** Cold north to northwest winds blowing across Lake Erie caused lake effect snow showers to develop during the early morning hours. These snow showers intensified after daybreak and persisted through the evening hours. Snowfall totals ranged from 6 to 9 inches across Lorain, Cuyahoga, Lake, Geauga and northern Ashtabula Counties. Most of the accumulation occurred during the late morning and early afternoon hours.

**March 7, 2008 - Winter Storm - \$7.5 Million.** Snow began during the morning hours of the 7<sup>th</sup> and continued for the most of the next day and a half. During the afternoon of the 7<sup>th</sup>, visibilities were reduced down to around one mile or less with the snow. During the evening hours the snow let up with mainly flurries across the area for several hours. During the overnight hours into the 8<sup>th</sup>, the snow picked up again with visibilities dropping to one mile or less again. Moderate to heavy snow continued through the daytime hours of the 8<sup>th</sup> with visibilities dropping to a quarter mile or less at times. Also, a peak wind of 40 mph was measured at Cleveland Hopkins Airport. Snow tapered off quickly during the late evening hours of the 8<sup>th</sup>. Snow totals for the event included 21.5 inches in Broadview Heights, 14.8 inches officially at Cleveland Hopkins Airport, 17.0

inches in Garfield Heights, and 16.3 inches in Lakewood. Numerous accidents were reported along with stranded cars in roadways.

**January 9, 2009 - Winter Storm - \$700,000.** Snow began during the afternoon hours of the 9th and continued through the evening hours of the 10th. Some lake effect snow continued across the area into the overnight hours of the 10th. The snow was heaviest during the early morning hours of the 10th. There was a short period of transition where some sleet and freezing rain occurred in the area. Snowfall amounts generally ranged from 8.0 to 12.0 inches. At Cleveland Hopkins Airport 10.8 inches was measured. Elsewhere, trained observers measured 9.8 inches in both Broadview Heights and Solon, 8.0 inches in Garfield Heights, 9.0 inches in North Royalton, and 8.5 inches in Pepper Pike. Numerous accidents were reported across the area.

### 4.4.3 Blizzards

Blizzards occur when a combination of conditions last for 3 hours or longer. These conditions include: 35 mph or greater wind speeds, snowfall and/or blowing snow that reduces visibility to below  $\frac{1}{4}$  mile, and temperature of 20° F or lower. Although Cuyahoga County experiences snowfall every year, the occurrence of blizzards is rare. The last two times the County experienced blizzard conditions occurred in 1993 and 1995.

### 4.4.4 Ice Storms

Snow and strong wind conditions ahead of a warm front can create ice storms. As the snow changes to rain it freezes upon contact. Ice storms that last for more than 12 hours can produce ice accumulation several inches thick. This can cause significant damage to power lines and tree limbs and create dangerous driving conditions. Although ice storms do not frequently occur in Cuyahoga County, the area has experienced an ice storm event as recently as 2005.

### 4.4.5 Wind Chill

Wind Chill is a calculation of how cold it feels outside when the effects of temperature and wind speed are combined. A strong wind combined with a temperature just below freezing can have the same effect as a still air temperature 35°F colder. Cuyahoga County is susceptible to extremely cold temperatures. For additional detail on this, please see the Temperature Extremes hazard analysis beginning on page 67.

## 4.4.6 Cuyahoga County Severe Winter Weather Mitigation Efforts

Severe winter weather and severe thunderstorms can pose similar consequences to Cuyahoga County in terms of power outages, impassible roadways, and safety concerns. Therefore, many of the mitigation activities identified for Severe Storms also benefit severe winter weather. For example, developing first responder interoperability, mapping critical facilities, and promoting proper tree maintenance are all actions that are relevant to the County's preparedness with regard to severe winter weather. Nevertheless, for the 2011 update, one action exclusive to severe winter weather was identified. Please refer the *Severe Winter Weather Action* section on the following page.

## 4.4.7 Critical Facilities and Infrastructure

Due to the non-site specific nature of severe winter weather, the impact on particular critical facilities and infrastructure cannot be determined. However, freezing temperatures and excessive snow can result in power failures and unsafe, impassable roadways. Moreover, severe winter weather is known to produce secondary effects that can damage infrastructure, such as flooding and ice jams on streams and rivers.

## 4.4.8 Current Development Trends

Since severe winter weather is a non-site specific hazard, current development trends have no effect. Accordingly, any mitigation activities considered for severe winter weather should be conducted countywide.

## 4.4.9 Hazard Assessment and Vulnerability Analyses/ Potential Dollars Lost

As occurrences of severe winter weather are random in nature, historic events were referenced to determine Cuyahoga County's susceptibility. According to the National Climatic Data Center website, between 1993 - 2010, Cuyahoga County has been impacted by **81** severe winter weather events that have accounted for **\$254.16** million in damages to affected areas throughout the State.



## 4.4.10 Action for Severe Winter Weather

- ***Produce/distribute family and traveler emergency preparedness information relating to severe winter weather hazards***

This activity will focus on publicizing recommended safety measures to take during the winter season.

## 4.5 Tornadoes

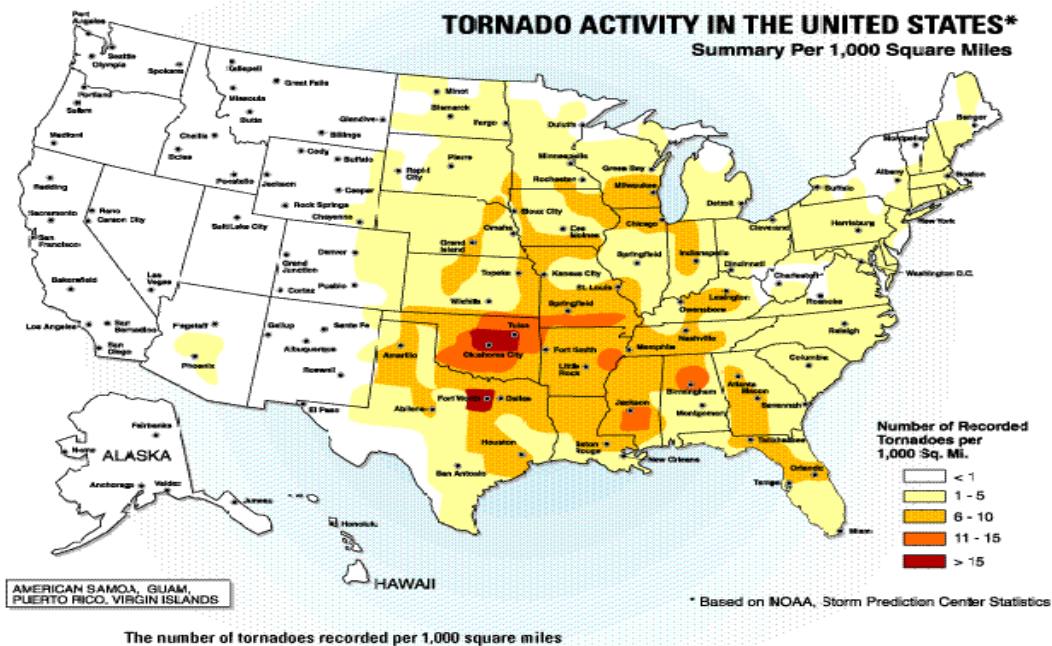
Tornadoes are considered the most violent atmospheric phenomenon on the face of the earth, having winds estimated at 300 mph in large tornadoes. Although the number of tornadoes in Ohio does not rank high compared to other states in the United States, the State does average around 15 tornadoes a year. Ohio's peak tornado season runs from April through July, with most tornadoes occurring between 2-10 p.m. Even though June has been the month with the most tornado occurrences, many of the State's major tornado outbreaks have taken place in April and May. However, history has shown that tornadoes can occur during any month of the year and at anytime of the day or night. Many of these tornadoes are weak (EF0 or EF1 on the Enhanced Fujita Scale), but Ohio has been struck by some of the most destructive (EF5) tornadoes ever, including the April 3, 1974 tornado which devastated Xenia, killing over 30 people and destroying 2,000 buildings.

Tornadoes are produced from the energy released during a thunderstorm, but account for only a tiny fraction of the overall energy generated by a thunderstorm. What makes them particularly dangerous is that the energy is concentrated in a small area, perhaps only a hundred yards across. Not all tornadoes are the same, of course, and science does not yet completely understand how a portion of a thunderstorm's energy becomes focused into something as small as a tornado.

Tornadoes occur whenever and wherever conditions are right, but they are most common in the central plains of North America, east of the Rocky Mountains and west of the Appalachian Mountains. They occur primarily during the spring and summer – the tornado season comes early in the south and later in the north according to the seasonal changes in relation to latitude – usually during the late afternoon and early evening. They have been known to occur in every state in the United States and every continent on the earth, any day of the year, and at any hour.

The damaging strong winds generated from tornadoes can reach 300 mph in the most violent tornadoes, causing automobiles to become airborne, rip

ordinary homes to shreds, and turn broken glass and other debris into lethal missiles. The biggest threat to living creatures (including humans) during tornadoes is flying debris and the risk of being tossed about in the wind. Contrary to previous belief, it is not true that the pressure in a tornado contributes to damage by making buildings "explode."



**Based on NOAA Storm Prediction Center Statistics**

Today, the development of Doppler radar has made it possible, under certain circumstances, to detect tornado winds with radar. However, spotters remain an important part of the system to detect tornadoes, because not all tornadoes occur in situations where the radar can "see" them. Ordinary citizen volunteers make up what is called the SKYWARN ([www.skywarn.org](http://www.skywarn.org)) network of storm spotters, who work with their local communities to watch out for approaching tornadoes to ensure that appropriate action is taken during tornado events. Spotter information is relayed to the National Weather Service, which operates the Doppler radars and issues warnings (usually relayed to the public by radio and TV) for communities ahead of the storms. They utilize all the information they can obtain from weather maps, modern weather radars, storm spotters, monitoring power line breaks, and so on.

Although the process by which tornadoes form is not completely understood, scientific research has revealed that tornadoes usually form under certain types of atmospheric conditions. Those conditions can be predicted, but it is not yet possible to predict in advance exactly when and where they will develop, how strong they will be, or precisely what path they will follow. There are some "surprises" every year, when tornadoes form in situations that do not look like the

right conditions in advance, but these are becoming less frequent. Once a tornado is formed and has been detected, warnings can be issued based on the path of the storm producing the tornado, but even these cannot be absolutely precise regarding who will, or will not, be struck.

The table below shows that although the State of Ohio may not have the most tornadoes, those that do hit Ohio are significant in damage and in all the indication factors of a large-scale tornado.

Rank	Total Number of Tornadoes	Deaths per 10,000 sq. miles	Number of Killer Tornadoes	Total Tornado Path Length per 10,000 sq. miles	Killer Tornadoes as a % of all Tornadoes	Annual Tornadoes per 10,000 sq. miles
1	Texas	Massachusetts	Texas	Mississippi	Tennessee	Florida
2	Oklahoma	Mississippi	Oklahoma	Alabama	Kentucky	Oklahoma
3	Florida	Indiana	Arkansas	Oklahoma	Arkansas	Indiana
4	Kansas	Alabama	Alabama	Iowa	<b>Ohio</b>	Iowa
5	Nebraska	<b>Ohio</b>	Mississippi	Illinois	Alabama	Kansas
6	Iowa	Michigan	Illinois	Louisiana	Mississippi	Delaware
7	Missouri	Arkansas	Missouri	Kansas	North Carolina	Louisiana
8	Illinois	Illinois	Indiana	Indiana	Michigan	Mississippi
9	S Dakota	Oklahoma	Louisiana	Nebraska	New York	Nebraska
10	Louisiana	Kentucky	Tennessee	Wisconsin	Massachusetts	Texas

The Enhanced Fujita scale (EF-scale) is the mechanism used to determine the potential type of tornado that may have affected a particular community. In February of 2007, the EF-scale replaced the original Fujita scale in all tornado damage surveys in the United States. Although the EF-scale improves the ranking process, it is still consistent with the original Fujita scale. The EF-scale documentation includes additional enhanced descriptions of damage to multiple types of structures and vegetation, a PC-based expert system, and enhanced training materials. The table to the right compares the estimated winds in the original Fujita scale with

FUJITA SCALE			OPERATIONAL EF-SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	<b>0</b>	<b>65-85</b>
1	73-112	79-117	<b>1</b>	<b>86-110</b>
2	113-157	118-161	<b>2</b>	<b>111-135</b>
3	158-207	162-209	<b>3</b>	<b>136-165</b>
4	208-260	210-261	<b>4</b>	<b>166-200</b>
5	261-318	262-317	<b>5</b>	<b>Over 200</b>

the operational EF-scale that is currently in use by the NWS.

## 4.5.1 Cuyahoga County Events

Cuyahoga County lies in the northeast corner of Ohio. Because of the geography and prevailing weather patterns in the spring and summer, storm systems produce tornadoes across the northern part of Ohio several times each year. Records since 1950 suggest that Cuyahoga County can expect a tornadic event every 6 years, on the average. There are records of tornadoes striking the Cleveland area dating back to the early 1800s, but not nearly as frequently as they have occurred in the past 50 years, which may be an indicator of better reporting and coverage in recent years.

## 4.5.2 Tornado Path Map

According to the National Climatic Data Center (NCDC) website, Cuyahoga County has experienced 14 tornadoes since 1951. The Cuyahoga County Locations and Path Map on page 64 shows that tornadoes, as a non-site specific hazard, are best mitigated through countywide planning and education. The community is served by having well informed officials who instruct their residents about tornado dangers. All of the 14 tornadoes moved in a west to east direction. Additional information on each tornado event can be found in the table on the following page.

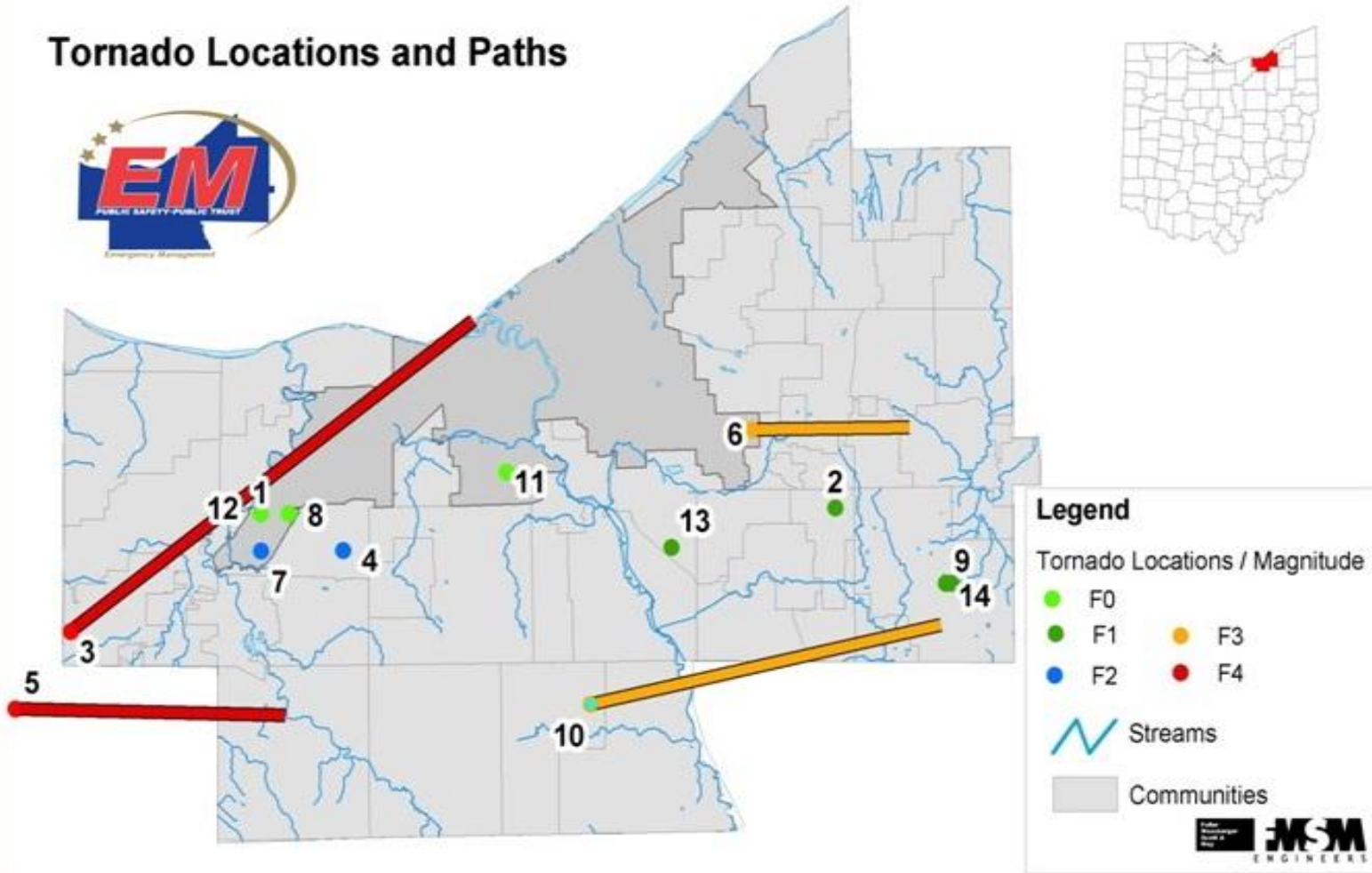
## Tornado Events Table

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 CUYAHOGA	06/22/1951	1530	Tornado	F2	0	0	2.5M	0
2 CUYAHOGA	05/24/1952	1505	Tornado	F1	0	0	25K	0
3 CUYAHOGA	06/08/1953	2000	Tornado	F4	6	300	0K	0
4 CUYAHOGA	08/20/1962	2030	Tornado	F2	4	20	2.5M	0
5 CUYAHOGA	04/11/1965	2220	Tornado	F4	1	100	25.0M	0
6 CUYAHOGA	09/29/1966	1545	Tornado	F3	0	20	2.5M	0
7 CUYAHOGA	07/15/1970	0215	Tornado	F2	0	1	250K	0
8 CUYAHOGA	05/08/1973	1600	Tornado	F0	0	0	3K	0
9 CUYAHOGA	04/02/1977	2057	Tornado	F1	0	0	2.5M	0
10 CUYAHOGA	05/02/1983	1455	Tornado	F3	1	25	25.0M	0
11 CUYAHOGA	03/31/1985	1625	Tornado	F0	0	0	250K	0
12 CUYAHOGA	07/12/1992	1842	Tornado	F0	0	0	250K	0
13 Valley View	07/28/1999	10:58 PM	Tornado	F1	0	0	175K	0
14 Solon	11/10/2002	07:08 PM	Tornado	F1	0	0	6.8M	0
TOTALS:					12	466	67.753M	0

**Key to table abbreviations:**

Mag = Magnitude (knots)  
Dth = Deaths  
Inj = Injuries  
PrD = Property Damage  
CrD = Crop Damage

### Tornado Locations and Paths





### 4.5.3 Tornado Mitigation Efforts

During the 2011 update, two communities, Cuyahoga Heights and Valley View, reported that they had installed warning/tornado sirens. Developing a countywide public notification/warning system remains a priority for Cuyahoga County.

### 4.5.4 Current Development Trends

Since tornadoes are a non-site specific hazard, current development trends have no effect. Cuyahoga County is a built-out community and as such, development trends are a non-issue except potentially when it comes to redevelopment of particular areas of the communities within Cuyahoga County.

### 4.5.5 Hazard Assessment and Vulnerability Analyses/ Potential Dollars Lost

As tornadoes are a random event, the best way to address the hazard event is to review historic information and attempt to be as prepared as possible. Tornadoes are usually accompanied by other hazards. In fact, when tornadoes hit a community they are typically coupled by other natural events such as high winds, thunderstorms, lightning and possibly flash floods.

Damage estimates in the 14 documented tornado events since 1950 have ranged from \$3,000,000 to \$25,000,000. Based on the information available and the number of events that have occurred in Cuyahoga County, the average amount of damage incurred by a tornado is approximately **\$6.9 million** per event.

### 4.5.6 Actions for Tornadoes

- ***Seek funding to develop a countywide public notification/warning system. Identify most appropriate type of system, whether in the form of siren, reverse 9-1-1, social media, or other mode.***

This activity stresses the importance of having a notification/warning system that can warn citizens throughout the County of dangerous weather conditions.

- Develop detailed PSAs on the public notification/warning system.**  
 This activity addresses the fact that the residents will have to be educated about the new system to facilitate their understanding of its functions. Public service announcements will serve to familiarize the residents with the system.
- Develop Social Media programs to provide weather information to citizens.**  
 This activity will promote severe weather safety by providing the public with easy access to valuable information pertaining to hazards and preparedness.
- Identify funding to purchase Preliminary Damage Assessment (PDA) Field Guides to disseminate among first responders.**  
 This activity will help expedite the damage assessment process following tornadoes and other severe weather events. Surveying and accurately documenting damage following severe weather enables the County to quickly determine if a request for State and/or Federal assistance is necessary.

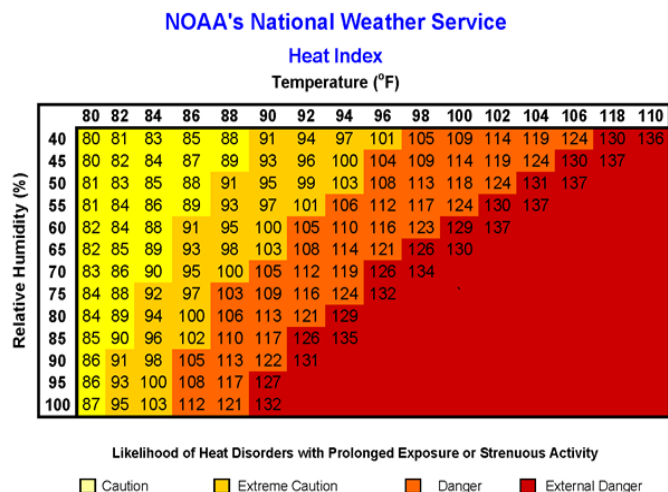
## 4.6 Temperature Extremes

Temperature Extremes can occur at any place and any time and incorporate either excessively cold or hot weather.

Typically, extreme heat is accompanied by high humidity and can result in crop failure, power outages, and deaths from hyperthermia. Conversely, extreme cold is brought on by excessively frigid conditions coupled with high winds and extreme wind chills. This combination can cause temperatures to feel colder than they actually are. Extremely cold temperatures can cause frost bite and a number of other health emergencies. Often times, extreme cold can precede or be accompanied by blizzards or ice storms. Both extreme heat and cold threaten public health, safety, and utilities in Cuyahoga County.

### 4.6.1 Extreme Heat

According to the Center for Disease Control and Prevention (CDC), conditions of extreme heat are defined as summertime temperatures that are substantially





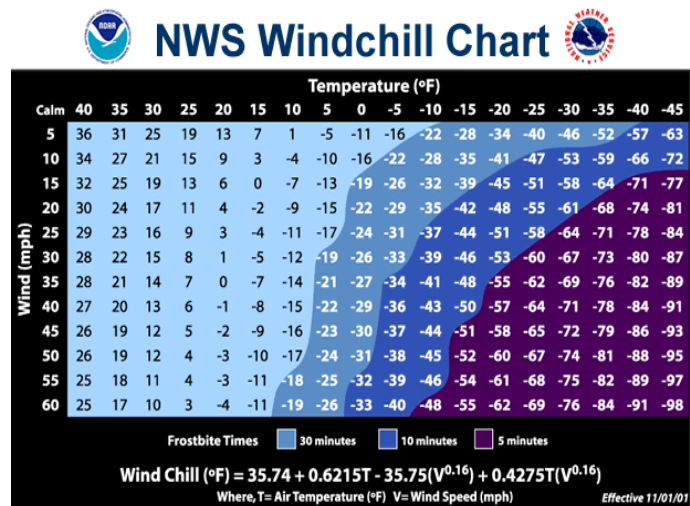
hotter and more humid than a location's average for a given time of year. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Extreme heat is the No. 1 non-severe-weather related killer in the U.S.

Exposure to extreme heat can pose a number of health risks to the population including: heat stroke, heat exhaustion, heat cramps, sunburn, and dehydration.

### 4.6.2 Extreme Cold

Cuyahoga County is susceptible to extremely cold temperatures between late fall and early spring. Wind chill readings can easily plummet to the single digits or subzero temperatures during this period. Since 1996, Cuyahoga County has experienced 24 days in which the wind chill temperature has fallen to 18° F or lower.

According to the National Oceanic and Atmospheric Administration (NOAA), skin exposed to wind chills of -18° F will begin to suffer frostbite within 30 minutes.



During rare cases, the County has experienced subzero temperatures. Such occurrences are particularly dire for anyone caught outside, especially those without a means for shelter. In January of 1997, temperatures in the County dropped to single and subzero digits. The extreme cold during this period resulted in five deaths from hypothermia.

### 4.6.3 Cuyahoga County Temperature Extremes Mitigation Efforts

Currently, there are no mitigation efforts underway in Cuyahoga County to exclusively address temperature extremes. However, several actions identified for severe storms are also applicable to temperature extremes; specifically, the continued mapping of critical facilities and the development of social media programs to disseminate weather preparedness information. Both actions will help the County prepare for and mitigate the impacts of temperature extremes.

## 4.6.4 Current Development Trends

Since Temperature Extremes are a non-site specific hazard, current development trends have no effect. Accordingly, any mitigation activities considered for temperature extremes should be conducted countywide.

## 4.6.5 Critical Facilities and Infrastructure

Due to the non-site specific nature of temperature extremes, it is impossible to identify particular critical facilities and infrastructure that would be impacted by the hazard. Extreme cold commonly causes water mains to freeze and break, while extreme heat stimulates increased electrical use which can result in power failures. In this way, both extreme heat and cold have the capacity to affect critical facilities and infrastructure throughout the County.

## 4.6.6 Hazard and Vulnerability Assessment/ Potential Dollars Lost

Although Cuyahoga County is exposed to a wide variety of temperature changes, its proximity to Lake Erie helps reduce the occurrence of extreme temperatures. Nevertheless, since 1993 Cuyahoga County has experienced 6 extreme heat events and 9 extreme cold events. Statewide, these events accounted for **33 deaths** and over **\$5.5 million** in property damages. Of the 33 fatalities, 28 occurred in Cuyahoga County.

## 4.6.7 Actions for Temperature Extremes

- **Identify populations vulnerable to temperature extremes and organize outreach regarding temperature extreme safety and accessible heating or cooling centers in the communities.**  
Concentrate outreach efforts on those populations most vulnerable to temperature extremes

## 4.7 Erosion and Landslides

Landslides are events which include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. The greatest threats to Cuyahoga County from landslides are along the Lake Erie coastline and the Cuyahoga River Valley. Gravity is the main cause for a landslide, although, other factors can contribute. For instance, in Cuyahoga County, streambank erosion by rivers and coastal erosion resultant from lake waves pose the greatest risk for landslide occurrences.

Coastal and streambank erosion are major issues in the County that contribute to other hazards like landslides and flooding. Therefore, as a result of their impact on the County as well as their influence on other hazards, coastal and streambank erosion were analyzed as priority hazards.

### 4.7.1 Streambank Erosion

Erosion, the detachment of particles of soil and surficial sediments and rocks, is a natural process. This process becomes a problem when human activities like construction cause it to occur much faster than under natural conditions.

Urbanization increases erosion rates by replacing vegetation with impervious surfaces like pavement and rooftops. Surfaces such as these do not allow any infiltration of rainwater, causing water to run across these surfaces in large sheets that often flow at high velocities. When this increased surface flow reaches a stream, the result is often increased erosion rates.

By removing vegetation, the important roles of providing protective cover and soil erosion prevention are thus eliminated. Plants function in intercepting rainwater before it hits the ground, breaking the impact of a raindrop before it hits the soil, thus reducing its ability to erode. Plants slow down the water as it flows over the land (runoff) and this allows much of the rain to soak into the ground. Plant roots also have an important function in holding the soil in position and preventing it from being washed away.

The impacts of streambank erosion can be severe. In addition to the loss of land due to bank erosion, dramatic changes in the course of a river or creek can result. These changes in the stream's course can result in a loss of aquatic



***Damage from streambank erosion in the City of Pepper Pike.***

habitats. Deposition of the eroded soil can lead to sedimentation in reservoirs and downstream areas. Water quality is reduced due to the high sediment loads, which also impacts aquatic habitats. Damage to public utilities (roads, bridges and dams) can also result due to increased stream flow and stream velocity as well as sedimentation and there are often high maintenance costs associated with trying to prevent or control erosion.

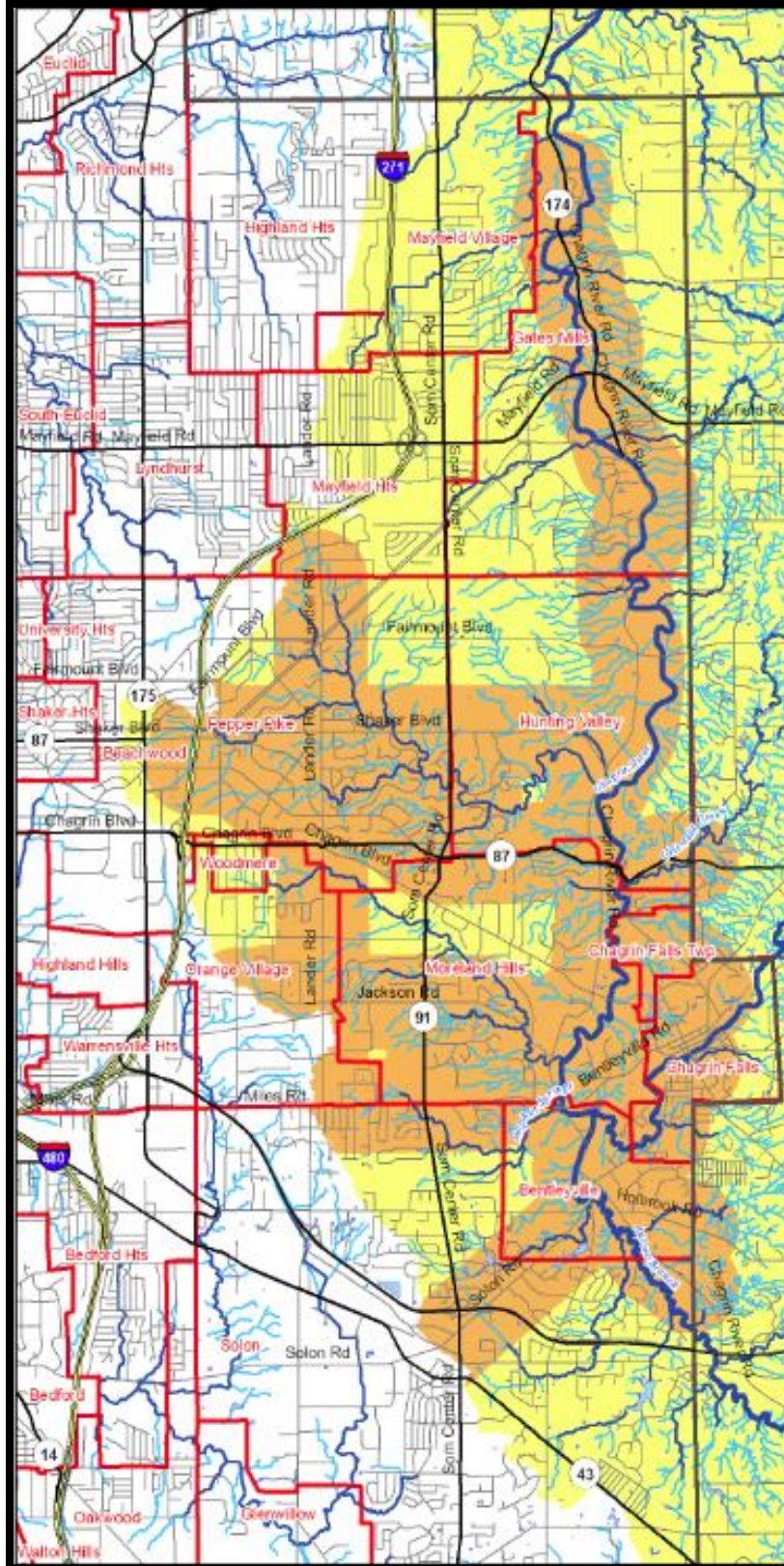
Conservation easements, restrictions placed on the deed of a piece of property to protect its natural resources in perpetuity, can preserve critical riparian buffer and floodplain areas to allow for water quality improvement, the protection of wildlife habitat and flood protection. Conservation easements constitute a legally binding agreement that prohibits certain land uses and types of development from taking place.

The table below provides a summary of streambank erosion locations and concerns identified by the Chagrin River Watershed Partners (CRWP).

Location	Summary
Solon	The City of Solon completed a stream restoration on Boulder Creek in response to streambank erosion. In 2011 and 2012 CRWP, in cooperation with Cleveland Metroparks and Emerald Necklace Chapter of Trout Unlimited, will complete monitoring and restoration of Sulphur Springs with funding from the Great Lakes Basin Fish Habitat Partnership. The restoration site is located in the Cleveland Metroparks South Chagrin Reservation and is a historic impoundment that has been breached resulting in an entrenched stream that has scoured the channel down to the shale bedrock.
Bentleyville	The confluence of the Aurora Branch of the Chagrin River with the Upper Main Branch of the Chagrin River is located in Bentleyville and flooding and erosion concerns exist primarily in the Madison Woods and Chagrin River Run subdivisions. Several sites along Chagrin River Road, Miles Road, Holbrook Road, and Solon Road also exhibit evidence of stream bank erosion.
Moreland Hills	Erosion issues have been investigated at several small tributaries along Bentleyville Road, Skyline Drive, and Old Plank Lane. A streambank stabilization project was completed on Wiley Creek as it crosses Chagrin River Road. Other sites investigated for streambank erosion and flooding were located along Miles Road, Greentree Road, Jackson Road, and Fairway Trail. Streambank erosion has also been noted along the Chagrin River through Jackson Field in the South Chagrin Reservation, due to lack of riparian buffers, unstable soils, and stormwater inputs.
Hunting Valley	Streambank erosion is a concern on properties along Chagrin River Road as it parallels the Chagrin River and along the lower reaches of Pepper/Luce Creek by Hackney Road. Griswold Creek, a tributary to the Chagrin that runs parallel to South Woodland Road (State Route

Location	Summary
	<p>87) has had significant erosion and loss of streambank from periodic flood events, steep slopes, and sandy floodplain soils. Stream bank erosion washed out over half of State Route 87 in 1989 and several property owners along Griswold Creek in Hunting Valley have completed streambank stabilization projects. Several areas including the Ohio Department of Transportation repair shown below have been subject to more than one effort to stabilize the streambank. A property owner near the mouth of Griswold Creek completed a stabilization project when the streambank eroded over 35 feet towards structures on the property. An upstream property owner along State Route 87 completed a gabion basket stabilization that has been destroyed and the property's water well is currently in jeopardy. The photo below shows ODOT repair near State Route 87 with the private bank stabilization downstream in the background.</p>
Pepper Pike	<p>Sites that have been investigated within Pepper Pike include locations along Cedar Road, the intersection of Chagrin Boulevard and Lewis Road, Bolingbrook Road, Lander Road, Shaker Boulevard, Pinetree Road, and Pepper Creek Drive. Pepper/Luce Creek is the major tributary to the Chagrin River in Pepper Pike, and has significant loss of riparian cover in its more developed reaches. Loss of riparian cover combined with the unstable soils in this area and increased flashy flow from development contributes to significant erosion and sedimentation issues. CRWP investigated a site along Lander Road in August 2011 with an undermined concrete wall that was severely damaged in a single heavy storm event, shown below:</p>
Orange Village	<p>A small tributary to Wiley Creek in the Orangewood subdivision has been investigated for streambank erosion related to increased stormwater runoff.</p>
Chagrin Falls	<p>CRWP investigated properties along Solon Road and Chagrin Falls Road for streambank erosion concerns. The Citadel Condominiums at Solon Road and Monticello Drive experience significant flooding and erosion during stormwater events. Bentleyville Road has also been impacted by damage related to streambank erosion and flooding and has been narrowed to one lane.</p>
Chagrin Falls Township	<p>Steep slopes and unstable soils contribute significantly to streambank erosion within this community. CRWP investigated erosion on tributaries to the Chagrin River on Falls Road and North Main Street as they cross through the township.</p>
Gates Mills	<p>Locations along Chagrin River Road as it runs parallel to the Chagrin River mainstem through Gates Mills are susceptible to erosion. Steep valley slopes and unstable poorly-draining soils lead to heavy runoff and potential damage to roadways, bridges, and culverts. On February 28, 2011, a storm event combined with runoff from snowmelt caused significant flooding resulting in the failure of the Gates Mills Dam. The area is being investigated by CRWP for potential streambank erosion.</p>





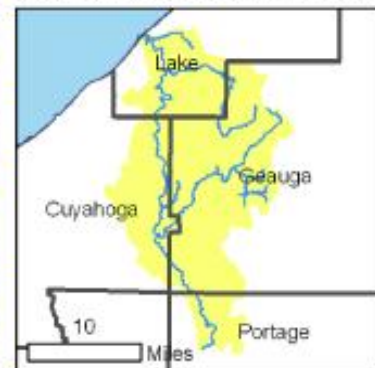
# Streambank Erosion Hazard Areas in the Chagrin River Watershed, Cuyahoga County

## Legend

-  County Boundaries
-  Community Boundaries
-  Rivers
-  Major Tributaries
-  Minor Tributaries
-  Streambank Erosion Hazard Areas
-  Chagrin River Watershed



Note: This map was compiled from CRWP site visit data on known locations. Additional unmarked locations may also exist within this area.



 Chagrin River Watershed Partners, Inc.  
 P.O. Box 229  
 Willoughby, OH 44096  
 (440) 975-3870  
[www.crwp.org](http://www.crwp.org)

## 4.7.2 Coastal Erosion

Due to its location along Lake Erie, Cuyahoga County is prone to coastal erosion. Many lakefront properties are situated on cliffs in highly erodible areas.

The Lake Erie coastal erosion problem is widespread and costly. The following statistics obtained from the Ohio Department of Natural Resources illustrate the magnitude of the coastal erosion problem:



**Damage caused by an eroding bluff in Cuyahoga County (1986).**

- Economic losses exceed tens of millions of dollars per year.
- Nearly 2,500 structures are within 50 feet of destruction.
- 95% of Ohio's Lake Erie shore is eroding.
- Erosion rates are as high as 110 feet in one year.
- Protection structures often increase erosion rates.
- Manmade shoreline structures trap sand supply; 43% of the shore is now beachless.

### Cuyahoga County Coastal Erosion Statistics

	CUYAHOGA COUNTY <sup>1</sup>	BAY VILLAGE	ROCKY RIVER	LAKWOOD	CLEVELAND W <sup>2</sup>	BRATENAHL	CLEVELAND E <sup>3</sup>	EUCLID
Shoreline length	22.4	5.4	2.0	3.9	1.5	2.7	2.9	4.0
<b>LONG-TERM (1877 TO 1973) RECESSION (all figures approximate)</b>								
Average recession distance (ft)	19	11	30	12	23	31	16	11
Average recession rate (ft/yr)	0.2	0.1	0.3	0.1	0.2	0.3	0.2	0.1
Maximum recession distance (ft)	137	50	71	46	137	64	66	47
Maximum recession rate (ft/yr)	1.4	0.5	0.7	0.5	1.4	0.7	0.7	0.5
Estimated acreage lost	45	7.4	7.3	5.6	4.1	10	5.6	5.3
<b>1973-1990 RECESSION</b>								
Average recession distance (ft)	3.6	3.4	2.6	3.6	3.0	2.5	3.7	6.4
Average recession rate (ft/yr)	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.4
Maximum recession distance (ft)	86	21	20	34	33	86	57	84
Maximum recession rate (ft/yr)	5.0	1.2	1.2	2.0	1.9	5.0	3.4	4.9
Estimated acreage lost	10	2.2	0.6	1.7	0.5	0.8	1.3	3.1
<b>1990-2004 RECESSION (CURRENT CEA MAPPING)</b>								
Average recession distance (ft)	3.2	5.4	2.0	3.9	1.5	2.7	2.9	4.0
Average recession rate (ft/yr)	0.1	0.1	0.1	0.2	0.1	0.02	0.1	0.1
Maximum recession distance (ft)	28	13	17	14	17	6.0	19	28
Maximum recession rate (ft/yr)	2.0	0.9	1.2	1.0	1.2	0.4	1.3	2.0
Estimated acreage lost	4.4	1.0	0.3	1.1	0.3	0.1	0.6	1.0
Length of shore affected by measurable recession, 1990-2004	8.4 mi	2.5 mi	0.5 mi	2.1 mi	0.4 mi	0.3 mi	1.1 mi	1.5 mi
Length of shore currently under a CEA designation	1.2 mi	0.1 mi	0.04 mi	0.1 mi	0.2 mi	0.0 mi	0.2 mi	0.3 mi
Average 30-year anticipated recession distance, ft (per the current CEA maps)	3.1	3.0	2.0	4.8	3.6	0.6	3.3	4.2
Maximum 30-year anticipated recession distance, ft (per the current CEA maps)	31	15	15	19	18	5.0	27	31
Anticipated 30-year acreage to be lost (estimated)	6.4	0.1	0.3	0.8	1.5	0.0	0.8	2.9

1. Not including the artificially filled shore from Edgewater Park to Dike 14

2. Cleveland shore between Lakewood and Edgewater Park

3. Cleveland shore between Bratenahl and Euclid

Source: Ohio Department of Natural Resources, Division of Geological Survey



### 4.7.3 Mitigation Efforts

Through the Northeast Ohio Regional Sewer District's (NEORS) emerging Stormwater Management Program, several erosion actions identified in the original Plan are being pursued. Additionally, the watershed groups and the Cuyahoga County Soil and Water Conservation District (SWCD) are pursuing activities that address streambank erosion. Please see the Mitigation Action Table beginning on page 100 to view these efforts.

In an effort to reduce erosion, it is a priority of SWCD to encourage communities to adopt flood zone ordinances, or riparian buffers. Working with NEORS and the watershed groups, SWCD educates communities on the utility of implementing riparian buffers to promote streambank stabilization.

The Ohio Department of Natural Resources (ODNR) implemented a program entitled the "Ohio Coastal Management Program" as a means of mitigating coastal erosion losses. Information regarding both the NEORS Stormwater Management Program and the ODNR Coastal Management Program can be found in the following sections.

#### ***Northeast Ohio Regional Sewer District Stormwater Management Program***

The Northeast Ohio Regional Sewer District has invested billions of dollars in clean water projects that protect greater Cleveland's public health and environment. Currently, the District is embarking on a comprehensive new program to better manage the impact of wet weather (also called stormwater) on regional rivers, streams, and Lake Erie.

Stormwater related problems must be addressed regionally. It is important to manage stormwater flows for several reasons:

- Excessive stormwater can overwhelm streams across the region.
- Stormwater creates land erosion that leads to flooding and the transport of pollutants to local streams, rivers, and Lake Erie.

By meeting with communities and other public and private stakeholders, NEORS gained input about major issues facing the region, services, and components necessary for developing a successful regional stormwater management program. In doing so, NEORS adopted a Stormwater Management Code in January 2010.

Additional details regarding the Stormwater Management Program can be found by visiting the NEORS website at:

<http://www.neors.org/stormwaterprogram.php>

### **Ohio Coastal Management Program**

Ohio's Lake Erie coast has experienced numerous pressures and conflicts regarding the use and enjoyment of the area. Ohio's coast is now more than 85% developed, and significant losses of wetlands and other habitat have occurred.

In recognition of the Lake Erie region's value and the pressures that threaten its resources, the Ohio General Assembly passed the Ohio Coastal Management Law in 1988. This law authorized ODNR to act as lead agency in developing and implementing a comprehensive Coastal Management Program (OCMP).

The purpose of the OCMP is to integrate management of Ohio's Lake Erie coastal region in order to preserve, protect, develop, restore and enhance its resources. OCMP policies attempt to establish a balance between resource protection and development, and to provide guidance to coastal property owners as well as government agencies and commercial interests.

Each year, Ohio receives close to \$2 million from the National Oceanic and Atmospheric Administration, which provides federal funding oversight. This money is used to help upgrade coastal neighborhoods, as well as improve lake access; relieve nonpoint pollution in tributary streams; preserve coastal wetlands; and protect historic shipwrecks and underwater preserves.

There are six areas of strategic emphasis for the OCMP. Activities that would accomplish goals related to these six areas are given highest priority for funding.

1. Water resources and watersheds
2. Coastal land use and development
3. Coastal habitat, wetlands, and natural areas
4. Coastal flooding and erosion
5. Recreational opportunities, and
6. Fish and wildlife resources

For further details on eligible parties and activities, visit the ODNR website at: <http://ohiodnr.com/Default.aspx?alias=ohiodnr.com/coastal>

### **Coastal Erosion Area Program**

The Coastal Erosion Area Program is another area under the Ohio Coastal Management Program. Coastal Erosion Areas consist of land areas along Lake Erie that are anticipated to be lost due to erosion within a thirty-year period if no additional approved erosion control measures are completed within that time. These are areas where recession is expected to exceed 9 feet in the next 30 years.

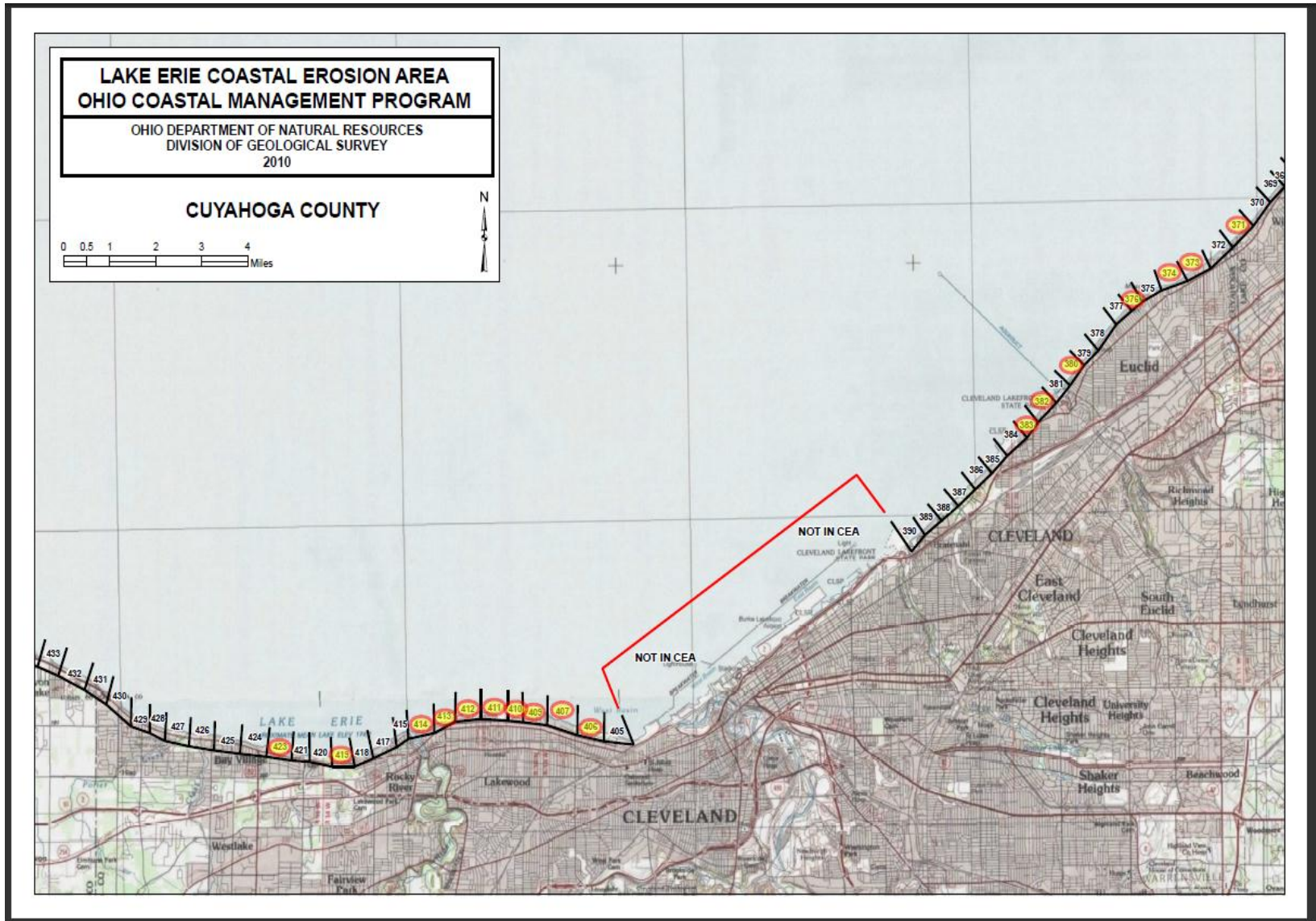
The ODNR, Division of Geological Survey determined which areas to include in the Coastal Erosion Area. They used scientific records and data to analyze recession of the Lake Erie shore and forecast erosion rates.

The purpose of the Coastal Erosion Area is to promote wise land use. Wise land use in turn, will among other things, reduce the risk and loss to private landowners by promoting stabilization of the shoreline.

ODNR will promote the Coastal Erosion Area through a permitting process. A permit must be obtained to construct a new building or septic system with a Coastal Erosion Area (CEA). The CEA permit requires that measures be taken to effectively protect the building or septic system from shore erosion and bluff instability. All new, permanent structures and additions equal to or greater than 500 square feet at ground level must obtain a permit. This applies to residential, commercial, industrial, institutional or agricultural buildings and septic systems.

In 2010, ODNR released updated coastal erosion area maps that show the amount of shore recession that occurred between 1990 and 2004. Based on recession between those years, calculations were made to project recession rates for the next 30 years. Areas projected to erode more than 11 feet are included in designated coastal erosion areas and are shown on the current coastal erosion maps. The updated maps were finalized in December 2010 and will remain in effect until the next revision.

The circled sections on the following index map show the Coastal Erosion Areas in Cuyahoga County designated by ODNR.



## 4.7.4 Current Development Trends

Cuyahoga County is a built-out community and as such, development trends are a non-issue except potentially when it comes to redevelopment of particular areas of the communities within Cuyahoga County.

## 4.7.5 Hazard Assessment and Vulnerability Assessment/ Potential Dollars Lost: Coastal Erosion

According to statistics released by the Ohio Department of Natural Resources, the average recession rate of coastal erosion is 0.1 feet per year in Cuyahoga County. There are six communities in Cuyahoga County located along the coast of Lake Erie: Bay Village, Rocky River, Lakewood, Cleveland, Bratenahl, and Euclid. Dollar loss estimates for coastal erosion were calculated for each community based upon the length of coastline subject to erosion in each community.

There were several assumptions underlying the analysis. The first was that there were no structures impacted by erosion along the coast. The second assumption was that 20% of the total property value is the land value. The analysis was based on an average lot size of  $\frac{1}{2}$  acre.

Median sale values for each community were obtained from a Cleveland Plain Dealer analysis of 2010 records from the Cuyahoga County Auditor's Office. 20% of the housing values were then used as the value of the land for a one-acre lot. In order to obtain the land value of a  $\frac{1}{2}$  acre lot, the land value for the one-acre lot was multiplied by two (2). Once this value was obtained, it was multiplied by the acres of coastline subject to erosion in each of the six communities located along Lake Erie and the average recession rate (0.1 ft/yr), to yield an overall estimate of total dollars lost for each community. The results can be found in the table on the following page.

Community	Length of coastline (feet)	Acres of coastline erosion	Land value of ½ acre lot	Total estimated dollars lost
Bay Village	28,000	0.064	\$75,000	\$4,800
Rocky River	10,280	0.023	\$82,000	\$1,886
Lakewood	19,800	0.045	\$46,040	\$2,083
Cleveland	52,000	0.119	\$9,400	\$1,118
Bratenahl	14,300	0.032	\$100,000	\$3,200
Euclid	16,700	0.038	\$23,640	\$898
<b>Total</b>	<b>141,080</b>	<b>0.321</b>	<b>\$336,340</b>	<b>\$13,985</b>

Formulas used: Length of coastline divided by 43,560 (#of square feet in an acre) multiplied by 0.1 (average rate of recession) = Acres of coastline lost to erosion  
Median sales value multiplied by 0.2 multiplied by 2 = ½ acre land value  
Acres of coastline multiplied by ½ acre land value = total estimated dollars lost

The total estimated dollars lost per year for land along the Lake Erie coast in Cuyahoga County is \$13,985.00.

## 4.7.6 Hazard Assessment and Vulnerability Assessment/ Potential Dollars Lost: Streambank Erosion

The information used to perform the streambank erosion analysis in the original plan was taken from the NEORSD “Regional Intercommunity Drainage Evaluation Study” (RIDE). The RIDE study provided the locations of observed and potential streambank erosion problems.

Since the original Plan’s creation, NEORSD has generated more current and accurate data on streambank erosion through their Stormwater Management Program. This information is superior to the historic RIDE data in that the locations of streambank erosion have all been confirmed with the associated communities. As part of their Stormwater Management Program, NEORSD has identified **71 areas of streambank erosion** among 35 jurisdictions in the County; totaling an **estimated \$90M of associated constructions costs**.

The following page contains an extract from a larger NEORSD table that lists the identified streambank erosion sites throughout Cuyahoga County. To view the complete table, refer to Appendix 11.



EXAMPLE Streambank Erosion Areas*			
Community	Problem Description	Potential Solution**	Estimated 2010 Construction Cost
Bedford	Streambank erosion and flooding along Wood Creek, from the northern border of Bedford to Conrail. City would like the culverts/bridges along Wood Creek to be replaced or repaired.	Construct 4530 LF of 9' high eathern flood berm; includes 8 acres clearing/grubbing, 7725 CY unsuitable material removal and 1 detention facility control structure	\$3,966,536.77
Bedford Hts., North Randall, Warrensville Hts.	Streambank erosion from I-271 to a point approximately 100' downstream of the Conrail Railroad.	Construct additional pipe culverts at Conrail, Green Road, and Miles Road crossings of Tinkers Creek Tributary 3.	\$2,378,961.49
Bedford Hts., North Randall, Warrensville Hts.	Streambank erosion from Miles Rd. to Libby Rd. There are flooding and erosion problems along all of Bear Creek in these communities.	Construct an additional culvert, using trenchless technology, at the I-480 crossing of Bear Creek Main Branch.	\$4,070,038.09

\*List based off of NEORS D Stormwater Management Program Preliminary Construction Planning. Not comprehensive: NEORS D does not serve Chagrin Falls, Chagrin Falls TWP, Bentleyville, Woodmere, Fairview Park, Rocky River, Bay Village, North Olmsted and Westlake.

\*\* Most of the potential solutions were developed during the Regional Intercommunity Drainage Evaluation conducted by NEORS D in 2001-2004 for the purpose of estimating the costs for a regional stormwater management program. Solutions have not been confirmed with the property owners.

## 4.7.7 Erosion and Landslides Actions

- **Develop a plan that will be used to guide the evaluation of several peripheral issues like the maintenance of waterways and drainage concerns.**

By developing a plan that addresses the peripheral issues associated with erosion, problems and erosion occurrences can be lessened throughout the County.

- **Work with established watershed groups to evaluate the causes of erosion and seek funding to create an action plan to reduce it.**

The plan will then be used as a guide by residents and other groups for minimizing the occurrence of erosion by undertaking preventative measures.

- **Seek funding to permanently mitigate infrastructure that is being affected by streambank erosion.**

This activity addresses the infrastructure issues that arise in conjunction with erosion, primarily roadways falling in and the cleanup of debris. This activity will increase safety for all residents.



- **Disseminate model ordinances addressing streambank erosion to establish continuity among communities.**  
This activity addresses the inconsistent interpretations and ordinances related to streambank erosion among the 59 jurisdictions.

## 4.8 Droughts and Wildland Fires

A drought is a period of abnormally dry weather that persists long enough to produce a serious hydrologic imbalance (i.e., crop damage, water supply shortage, etc.). The severity of the drought depends upon the degree of moisture deficiency, and the duration and the size of the affected area.

According to the National Climatic Data Center (NCDC) website, there have been 6 drought events that have affected Cuyahoga County since 1995. The most costly in terms of damages was the following:

### **September 1999**

Drought conditions continued across most of northern Ohio during September. Widespread heavy rain occurred on September 29<sup>th</sup> but did little to help crop conditions. For the month, only 1.63 inches of rain fell in Mansfield, making it the 9<sup>th</sup> driest September on record. Of the 1.63 inches, 1.14 inches fell on the 29<sup>th</sup>. Even with an inch of rain on the 29<sup>th</sup>, both Toledo and Cleveland finished with below two inches of rain for the month. Losses from reduced crop yields are estimated at \$200 million for northern Ohio alone.

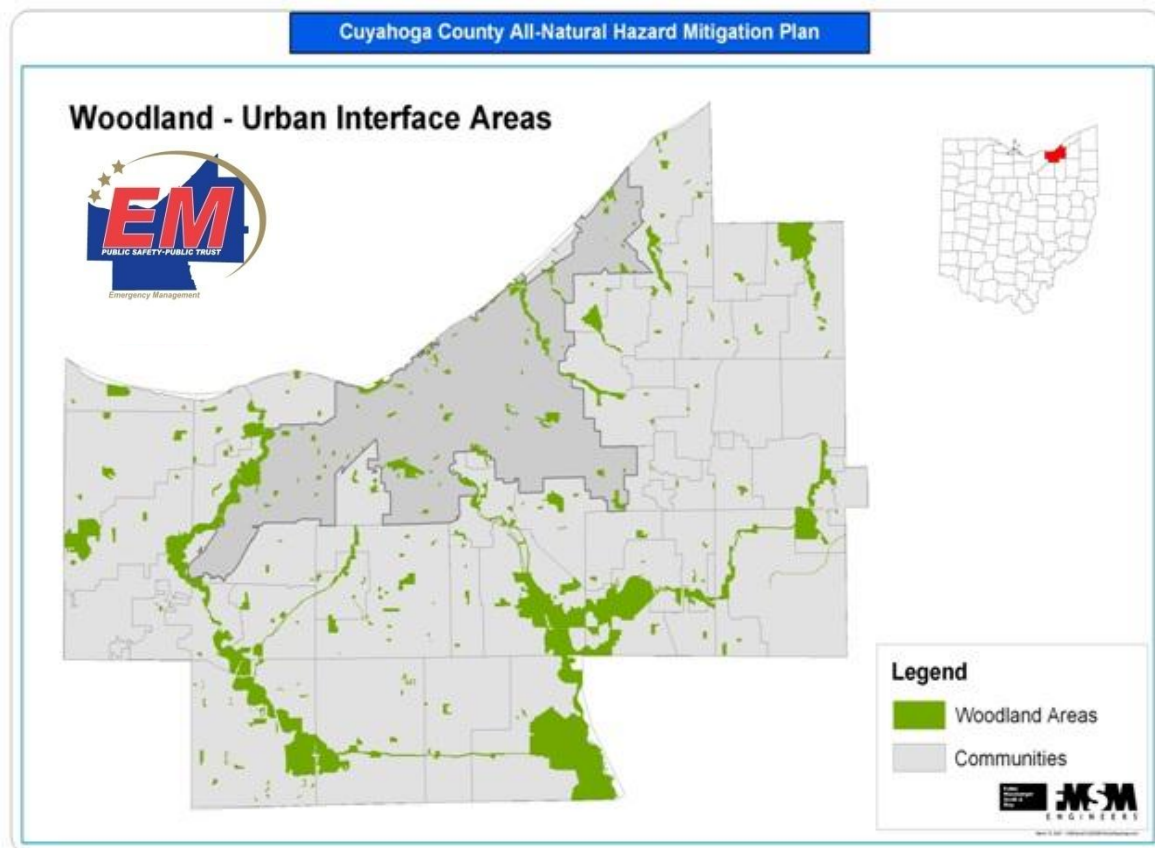
### 4.8.1 Droughts Precursor to Other Disasters

Due to the drying effects of a drought, the potential for wildland fires is often increased during and after a drought event. During an average year in Ohio, an estimated 15,000 wildfires and natural fuel fires occur. Typically, a reported 1,000 wildland fires burn an average of between 4,000 to 6,000 acres in Ohio each year.

The threat of wildland fires is especially great in areas referred to as the Wildland Urban Interface (WUI). The WUI can be defined as the zone where structures and other human developments meet or intermingle with undeveloped lands. The map on the following page illustrates these interface areas within Cuyahoga County.

## 4.8.2 Cuyahoga County Drought and Wildland Fire Mitigation Efforts

Currently, there are no mitigation efforts underway in Cuyahoga County exclusive to droughts. However, one mitigation action identified for droughts in the original Plan sought to create a map of sensitive populations (elderly and children). The mapping of critical facilities is an ongoing activity in Cuyahoga County that accounts for sensitive populations by mapping locations like nursing homes and schools.



## 4.8.3 Current Development Trends

Since droughts are a non-site specific hazard, current development trends have no effect. Cuyahoga County is a built-out community and as such, development trends are a non-issue. As the County is largely urbanized, the threat of wildfires is generally low due to the low occurrence of Wildland Urban Interface areas.

## 4.8.4 Hazard and Vulnerability Assessment

Cuyahoga County has experienced six drought events during the time period from 1995 - 2011. Unlike most hazards, the threat of a drought tends to be dismissed because of the relatively long time a drought takes to have damaging effects. The National Climatic Data Center (NCDC) website had no recent record of wildland fires occurring in the County.

## 4.8.5 Potential Dollars Lost

Due to the non-site specific nature of drought, the best way to deal with preparing for future events is to consider historical occurrences. According to the National Climatic Data Center (NCDC) website, between 1950 – 2011 6 drought events have occurred within Cuyahoga County. Due to the fact that only one of the drought events includes a damage estimate, an average for the six events has not been calculated. Cuyahoga County is an urban county with a small percentage of land use falling in the agricultural category. Therefore, damage estimates for the County would not be as significant as other counties with a greater proportion of agricultural land use. Also, because the NCDC has no record of wildland fires occurring in Cuyahoga County, potential dollars lost estimates for wildfires were not determined either.

## 4.8.6 Actions for Droughts and Wildland Fires

- ***Development of a PSA on how droughts can lead to fires, how flash floods can exacerbate the problem, the effects of drought on a community and how to react when one occurs.***

This activity addresses the lack of educational awareness on the subject of droughts.

- ***Create a map of where sensitive populations (elderly and children) are located. Determine areas that may have a higher concentration of such populations like senior centers and low-income housing.***

This activity addresses the concern for the well-being of sensitive populations as they are often more affected by drought and heat distress.

- ***Seek funding for fire departments to procure equipment to fight wildland fires.***

This activity addresses the lack of necessary equipment within the County to respond to wildland fires.

## 4.9 Earthquake History in Cuyahoga County

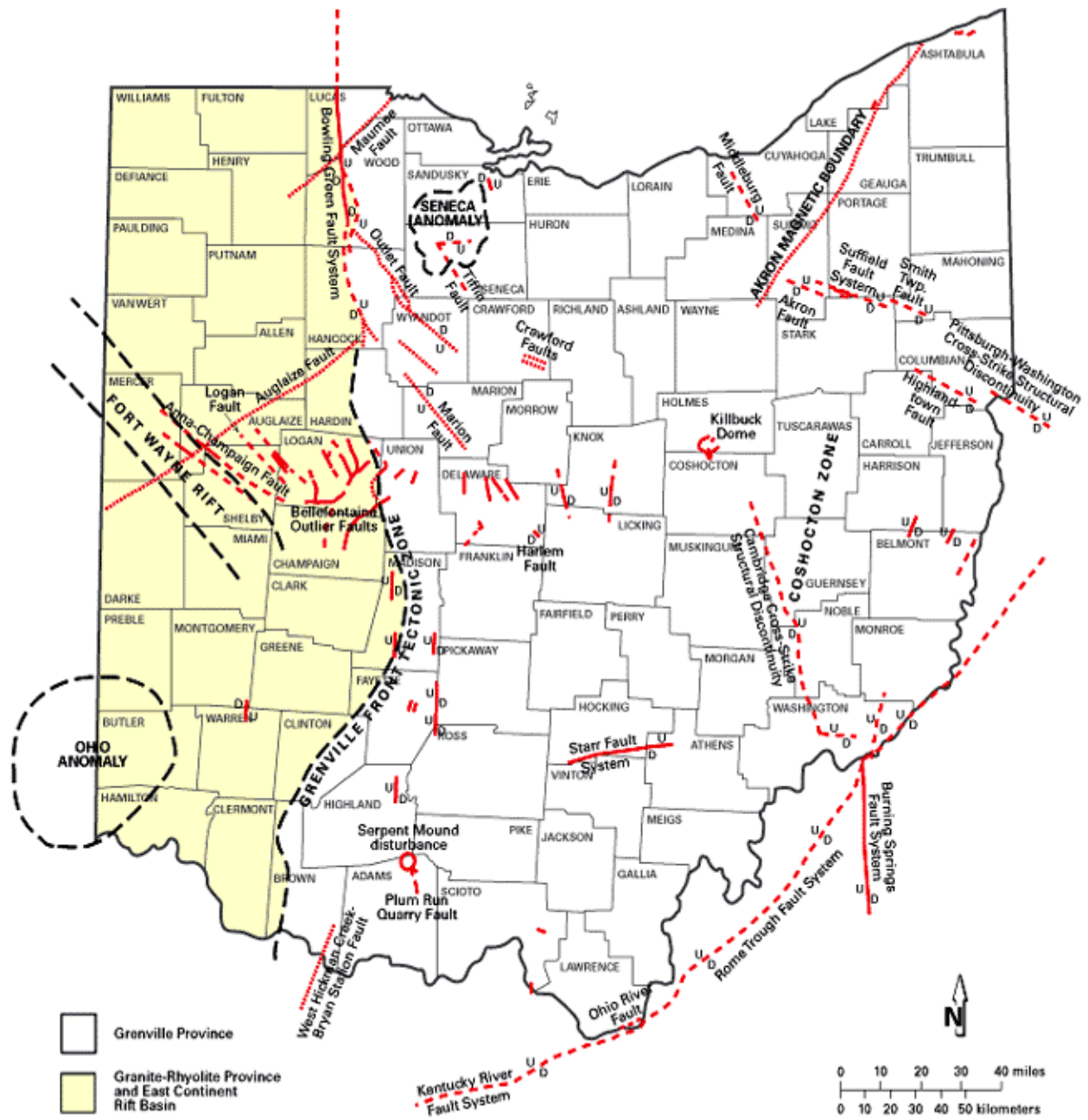
Ohio has experienced more than 160 earthquakes since 1776, and that 15 of these events have caused minor to moderate damage. The largest historic earthquake in Ohio was centered in Shelby County in 1937. This event, estimated to have had a magnitude of 5.5 on the Richter scale, caused considerable damage in Anna and several other western Ohio communities, where at least 40 earthquakes have been felt since 1875.

Northeastern Ohio, east of Cleveland, is the second most active area of the State. At least 20 earthquakes are recorded in the area since 1836, including a 5.0 magnitude event in 1986 that caused moderate damage. A broad area of southern Ohio has experienced more than 30 earthquakes. The figure on the following page illustrates locations of the fault systems and tectonic zones within the State of Ohio.

### 4.9.1 Cuyahoga County Risk Zone

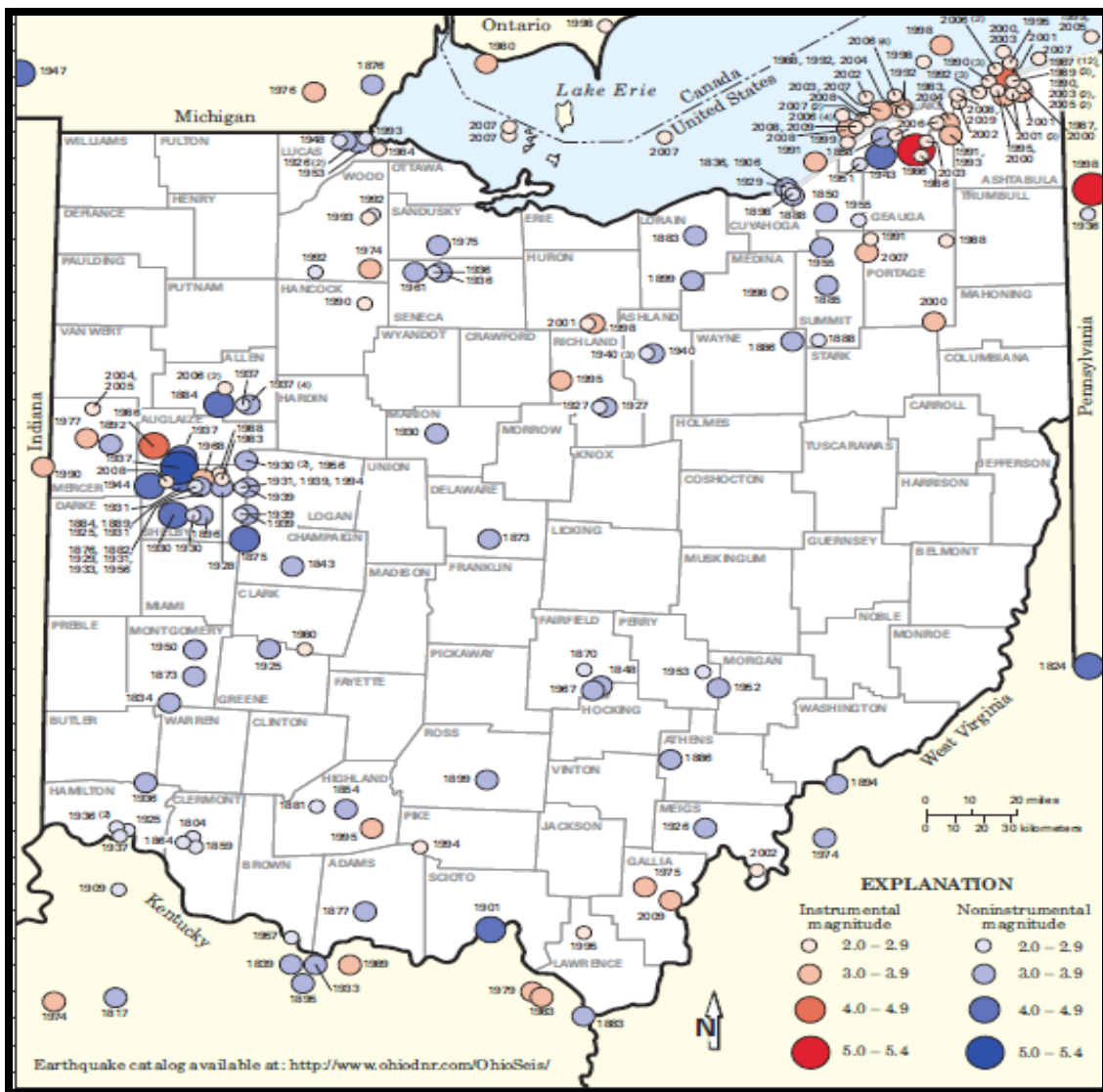
According to Candice Sherry, Ohio Earthquake Program Manager, Cuyahoga County and the northeast quadrant of the State of Ohio are in one of the most active areas as it relates to earthquakes. However, based on geology, Cuyahoga County is at a low risk as it relates to potential damage caused by an earthquake.

Please reference the maps on the following pages to view Ohio fault lines and earthquake locations.



Source: <http://www.dnr.state.oh.us/OhioSeis/html/fltmap.htm>

The map below depicts Ohio earthquake locations and magnitudes:



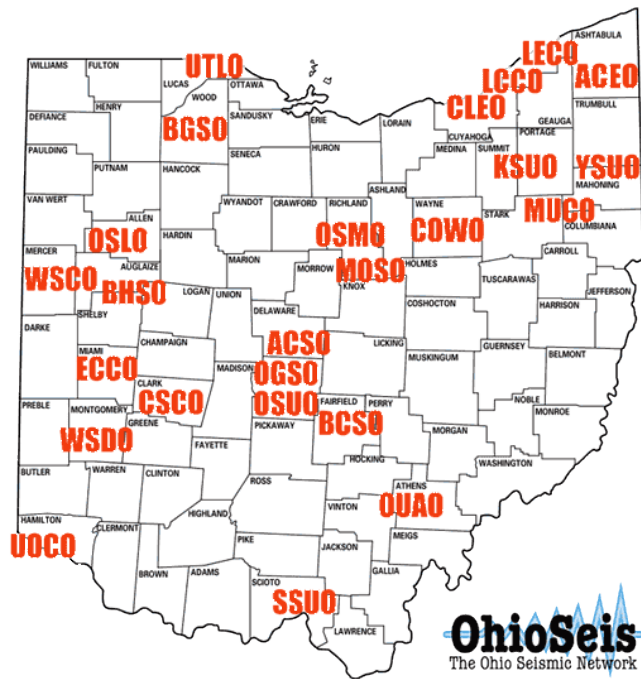
Source: Educational Leaflet No. 9 Revised Edition 2007. ODNR - Division of Geological Survey

## 4.9.2 Monitoring of Earthquakes

The Ohio Department of Natural Resources (ODNR) Division of Geological Survey has established a 25 station cooperative network of seismograph stations throughout the State in order to continuously record earthquake activity. The network, which went on line in January 1999, ended a five-year gap during which there was only one operating station in Ohio. The state was dependent on seismographs in Kentucky and Michigan to record Ohio earthquakes.



The 25 stations of the new seismograph network, which is called OhioSeis, are distributed across the state, but are concentrated in the most seismically active areas or in areas that provide optimal conditions for detecting and locating very small earthquakes that are below the threshold of human notice. These small micro earthquakes are important because they occur more frequently and help to identify the location of faults that may periodically produce larger, potentially damaging earthquakes.



The OhioSeis seismograph stations are located at colleges, universities and other institutions, employing technology that not only makes them very accurate, but also relatively inexpensive and easy to operate and maintain. In contrast to the old technology, in which a pen made a squiggly line on a paper drum, the new system is entirely digital and uses a Macintosh desktop computer to continuously record and display data. Two other innovations have made the system unique. An inexpensive Global Positioning System (GPS) receiver is used to keep very precise time on the continuously recorded seismogram, and each station's computer is connected to the Internet for rapid data transfer.

Each OhioSeis station is a cooperative effort. Seismometers, the instruments that detect Earth motions, and other seismic components were purchased by the Division of Geological Survey with funds provided by the Federal Emergency Management Agency (FEMA) through the Ohio Emergency Management Agency, as part of the National Earthquake Hazards Reduction Program. The computers and Internet connection were purchased and provided by the cooperating institutions.

The Division of Geological Survey is coordinating the seismic network and has established the Ohio Earthquake Information Center at the Horace R. Collins Laboratory at Alum Creek State Park, north of Columbus. This facility functions as a repository and laboratory for rock core and well cuttings, but has a specially constructed room for earthquake recording. The seismograph system allows for very rapid location of the epicenter and calculation of the magnitude



of any earthquake in the State. The earthquake records, or seismograms, from at least three seismograph stations are needed to determine earthquake locations (epicenters). These records can be downloaded from the Internet at any station on the network, and location and magnitude can be determined. Small earthquakes were in many cases not even detected by distant, out-of-date seismograph stations.

The OhioSeis network provides a whole new dimension of understanding about the pulse of the Earth beneath Ohio. Although the new seismograph network will not predict earthquakes or provide an alert prior to an event, it will provide insight into earthquake risk in the State so that intelligent decisions about building and facility design and construction, insurance coverage and other planning decisions can be made by individuals, business and industry, and governmental agencies. Two monitoring stations are located in Cuyahoga County: one at the Cleveland Museum of Natural History and the other at Lakeland Community College.

**Station CLEO**

**Location:**

Cleveland Museum of Natural History  
1 Wade Oval Drive, University Circle  
Cleveland, OH 44106-1767

Lat: 41.512° North  
Long: 81.614° West  
Elev: 192 m

**Contact Persons:**

Robert J. Bartolotta  
rbartolo@cmnh.org

Joe DeRocher  
jderocher@cmnh.org

**Station WSDO**

**Location:**

Lakeland Community College  
7700 Clocktower Dr.  
Kirtland, OH 44094-5198

Lat: 41.637° North  
Long: 81.365° West  
Elev: 231 m

**Contact Person:**

David Pierce  
dpierce@lakeland.cc.oh.us

### 4.9.3 Earthquake Occurrence in Cuyahoga County

According to the Geological Survey, the following is a list of earthquakes with a magnitude of 2.0 or greater that have occurred in Cuyahoga County since 1900.

Year	Magnitude
1906	2.9
1929	2.9
1951	2.9
1955	3.3
1955	2.7
1991	3.5
2011	2.0

Source: OhioSeis – The Ohio Seismic Network located at [www.dnr.state.oh.us/OhioSeis/html](http://www.dnr.state.oh.us/OhioSeis/html)

### 4.9.4 Cuyahoga County Earthquake Mitigation Efforts

There are currently no earthquake mitigation efforts underway in Cuyahoga County, nor have there been any in the recent past.

### 4.9.5 Current Development Trends

Since earthquakes are a non-site specific hazard, current development trends have no effect. Cuyahoga County is a built-out community and as such, development trends are a non-issue except potentially when it comes to redevelopment of particular areas of the communities within Cuyahoga County.

### 4.9.6 Hazard Assessment and Vulnerability Analyses

Since Cuyahoga County has only experienced 2 earthquakes with a 2.0 or greater magnitude in the last 20 years, the Mitigation Core Group felt that the best approach to analyzing vulnerability to an earthquake would be by looking at other communities and how they deal with earthquakes and preparedness.

### 4.9.7 Potential Dollars Lost

Due to the non-site specific nature of this hazard, the best way to prepare for future events is to consider historical occurrences. Cuyahoga County has only

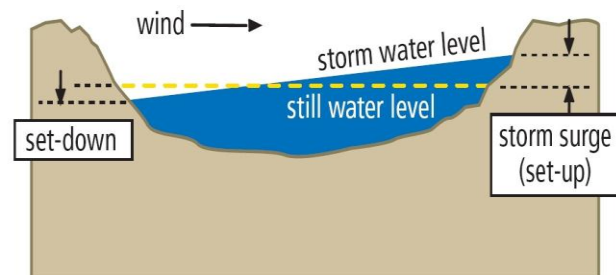
recorded two earthquakes of 2.0 or greater magnitudes in the last 20 years neither of which caused significant damage. Because of the history of earthquake occurrences in Cuyahoga County (see table on page 89) and the natural geology, which puts the County at low risk as it relates to potential damage by an earthquake, no dollar calculations have been considered at this time.

## 4.9.8 Actions for Earthquakes

- **Develop PSAs targeting children and senior citizens that will educate them on the seriousness of earthquakes and the effects of such events.**  
This emphasizes the need for more public awareness of earthquakes. Residents of Cuyahoga County need to know that earthquakes are a potential hazard for their community.
- **Evaluate regulations for wind resistance and earthquake resistance. Work with the Building Department to develop standards to mitigate potential damage during and after an earthquake.**  
This activity addresses the current lack of building standards that address earthquake resistance.
- **Most buildings and infrastructure in Cuyahoga County are not constructed to withstand earthquakes with a magnitude of 6.0 or greater. Identify buildings and infrastructure that may be particularly vulnerable to earthquakes.**  
This activity would identify areas of concern or “weak links” in buildings and infrastructure that may experience significant damage from an earthquake.

## 4.10 Coastal Flooding

Coastal flooding occurs when water is driven onto land from an adjacent body of water. This generally happens when there are significant storms but can also result from seiches and storm surges.



Lake Profile Showing Wind Set-Up

### 4.10.1 Seiche

A Seiche is a standing wave in an enclosed or partially enclosed body of water which can result in coastal flooding. The most common cause of seiches in Lake Erie is a strong, constant wind, blowing over the surface of the water forcing it to

accumulate at the down-wind shore. When the wind diminishes, the water level will begin to return to its original equilibrium through a series of broad oscillations across the entire body. Often referred to as the bathtub effect, seiches cause the water levels to rise and fall along the shorelines repeatedly until equilibrium is restored. Other causes of seiches include earthquakes, changes in barometric pressure, or any variety of atmospheric changes. The magnitude of seiche events is dependent on a number of factors. Wind speed and barometric pressure are the most obvious contributors to the size of an event. This can have significant impact on artificial bodies of water such as reservoirs.

## **4.10.2 Storm Surge**

Storm surges are temporary rises in water level caused by storm winds blowing across miles of open water and dragging water towards the down-wind shore. The National Climatic Data Center (NCDC) website identifies 28 storm surge events that have occurred on Lake Erie; none of the events are recorded as having impacted Cuyahoga County. It should be noted that the NCDC data regarding storm surges covers only a brief period in the late 1990s.

## **4.10.3 Cuyahoga County Coastal Flooding Mitigation Efforts**

Currently, there are no coastal flooding mitigation efforts underway in Cuyahoga County.

## **4.10.4 Current Development Trends**

Cuyahoga County is a built-out community and as such, development trends are a non-issue. There are six communities in the County located along the coast of Lake Erie: Bay Village, Rocky River, Lakewood, Cleveland, Bratenahl, and Euclid. Overall, development in the County has remained relatively static in recent years.

## **4.10.5 Hazard and Vulnerability Assessment**

Historically, seiches and storm surges have had minimal impact on Cuyahoga County. Seiching is less likely to occur along the Cuyahoga County line than in the shallow western basin of Lake Erie. The NCDC website lists only one seiche event that occurred in Lake Erie in 1998. This event did not impact Cuyahoga County. The Cleveland Plain Dealer reported a 1942 storm surge that killed 7 people from Bay Village to Ashtabula when a wall of water slammed onto the

shore. Typically, boat docks and low-lying areas along the lakeshore will incur the most damage from coastal flooding in the County.

### **4.10.6 Potential Dollars Lost**

The State of Ohio's Hazard Mitigation Plan uses FEMA's hazard analysis and loss estimation software, HAZUS-MH MR3, to generate coastal flooding loss estimations for each county bordering Lake Erie based on a 100 year return event. Cuyahoga County was included in the State's analysis of Region 2 counties. Results of the analysis are shown on the following page.

Estimate of Potential Losses to Seiche / Coastal Flooding Region 2										
County	Building Exposure Value	1-10% Damage Count	11-20 % Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	Substantial Damage Count	Essential Facilities Count	Estimated Business Interup	Estimated Property Loss
Ashtabula	\$240,029,000	3	12	8	1	0	1	0	\$80,000	\$5,280,000
Cuyahoga	\$1,033,868,000	2	19	16	0	2	0	0	\$110,000	\$10,410,000
Lake	\$671,888,000	55	159	206	89	12	12	0	\$240,000	\$43,840,000
Lorain	\$450,219,000	25	82	56	2	6	0	0	\$150,000	\$28,710,000
<b>TOTAL</b>	<b>\$2,396,004,000</b>	<b>85</b>	<b>272</b>	<b>286</b>	<b>92</b>	<b>20</b>	<b>13</b>	<b>0</b>	<b>\$580,000</b>	<b>\$88,240,000</b>

#### 4.10.7 Action for Coastal Flooding

Although seiches and storm surges occur on Lake Erie, they typically have minimal impact on Cuyahoga County. Therefore, specific mitigation actions have not been identified for coastal flooding. However, as a result of the 2011 Plan update, the Mitigation Core Group expressed interest in analyzing coastal flooding in relation to areas of significant coastal erosion in the County.

## 4.11 Other Hazards – Dams

A dam failure is defined as a gradual or immediate collapse or failure of water impounding systems or structures, resulting in downstream damages. For planning purposes dam failures are categorized as *sunny day failures* or *rainy day failures*. Sunny day failures occur during non-flooding conditions with the dam reservoir near normal levels. Rainy day failures typically involve periods of prolonged rainfall and flooding. As sunny day dam failures are usually unexpected, they tend to be more catastrophic.

According to the Ohio Administrative Code, dams are classified into four classes, Class I, II, III, and IV. The following parameters are the criteria for the classification:

- 1) Height of dam – defined as the vertical dimension as measured from the natural streambed at the downstream toe of a dam to the low point along the top of the dam.
- 2) Storage volume – defined as the total volume impounded when the pool level is at the top of the dam immediately before it is overtopped.
- 3) Potential downstream hazard – defined as the resultant downstream damage should the dam fail, including probable future development.

Classes are defined as the following:

### Class I

- *Height of dam:* Greater than 60 feet
- *Storage volume:* Greater than 5000 acre-feet
- *Potential downstream hazard:* Probable loss of life, serious hazard to health, structural damage to high value property (i.e., homes, industries, major public utilities)

### Class II

- *Height of dam:* Greater than 40 feet
- *Storage volume:* Greater than 500 acre-feet
- *Potential downstream hazard:* Possible health hazard including loss of a public water supply or wastewater treatment facility; flood water damage to homes, businesses, industrial structures (no loss of life envisioned), damage to state and interstate highways, railroads, roads that provide the only access to residential or critical areas such as hospitals and nursing homes



Class III

- *Height of dam:* Greater than 25 feet
- *Storage volume:* Greater than 50 acre-feet
- *Potential downstream hazard:* Damage to low value non-residential structures, local roads, agricultural crops and livestock

Class IV

- *Height of dam:* Less than or equal to 25 feet
- *Storage volume:* Less than or equal to 50 acre-feet
- *Potential downstream hazard:* Losses restricted mainly to the dam

The table below lists the 9 Class I dams located in Cuyahoga County. Only two of the Class I dams in the County currently maintain emergency action plans (EAP) with associated inundation mapping. The other Class I dams maintain non-technical Emergency Preparedness Plans (EPP).

Name	EAP / EPP	Stream	Nearest Community	Distance from Dam (miles)	Owners
Forest Hill Park Dam #2	EPP	East Branch of Dugway Brook	East Cleveland	0.4	City of East Cleveland
Lakeview Cemetery Flood Control Dam	<b>EAP</b>	Dugway Brook	East Cleveland	0.02	Northeast Ohio Regional Sewer District
Kerruish Stormwater Control Facility Dam	EPP	Mill Creek	Maple Heights	0.35	City of Cleveland
Briar Hill Lake Dam	EPP	Tributary to Aurora branch of Chagrin River	Solon	0.02	Briar Lake Association
Lower Shaker Lake Dam	EPP	Doan Brook	Cleveland Heights	0.1	City of Cleveland
Upper Shaker Lake Dam	EPP	Doan Brook	Cleveland Heights	0.1	City of Cleveland
Fairmount Reservoir	EPP	Offstream	Cleveland	0.02	City of Cleveland
Ivex Corp. Lower Lake Dam	<b>EAP</b>	Chagrin River	Chagrin Falls	0.02	Ivex Corporation
Hollenbeck Lake Dam	EPP	Tributary to Big Creek	Parma Heights	0.8	Private citizens

During the 2011 Plan update, the Ohio Department of Natural Resources (ODNR), Division of Soil and Water Resources reported that there were plans to remove the Fairmount Reservoir. Also, in 2008, Chagrin River Watershed Partners assisted the Village of Chagrin Falls in applying for a US EPA 319 grant to modify the IVEX Lower Dam. The dam pool has been dewatered slowly through the drilling of weepholes and the next stages will reduce the total height of the earthen dam to less than 10 feet and lower the height of the concrete weir structure by approximately 10 feet. Lowering the dam to less than 10 feet will allow the dam to be declassified under ODNR dam safety regulations and will result in increases in water quality and public safety in the Chagrin River watershed.

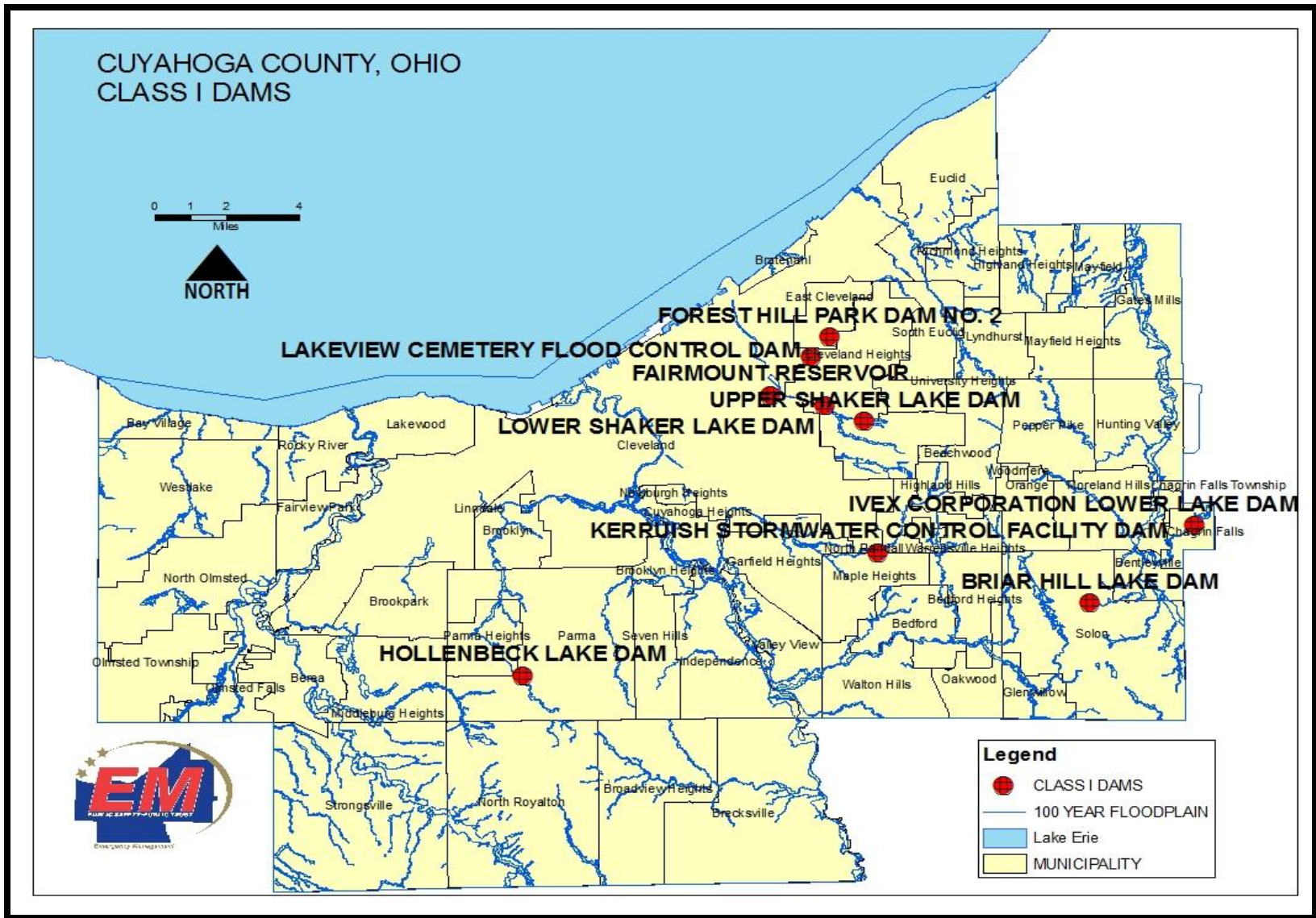
The map on the following page shows the location of all Class I dams in the County.

### **4.11.1 Hazard Assessment and Vulnerability Assessment**

Due to the lack of emergency action plans with inundation maps of the affected areas and structure inventories, a comprehensive assessment of vulnerability and potential loss estimate is not possible at this time. ODNR, Division of Soil and Water Resources maintains a list of “high priority” Class I dams. The list identifies dams with a high hazard potential should a failure occur. One class I dam in Cuyahoga County is included on this list. The Lakeview Cemetery dam was identified on the high priority list due to the population at risk (PAR) should the dam fail.

### **4.11.2 Action Item**

Regulated dams (Class I, II, and III) are required to prepare and maintain Emergency Action Plans (EAP). The action item for this hazard is to encourage dam owners to develop EAPs for any facility owned by one of the communities represented in the Mitigation Plan. The City of Cleveland owns four of the Class I dams and the City of East Cleveland owns one. The long-range plans for both of these communities should include developing emergency action plans for the dams that they own.



## 5.0 Mitigation Strategy

### 5.1 Action Prioritization Methodology

According to the planning requirements of DMA 2000, Hazard Mitigation Plans shall contain mitigation actions that are cost-effective, environmentally sound, and technologically feasible. The actions enable an area to pursue its mitigation goals (reference Appendix 7 for Cuyahoga County's mitigation goals). Additionally, it is required that the actions be prioritized. New actions identified during the 2011 Plan update were prioritized with the existing/ongoing actions included in the original Plan. The prioritization process sought to maximize benefits by emphasizing a cost-benefit review of all the actions.

For the 2011 Plan update, action priority was established using the prioritization technique employed in the State of Ohio's Hazard Mitigation Plan:

<b>Priority</b>	<b>Description</b>
<b>A</b>	Projects or activities that permanently eliminate damages or deaths and injuries across the County from any hazard
<b>B</b>	Projects or activities that reduce the probability of damages, deaths, and injuries across the County from any hazard
<b>C</b>	Projects or activities that educate the public on the subjects of hazard mitigation, hazard research, and disaster preparedness
<b>D</b>	Projects or activities that warn the public to approaching natural hazard threats

Once the actions were organized based on the priority descriptions listed above, the Hazard Mitigation Core Group analyzed the resulting order. Referencing FEMA's Benefit Cost Review guide (386-5), each of the action's benefits and costs were reviewed by the Group to determine if the sequence of actions required further adjustment. This additional evaluation was of particular value in areas where two or more actions were categorized with the same priority letter under a given hazard. When this occurred, the Group collaboratively weighed the benefits and costs of actions similar in nature to further narrow down their prioritization.

The Mitigation Action Table beginning on page 100 displays the prioritized actions. The Table also provides additional information concerning each

action's responsible parties, resources, timeframe, and status. **It is important to note that the priority of actions was established purely for planning purposes. Actions may be developed out of sequence based on funding availability or changes in County conditions and priorities.**

As most of the natural hazards that impact Cuyahoga County are non-site specific, the mitigation actions identified within the Action Table are intended to be countywide efforts. As such, every participating community supports the actions by reviewing and providing input to them as well as assisting in their implementation, where applicable. FEMA requires that multi-jurisdictional plans include action items specific to each community requesting credit for the Plan. Accordingly, a matrix was developed to distinguish identifiable action items specific to each community represented in the Plan. This Matrix can be found in Appendix 12.

## 5.2 Mitigation Action Plan Table

### Severe Storm Actions

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
1: Seek funding to make communities' first responders interoperable.	Severe Storms	B	2008	Ongoing	UASI and Homeland Security Grants	Communications subcommittee of the Cleveland-Cuyahoga Urban Area Working Group (UAWG)	<b>ONGOING:</b> The County continues to evaluate and develop interoperability utilizing the State of Ohio's Multi-agency Radio Communications System (MARCS).
2: Map critical facilities within the County.	Severe Storms	B	Ongoing		Existing Budgets of identified lead agencies	The Northeast Ohio Regional Fusion Center/ Cuyahoga County Planning Commission/ Cuyahoga County Office of Emergency Management	<b>ONGOING:</b> The mapping of critical facilities is an ongoing effort in Cuyahoga County.
3: Develop Social Media programs to provide severe weather preparedness information to citizens.	Severe Storms	C	2012	2013	Existing Budget	Cuyahoga County Office of Emergency Management	<b>NEW:</b> The Cuyahoga County Office of Emergency Management is currently evaluating/developing the use of social media (i.e. facebook, twitter) to disseminate general information to the public regarding severe weather and preparedness.
4: Develop strategic outreach to promote a program for regional NWS Sky Warn classes to educate identified community/voluntary organizations (e.g. Neighborhood Watch, CERT, etc.).	Severe Storms	C	2012	2014	Existing Budget	Cuyahoga County Office of Emergency Management/ NWS	<b>NEW:</b> Working with the NWS, the Cuyahoga County Office of Emergency Management will develop an outreach program to promote regional Sky Warn classes to educate identified community/voluntary organizations.



Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
5: Develop outreach educating citizens on the responsibility of tree maintenance and removal with regard to power outages caused by severe weather.	Severe Storms	C	2012	2014	Existing Budget	Cuyahoga County Office of Emergency Management	<b>NEW:</b> Most property owners are unaware that they may be held responsible for trees/limbs that fall on their property and damage power lines. Property owners can incur the cost of the clean-up as well as the expense of repairs to the power lines. By providing information on the matter to property owners, proper tree maintenance will be encouraged which will reduce power outages caused by severe weather.
6: Seek funding to develop a countywide public notification/warning system. Identify most appropriate type of system, whether in the form of siren, reverse 9-1-1, social media, or other mode.	Severe Storms	D	TBD	TBD	Exploring HMA Funds as possible funding source	Cuyahoga County Office of Emergency Management/ individual municipalities	<b>DEFERRED:</b> In the original Plan, this action sought to identify funding to implement a countywide, interoperable siren and warning system. However, the project has proven cost prohibitive. For the 2011 update, the Mitigation Core Group determined that it would be prudent to investigate alternative modes for countywide public notifications and warning, other than just traditional siren/warning systems.
7: Develop PSA's about countywide public notification/warning system.	Severe Storms	D	TBD	TBD	Exploring HMA Funds as possible funding source	Cuyahoga County Office of Emergency Management/ individual municipalities	<b>DEFERRED:</b> This action is contingent on the implementation of a countywide public notification/warning system.
Develop a plan to coordinate clean-up and mitigation efforts following severe weather events.	Severe Storms	B	2006	2011	Existing Budget	Public Works subcommittee of the Cleveland-Cuyahoga Urban Area Working Group/ Cuyahoga County Office of Emergency Management	<b>COMPLETED:</b> The local Public Works discipline and the Cuyahoga County Office of Emergency Management developed a Public Works Disaster Procedure Manual to coordinate the Public Works response to large-scale incidents. Also, an updated Cuyahoga County NIMS-typed resource database has been developed.



*Flooding*  
*Flash Flooding Actions*

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
<b>8:</b> Seek funding to install diversion devices on roadways prone to flash flooding throughout the County. The devices would be intended to either dissuade or inhibit drivers from attempting to navigate flooded roadways.	Flash Flooding	B	2012	2017	Exploring HMA Funds	Cuyahoga County Office of Emergency Management/ NWS/ individual communities	<b>NEW:</b> The original plan contained an action that sought to install elevation markers in flood-prone areas to dissuade people from driving through flooded roadways. For the 2011 Plan update, the action was altered, to incorporate other types of detour devices, including the NWS's "Turn Around Don't Drown" signs (TADD) as well as gates that could be lowered when roadways are flooded and impassable.
<b>9:</b> The undersized infrastructure is unable to handle the stormwater in some areas of the County. Seek funding to replace inadequate undersized infrastructure.	Flash Flooding	B	Ongoing		NEORSD Stormwater Management Program/ individual community budgets/ misc. grants	NEORSD, individual municipalities	<b>ONGOING:</b> Through the Stormwater Management Program, NEORSD identifies infrastructure concerns and seeks to work with communities to remedy them. Also, based on community survey responses, many jurisdictions reported activities that they have undertaken to mitigate problematic areas related to stormwater.
<b>10:</b> Develop partnerships to enhance stormwater regulations countywide.	Flash Flooding	B	Ongoing		NEORSD Stormwater Management Program/ Existing Budgets	NEORSD, Cuyahoga County Soil and Water Conservation District	<b>ONGOING:</b> The NEORSD Stormwater Management Program develops regional partnerships to address problems of this nature that cross community borders. Ongoing efforts of the Cuyahoga County Soil and Water Conservation District also contribute to this action.

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Lead Agencies
11: Develop outreach for school aged children in the form of PSA's or other innovative connection to educate them on the dangers of flash floods.	Flash Flooding	C	Ongoing		Existing Budget	Cuyahoga County Office of Emergency Management/ individual municipalities	<b>ONGOING:</b> Cuyahoga County Office of Emergency Management staff regularly attends school events and community home days throughout the County to disseminate safety and preparedness literature. Additional materials specific to flash flood safety will be sought for future events.
12: Develop outreach to educate citizens on the importance of having a NOAA weather radio at home and work.	Flash Flooding	C	2012	2014	Existing Budget	Cuyahoga County Office of Emergency Management	<b>NEW:</b> Cuyahoga County Office of Emergency Management will develop outreach to promote the utility of purchasing and maintaining access to a NOAA weather radio.
Seek funding to acquire NOAA radios for critical facilities (schools).	Flash Flooding	D	2008	2009	Homeland Security Funding	Cuyahoga County Office of Emergency Management/ individual municipalities	<b>COMPLETED:</b> As part of the federally sponsored effort " <i>America is safer when our schools are safer</i> ", the Cuyahoga County Office of Emergency Management received NOAA weather radios which were distributed to schools throughout the County

100 Year Floodplain Flooding

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
13: Develop and implement an outreach strategy targeting communities in the County that have repetitive loss properties.	100 Year Floodplain Flooding	A	2012	2017	HMA Grant Programs/Existing Budget	Cuyahoga County Office of Emergency Management/ individual communities	<b>NEW:</b> In effort to reduce the number of repetitive loss properties throughout the County, the program would aim to educate the applicable communities and citizens on mitigation techniques and funding opportunities available through FEMA's Hazard Mitigation Assistance (HMA) Programs. The outreach will stimulate more mitigation projects such as, acquisition/ demolition, elevation, relocation, etc. .
14: Evaluate and implement USGS program that incorporates additional stream gauges with historical data to develop web based interactive flood-inundation maps.	100 Year Floodplain Flooding	B	2011	TBD	HMA Grant Programs	Cuyahoga County Office of Emergency Management/ Cuyahoga County Planning Commission/ USGS	<b>NEW:</b> The Cuyahoga County Office of Emergency Management is evaluating a similar program created in Findley, Ohio to implement on the Cuyahoga River in the Valley View/ Independence area. The program would help project the severity of flooding as water reaches defined levels.
15: Evaluate and rank infrastructure problems. Determine areas of vulnerability for both utilities and roadways and seek funding to permanently mitigate.	100 Year Floodplain Flooding	B	Ongoing		NEORSRD Stormwater Management Program	NEORSRD/ individual municipalities	<b>ONGOING:</b> Through their Stormwater Management Program, NEORSRD is working with local jurisdictions to identify problematic infrastructure and recommend solutions.
16: Coordinate and facilitate outreach to all participating NFIP communities within Cuyahoga County. Evaluate higher standards that could be implemented in the County.	100 Year Floodplain Flooding	C	Ongoing		NEORSRD Stormwater Management Program/ Existing Budgets	NEORSRD/ individual municipalities/ watershed groups	<b>ONGOING:</b> In the original plan a lack of continuity was identified among the 59 communities' respective interpretations of NFIP regulations. Through their Stormwater Management Plan, NEORSRD seeks to work with the watershed groups and municipalities to increase the continuity of NFIP regulation interpretations among relevant stakeholders.

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
Secure funding to update FEMA Flood Insurance Rate Maps (FIRM)	100 Year Floodplain Flooding	C	2004	2010	N/A	Cuyahoga County Planning Commission/ Cuyahoga County Office of Emergency Management/ individual municipalities	<b>COMPLETED:</b> All jurisdictions within Cuyahoga County have adopted the new (2010) FEMA Floodplain maps

### Non-Flood Zone Flooding

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
<b>17:</b> There is concern regarding areas that flood, but have no associated mapping. Seek funding to map non-flood Zone areas within the County.	Non-Flood Zone Flooding	B	Ongoing		NEORS Stormwater Management Program	NEORS/ individual municipalities	<b>ONGOING:</b> NEORS, via the Stormwater Management Program, is in the process of gathering this information.
<b>18:</b> Evaluate a program to install stream gauges in creeks and tributaries that cause flooding in areas not considered to be in the 100 year flood zone.	Non-Flood Zone Flooding	B	2012	2017	Explore HMA grants	Cuyahoga County Office of Emergency Management	<b>NEW:</b> Some areas throughout the County that are adjacent to creeks and tributaries repetitively flood, but are not considered to be within 100 year flood zones. Installing stream gauges in these areas would help inform impacted communities and residents.
<b>19:</b> There is generally a lack of awareness as it relates to non-flood zone flooding in the County. Develop initiatives/PSAs to educate residents.	Non-Flood Zone Flooding	C	Ongoing		Existing Budget	Cuyahoga County Office of Emergency Management	<b>ONGOING:</b> The Cuyahoga County Office of Emergency Management disseminates literature on hazards at various events (e.g. community fairs and homedays)

Severe Winter Weather

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
<p><b>20:</b> Produce/distribute family and traveler emergency preparedness information relating to severe winter weather hazards.</p>	<p>Severe Winter Weather</p>	<p>B</p>	<p>2012</p>	<p>2014</p>	<p>Existing Budget</p>	<p>Cuyahoga County Office of Emergency Management</p>	<p><b>NEW:</b> This outreach will focus on publicizing recommended safety measures to take during the winter season.</p>

Tornado Actions

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
21: Develop Social Media programs to provide weather information to citizens.	Tornadoes	B	2012	2013	Existing Budget	Cuyahoga County Office of Emergency Management	<b>NEW:</b> Cuyahoga County Office of Emergency Management is currently evaluating/developing the use of social media (i.e. facebook, twitter) to disseminate general information to the public regarding tornadoes and preparedness.
22: Identify funding to purchase Preliminary Damage Assessment (PDA) Field Guides to disseminate among first responders.	Tornadoes	B	2012	2017	Explore HMA funding	Cuyahoga County Office of Emergency Management	<b>New:</b> This activity will help expedite the damage assessment process following tornadoes as well as other severe weather events. Surveying and accurately documenting damage following severe weather enables the County to more quickly determine if a request for State and/or Federal assistance is necessary.

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
<p><b>23:</b> Seek funding to develop a countywide public notification/warning system. Identify most appropriate type of system, whether in the form of siren, reverse 9-1-1, social media, or other mode.</p>	Tornadoes	D	TBD	TBD	Exploring HMA Funds as possible funding source	Cuyahoga County Office of Emergency Management/ individual municipalities	<p><b>DEFERRED:</b> In the original Plan, this action sought to identify funding to implement a countywide, interoperable siren and warning system. However, the project has proven cost prohibitive. For the 2011 update, the Mitigation Core Group determined that it would be prudent to investigate alternative modes for countywide public notifications and warning, other than just traditional siren/warning systems.</p>
<p><b>24:</b> Develop PSA's about countywide public notification/warning system.</p>	Tornadoes	D	TBD	TBD	Exploring HMA Funds as possible funding source	Cuyahoga County Office of Emergency Management/ individual municipalities	<p><b>DEFERRED:</b> This action is contingent on the implementation of a countywide public notification/warning system.</p>



Temperature Extremes

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
<p><b>25:</b> Identify populations vulnerable to temperature extremes and organize outreach regarding temperature extreme safety and accessible heating or cooling centers in the communities.</p>	Temperature Extremes	A	2012	2017	Existing Budget	Cuyahoga County Office of Emergency Management/ Red Cross/ individual communities	<p><b>NEW:</b> Working with the relevant stakeholders. The Cuyahoga County Office of Emergency Management will develop and disseminate outreach to vulnerable populations regarding safety precautions during temperature extremes.</p>

### Erosion/ Landslide Actions

Action	Hazard Type	Priority	Start Date	End Date	Resources	Lead Agencies	Status/Remarks
<b>26:</b> There are infrastructure issues relating to roadways falling in, debris, redirecting traffic, and clean-up. Seek funding to permanently mitigate infrastructure that is being affected by streambank erosion.	Erosion/ Landslides	A	Ongoing		NEORS Stormwater Management Program	NEORS/ individual communities	<b>ONGOING:</b> Through the Stormwater Management Program, NEORS has identified infrastructure affected by erosion and is working with the individual communities to implement solutions.
<b>27:</b> Develop a plan that addresses maintenance of the waterways and drainage concerns.	Erosion/ Landslides	B	Ongoing		NEORS Stormwater Management Program	NEORS/ individual communities/ Watershed Organizations	<b>ONGOING:</b> The NEORS Stormwater Management Program incorporates planning for the inspection and maintenance of waterways
<b>28:</b> Work with established watershed groups to evaluate causes of erosion and seek funding to create an action plan to reduce it.	Erosion/ Landslides	B	Ongoing		NEORS Stormwater Management Program	NEORS/ Watershed Organizations	<b>ONGOING:</b> The NEORS Stormwater Management Program will set up a Watershed Advisory Committee (WAC) in each of the five major watersheds to provide input on problems and prioritize maintenance, monitoring activities, and construction projects
<b>29:</b> Disseminate model ordinances addressing streambank erosion to establish increased continuity among communities.	Erosion/ Landslides	B	Ongoing		Chagrin River Watershed Budget/ misc. grants	Chagrin River Watershed Partners (CWRP)/ individual communities	<b>NEW:</b> CRWP in conjunction with local and state agencies has developed a number of model ordinances/regulations and resolutions for communities to use.

## 6.0 Countywide All Natural Hazards Mitigation Plan Maintenance

The Cuyahoga County All Natural Hazards Mitigation Plan is evaluated on an annual basis to determine the effectiveness of programs and to reflect any changes that may impact mitigation priorities. The goals and actions are reviewed to evaluate their relevance to changing situations. Moreover, when a mitigation activity is conducted, the Plan is used at that time and updated after the mitigation activity takes place.

Efforts continue to be made to encourage input from communities, organizations, and the public. This is accomplished by keeping a current copy of the Plan posted on the County's website and sending notifications of meetings concerning Plan updates to all relevant stakeholders. Major revisions to the Plan are submitted to the Ohio Emergency Management Agency and the Federal Emergency Management Agency Region V to ensure the updates meet the required Disaster Mitigation Act Standards. A Cuyahoga County Office of Emergency Management staff member is designated as the plan writer and is responsible for performing the *pencil and ink* updates to the master copy of the Plan.

Every 5 years, the Cuyahoga County Office of Emergency Management will conduct a comprehensive review and update to the Plan. This process involves gathering current information and conducting a thorough reevaluation of the hazard analyses and mitigation initiatives within the Plan. To achieve this, effort is made to reengage and solicit input from all of the communities, relevant stakeholders, and members of the public. The Mitigation Core Group is re-assembled to coordinate the 5 year updates to the Plan.

### 6.1 Incorporation into Existing Planning Mechanisms

The Cuyahoga County All-Natural Hazard Mitigation Plan is incorporated into other existing planning documents and capital improvement plans where appropriate. Each individual community is responsible for integrating the Plan with any existing comprehensive plans or ordinances in that community. The Cuyahoga County Planning Commission refers to the Plan wherever feasible within the existing documents that support mitigation and growth within the County.

The Cuyahoga County Emergency Operations Plan (EOP) incorporates elements of the Plan within the support annex for Mitigation and Recovery. Additionally,

the EOP identifies emergency response and recovery contacts and capabilities by jurisdiction (Ref: Base Plan, Section 7.0, Communications, page 25.) As referenced in the EOP, each community's emergency contact information and resource information are also maintained in the County's emergency notification database and resource database.

# APPENDIX 1 – Existing Planning Documents / Organized Watershed Groups / Designated Floodplain Administrators

Community	Comprehensive Plan	Floodplain Ordinances	Land Use Ordinances	Organized Watershed Groups	Other Documents	Designated Floodplain Administrator
Bay Village	X	X	X			Douglas Milburn, Building Director, Chief Building Official
Beachwood		X	X	Euclid Creek, Chagrin River, Tinkers Creek		Thomas Kreczko, Staff Engineer
Bedford		X		Tinkers Creek Euclid Creek	Master Storm Sewer Maps and FEMA floodplain maps	Phil Seyboldt, Building Commissioner
Bedford Heights	X	X	X	Tinkers Creek	City Disaster Plan	Paul Konys, Building Commissioner
Bentleyville		X	X	Chagrin River		Jeff Filarski, Village Engineer
Berea	X	X	X			R. James Brown, Director of Public Service
Bratenahl	In process	X	X	Dugway Watershed	Phase II EPA NDES	Tom Jamieson, Building Commissioner
Brecksville		X		Chippewa Creek Watershed	Stormwater Management Plan, Stormwater Management Ordinance	Gerald M. Wise, City Engineer
Broadview Heights		X	X			Gene Esser, City Engineer

Community	Comprehensive Plan	Floodplain Ordinances	Land Use Ordinances	Organized Watershed Groups	Other Documents	Designated Floodplain Administrator
Brooklyn	X	X	X	Big Creek		Thomas Ockington
Brooklyn Heights	X	X	X	West Creek		Mike Henry, Village Engineer
Brook Park		X				Mark J. Elliott, Mayor
Chagrin Falls	X	X	X	Chagrin River	X	Benjamin Himes, Chief Administrative Officer
Chagrin Falls Township				Chagrin River		Rick Sicha, County Floodplain Administrator
Cleveland	X	X	X	Doan Brook, Euclid Creek		Timothy Wolosz
Cleveland Heights	X	X	X	Doan Brook	Stormwater Management Plan, Master Storm Sewer Maps	
Cuyahoga Heights	X	X	X			Paul Dey, Village Engineer
East Cleveland						
Euclid			X	Euclid Creek		Lee Bock, Asst. Service Director
Fairview Park		X				Mackay Engineering
Garfield Heights	X	X	X			Bill Wervey, Building Commissioner
Gates Mills	X	X	X	Chagrin River		Dave Biggert
Glenwillow		X		Tinkers Creek		Michael Skvasik

Community	Comprehensive Plan	Floodplain Ordinances	Land Use Ordinances	Organized Watershed Groups	Other Documents	Designated Floodplain Administrator
Highland Hills				Tinkers Creek		Lou Hovancsek
Highland Heights	X	X	X	Chagrin River, Euclid Creek		Dale Grabfelder
Hunting Valley		X	X	Chagrin River	Maps depicting 100 and 500-yr flood plains	Chris Courtney
Independence		X	X	West Creek	Stormwater Management Plan	Carl Opatrny, Chief Building Official
Lakewood	X	X	X	Rocky River		Robert Apanasewicz
Lyndhurst	X	X	X	Euclid Creek		Tom Kunz, Building Commissioner
Maple Heights	X	X	X	Tinkers Creek	Comprehensive Stormwater Management Plan	Edward Hren
Mayfield Heights	Master Plan	X	X	Chagrin River, Euclid Creek	Phase II EPA NPDES General Permit	David G. McCallops
Mayfield Village	X	X	X	Chagrin River, Euclid Creek		Thomas Cappello, P.E.,P.S.
Middleburg Heights				Rocky River		Frank Castelli, Service Director
Moreland Hills	X	X	X	Chagrin River		Jeff Filarski, Village Engineer
Newburgh Heights						
North Olmsted	X	X	X	Rocky River	Phase II EPA NPDES General Permit	Dale Mitchell, Building Commissioner



Community	Comprehensive Plan	Floodplain Ordinances	Land Use Ordinances	Organized Watershed Groups	Other Documents	Designated Floodplain Administrator
North Randall	X		X	Tinkers Creek		
North Royalton	X	X	X			Rito Alvarez, Building Commissioner
Oakwood Village	X	X	X	Tinkers Creek	Comprehensive Stormwater Management Plan	Edward Hren
Olmsted Falls	X	X	X	Rocky River	Riparian setback Ordinance (No. 25-2007). City also in process of adopting stormwater erosion and sediment control ordinance (Chapter 1469) that will modify Chapter 1214.	Robert McLaughlin, Building Administrator
Olmsted Township	X		X	Rocky River		Rick Sicha, County Floodplain Administrator
Orange Village	X	X	X	Chagrin River, Tinkers Creek		Lou Hovancsek, Building Commissioner
Parma	X	X	X	Big Creek, West Creek	X	Paul Deichmann, P.E. - City Engineer/Building Commissioner
Parma Heights		X	X	Big Creek		Michelle Teresi
Pepper Pike		X	X	Chagrin River	Comprehensive Erosion Study	Donald F. Sheehy, City Engineer
Richmond		X	X	Euclid Creek		Daniel Spada

Community	Comprehensive Plan	Floodplain Ordinances	Land Use Ordinances	Organized Watershed Groups	Other Documents	Designated Floodplain Administrator
Heights						
Rocky River				Rocky River		Kevin Beirne, Building Commissioner
Seven Hills	X	X	X	West Creek		Mark Papke, City Engineer
Shaker Heights	X	X	X	Doan Brook		Heinz J. Akers, Building Commissioner
Solon	X	X		Chagrin River, Tinkers Creek	Stormwater Management Plan	Jim Stanek, Public Works Commissioner
South Euclid	X	X	X	Euclid Creek		Andrew K. Blackley, P.E. City Engineer
Strongsville	X		X			Ken Mikula, City Engineer
University Heights	X	X	X	X		N/A
Valley View	X	X	X	Tinkers Creek		Paul Dey, Village Engineer
Walton Hills	X	X	X	Tinkers Creek		Donald Sheehy, Village Engineer
Warrensville Heights	X	X	X	Mill Creek Watershed Partnership, Tinkers Creek		Gene Hill
Westlake	X	X	X	X	Emergency Sewer Plan	Robert Kelly
Woodmere	X		X	Chagrin River Watershed Partners		Chief James Cartwright

# APPENDIX 2 – 2011 Community Survey

**Instructions:** Please answer as many of the questions as possible. Where noted, reference the additional attachments of the email to establish if updated information is necessary for your community. If updated information is not required, or a given question does not apply to your community, simply mark an “X” in the N/A box. Please identify the responding community in the space immediately below.

Completed Survey for:

1. Does your community participate in the National Flood Insurance Program (NFIP)?

Yes	No	N/A

2. Are residents in your community encouraged to purchase flood insurance?

Yes	No	N/A

3. Does your community have a designated Floodplain Administrator? If you answered “yes” to this question please provide the name and contact information for your community’s Floodplain Administrator.

Yes	No	N/A

**Contact Information:**

4. Has your community adopted the recently updated FEMA Floodplain Maps?

Yes	No	N/A

5. Reference **Attachment A** and identify if updates are necessary for the information pertaining to your community’s infrastructure concerns as they relate to flooding listed in the original plan. Please use the space below to provide additions or omissions. If the original information for your community is still current or this question does not apply to your community, please mark an “X” in the N/A box.

New Infrastructure Problem	Remedied Infrastructure Problem	N/A

6. Reference **Attachment B** and identify if any new plans, ordinances or watershed groups have been developed within your jurisdiction since the original Hazard Mitigation Plan was created. Please use the spaces below to identify any updates. If the original information for your community is still current or this question does not apply to your community, please mark an "X" in the N/A box.

Comprehensive Plan	Floodplain Ordinance	Land Use Ordinance	Organized Watershed Groups	Other Documents	N/A

7. Has your community completed any mitigation activities or projects since 2004? If yes, please specify and identify the results of the activity/project.

8. Is your community currently engaged in any mitigation activities or projects?

9. Does your community have plans to pursue mitigation activities or projects in the future?

10. Please list any other developments or information pertaining to your community which you feel may be influential and/or relevant for the County's All Natural Hazards Mitigation Plan.

## APPENDIX 3 – Organizations invited to Participate in 2011 Update

<b>Organizations Invited to Participate on the 2011 Mitigation Core Group (excluding community representation)</b>
Red Cross, Greater Cleveland Chapter
Cuyahoga County Planning Commission
Northeast Ohio Regional Sewer District
Cuyahoga County Department of Development
Cuyahoga County Public Works
Cuyahoga County Soil and Water Conservation
Chagrin River Watershed Partners
Ohio Emergency Management
Cleveland State University
Case Western Reserve University
Key Bank
Contingency Planners of Ohio
Northeast Ohio Area Coordinating Agency
Cuyahoga County Board of Health
Cleveland Emergency Management Agency
Lorain County Emergency Management Agency
Medina County Emergency Management Agency
Summit County Emergency Management Agency
Portage County Emergency Management Agency
Geauga County Emergency Management Agency
Lake County Emergency Management Agency

# APPENDIX 4 – Correspondences Regarding the 2011 Update

## Correspondence to Communities

Good morning,

Per Section 201.6 44CFR, the Disaster Mitigation Act of 2000 (DMA) requires all approved local hazard mitigation plans to be updated every 5 years. Accordingly, the current **Countywide All Natural Hazards Mitigation Plan for Cuyahoga County (CANHMP)** will need to be updated and ultimately approved by FEMA by the end of this year.

Our area's eligibility for participating in the various hazard mitigation grant programs is contingent on maintaining a FEMA-approved hazard mitigation plan. Without a FEMA-approved hazard mitigation plan, Cuyahoga County would not be in compliance with FEMA. As a result, communities in Cuyahoga County would be unable to receive hazard mitigation grant funds. The hazard mitigation plan update will focus on: reengaging the public and reviewing/revising the risk assessments, the goals, and the action plan. A Mitigation Planning group will be assembled to address the above mentioned items.

**Each community within Cuyahoga County represented in the plan must participate in its update. Community participation in the update process not only enhances the plan's development, but is also required by FEMA. Therefore, to meet this requirement, please review and complete the short community survey attached to this email. The additional attachments supplied contain the original community information used for the creation of the Plan. These documents should be referenced when completing the survey.**

Once completed, please forward the survey back to me no later than **April 15<sup>th</sup>, 2011** at [mchristie@ema.cuyahogacounty.us](mailto:mchristie@ema.cuyahogacounty.us). If you are unable to open the attachments or prefer the documents are mailed to you, please let me know.

Should you want to review the current version of our County's Hazard Mitigation Plan, it is posted on our website: <http://ja.cuyahogacounty.us/en-US/mitigation-recovery.aspx> . Upon your review, please feel free to forward any additional input or questions you may have.

Once the Plan's update is complete and it is approved by FEMA, each jurisdiction will need to formally re-adopt the updated document. Additional information will be provided regarding this at a future time.

Thank you.



## Correspondence to Mitigation Core Group

Good afternoon,

The Disaster Mitigation Act of 2000 (DMA) requires all approved local hazard mitigation plans to be updated every 5 years. Accordingly, the current **Countywide All Natural Hazards Mitigation Plan for Cuyahoga County (CANHMP)** will need to be updated and ultimately approved by FEMA by the end of this year.

As our area's eligibility for participating in the various hazard mitigation grant programs is contingent on maintaining a FEMA-approved hazard mitigation plan, this update is critical. Without a FEMA-approved hazard mitigation plan, Cuyahoga County would not be in compliance with FEMA. As a result, communities in Cuyahoga County would be unable to receive hazard mitigation grant funds.

The hazard mitigation plan update will focus on: reviewing the risk assessments, reviewing/revising goals and objectives, reviewing/revising the action plan, and reengaging participating jurisdictions as well as the public.

A mitigation planning group will be assembled to address many of the above mentioned items. If you are receiving this correspondence, your experience and expertise are requested through your participation in this important endeavor.

Participating on the mitigation planning group will be a small, albeit important, commitment which will require your attendance at 2 -3 meetings over the course of the update process.

Dean Irvin, State Mitigation Planner, from the Ohio Emergency Management Agency will provide a presentation on mitigation planning at a kick-off meeting on **Friday, April 1<sup>st</sup> at 10:00am** at the **Northeast Ohio Regional Sewer District** located at **4747 East 49th Street, Cleveland**. Please respond and advise if you will be able to attend this meeting and participate on the mitigation planning group.

A current copy of the hazard mitigation plan is located on the Cuyahoga County Emergency Management website. If you wish to review the plan, please follow the link below. <http://ja.cuyahogacounty.us/en-US/mitigation-recovery.aspx>

Thank you.

## Correspondence to Adjacent Counties

Good afternoon,

The Disaster Mitigation Act of 2000 (DMA) requires all approved local hazard mitigation plans to be updated every 5 years. Accordingly, the current **Countywide All Natural Hazards Mitigation Plan for Cuyahoga County (CANHMP)** will be reviewed and updated over the course of this year.

Please consider this correspondence our notification to adjacent counties that Cuyahoga County is actively engaged in the update process.

Dean Irvin, State Mitigation Planner, from the Ohio Emergency Management Agency will provide a presentation on mitigation planning at a kick-off meeting on **Friday, April 1<sup>st</sup> at 10:00am** at the **Northeast Ohio Regional Sewer District** located at **4747 East 49th Street, Cleveland**. If you are interested in attending this meeting and/or would like to participate in our plan update, please respond to this email and advise.

A current copy of our County's hazard mitigation plan is located on the Cuyahoga County Emergency Management website:  
<http://ja.cuyahogacounty.us/en-US/mitigation-recovery.aspx>  
Should you have any questions, comments, or concerns, please do not hesitate to contact me at 216.443.5683.

Thank you.

# APPENDIX 5 – Public Notification

## Cuyahoga County Office of Emergency Management Website Posting

Cuyahoga County's Hazard Mitigation Plan

*Public input is valuable to the Hazard Mitigation planning process. As our County's All Natural Hazard Mitigation Plan will be reviewed and updated this year, Cuyahoga County Emergency Management will make effort to solicit public participation in this process.*

*The link below will open a current version of Cuyahoga County's Hazard Mitigation Plan. As the planning process commences, the Plan will be available on our website for public review. During this period, the public is encouraged to provide comments and ask questions. Please direct any input or inquiries to [mchristie@ema.cuyahogacounty.us](mailto:mchristie@ema.cuyahogacounty.us).*

*Once the Plan is updated, the new version will be posted on our website. When this occurs, the public will be afforded the opportunity to review the Plan once again.*

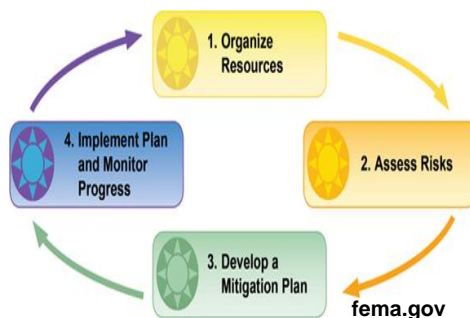
*Thank you in advance for your participation in this important endeavor.*

**[Cuyahoga County Hazard Mitigation Plan.pdf](#)**

# Cuyahoga County Office of Emergency Management January 2011 Newsletter Article

## County Hazard Mitigation Plan Due for Maintenance

It is known that the utility of any effective plan relies immensely on the plan's routine upkeep. Some acquire this knowledge the difficult way after a dated plan proves ineffective amid the response and recovery efforts to an incident. Others, appreciating the gravity of continued plan maintenance, take a proactive approach. FEMA encourages the latter, and in some cases mandates it.



Accordingly, the Disaster Mitigation Act of 2000 (DMA) requires all approved local hazard mitigation plans to be updated every 5 years. Therefore, the current Countywide All Natural Hazards Mitigation Plan for Cuyahoga County (CANHMP) will require an update by January 2012. As our area's eligibility for participating in the various hazard mitigation grant programs is contingent on maintaining a FEMA-approved Hazard Mitigation Plan, this update is vital.

Initially drafted in 2003, the CANHMP identifies and profiles the natural hazards facing our county while providing their respective risk and vulnerability assessments.

In doing so, the plan serves as a viable reference for the county to develop strategies and priorities to mitigate risk from natural hazards and identify actions or projects to reduce the risk. Additionally, the plan aims to guide individual communities in their risk management activities.

The hazard mitigation plan update will primarily focus on reviewing and revising the Plan's: risk assessments, goals and objectives, and mitigation strategy. To comprehensively accomplish this, a mitigation planning team will be assembled to analyze and perform the necessary updates. Furthermore, input and participation will be solicited from each of the communities within the county as well as the general public.

Additional information regarding this effort will be forthcoming as the process moves forward. Should you have any questions or comments in the meantime, please feel free to contact our office at [ema@ema.cuyahogacounty.us](mailto:ema@ema.cuyahogacounty.us)

# APPENDIX 6 – Historical Hazard Impacts Reference Document

## Severe Thunderstorms

One criteria of severe weather, as it relates to thunderstorms, is a wind classification of 58 mph and above. Hazards such as high winds, hail, and lightening all commonly accompany thunderstorms. According to the National Climatic Data Center (NCDC), from 1950-2010, Cuyahoga County has been impacted by 562 severe weather events (includes thunderstorm winds, lightening, and hail) totaling over \$67 million in damages throughout northeast Ohio.

## Severe Winter Weather

The leading cause of death during severe winter weather (i.e. snow storms, blizzards, and ice storms) is transportation accidents. According to the NCDC, since 1993 Cuyahoga County has been impacted by: 31 winter storm events, 3 ice storm events and 46 heavy snow events, all of which have amounted to roughly \$250M in damages throughout Ohio.

## Flooding

Three different types of flooding affect Cuyahoga County: Flash flooding, 100 – Year flooding, and Non-flood zone flooding

- **Flash Flooding** is the number one weather related killer in the United States, with around 140 deaths recorded each year. Flash Floods can happen anywhere at any time. Cuyahoga County has experienced 42 flash flooding events between 1993-2010.
- **100-Year Flooding:** In Cuyahoga County, roughly 1,600 structures were identified to be within the FEMA 100-year floodplains with a total potential loss of \$563,671,300.
- **Non-Flood Zone Flooding** can be defined as flooding that occurs in areas not defined as floodplains, usually in areas that have been developed at a fast rate. Many communities across the County experience issues with non-flood zone flooding, in terms of flood-prone intersections and infrastructure (bridges, culverts, etc.).

## Tornado

According to the NCDC, since 1950, Cuyahoga County has experienced 29 documented tornado events. Damage estimates have ranged from \$3,000,000 to \$25,000,000. Based on the information available and the number of events

that have occurred in Cuyahoga County, the average amount of damage incurred by a tornado is approximately \$6.9 million per event.

### **Earthquake**

Cuyahoga County and the northeast quadrant of the State are in one of the most active areas in Ohio as it relates to earthquakes. However, based on the geology, Cuyahoga County is at a low risk as it relates to potential damage caused by an earthquake. According to the Geological Survey, since 1900 Cuyahoga County has experience 7 earthquakes with a magnitude of 2.0 or greater. The most recent earthquake occurred in Lake Erie in June of 2011. No reports of damage resulted from this event.

### **Drought**

According to the NCDRC, there have been 6 drought events that have affected Cuyahoga County since 1995. The most costly, in terms of damages, occurred throughout northern Ohio during September 1999. As a result of this event, losses from reduced crop yields are estimated at \$200 million for northern Ohio alone. As Cuyahoga County is an urban county with a small percentage of agricultural land use, drought damage estimates for the County would not be as significant as other counties with a greater proportion of agriculture.

### **Wildfire**

Due to the drying effects of a drought, the potential for wildfires is often increased during and after a drought event. Each year an average of 800 wildfires burn 4,000 to 5,000 acres in Ohio. The threat of wildfires is especially great in areas referred to as the Wildland Urban Interface (WUI). The WUI can be defined as the zone where structures and other human developments meet or intermingle with undeveloped lands. The NCDRC had no recent record of wildfires occurring in the County. Also, as Cuyahoga County is largely urbanized, there are less WUI areas.

### **Temperature Extremes**

Hot and cold Temperature Extremes have affected Cuyahoga County 15 times since 1993. According to the NCDRC 10 extreme cold events have resulted in \$4.4m in property damage and 15 deaths across northern Ohio and statewide. Moreover 5 excessive heat events have caused \$1.1m in property damage as well as 18 deaths in northern Ohio and statewide.

### **Landslides (Coastal and Streambank Erosion)**

Landslides are events which include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Gravity is the main cause for a landslide; however, other factors can be involved including (but not limited to) erosion by rivers or lake waves. The greatest threats to Cuyahoga County from landslides are along the Lake Erie coastline and along the

Cuyahoga River Valley. To help evaluate the impact of landslides in the County, coastal and streambank erosion were both analyzed.

- **Streambank Erosion:** As part of the NEORSD Stormwater Management Program, a preliminary list of streambank erosion sites with respective construction estimates has been compiled. The List identifies 71 erosion sites within the County; totaling an estimated \$90M of associated constructions costs.
- **Coastal Erosion:** according to ODNR the average recession rate of coastal erosion is 0.1 feet per year in Cuyahoga County. There are six communities in the County located along the coast of Lake Erie: Bay Village, Rocky River, Lakewood, Cleveland, Bratenahl and Euclid. Dollar loss estimates for coastal erosion were calculated for each community based upon the length of coastline subject to erosion in each community. On average, an estimated \$14,000 per year is lost due to coastal erosion.

### **Storm Surge**

Storm surges are temporary rises in water level caused by storm winds blowing across miles of open water and dragging some water towards the down-wind shore. The NCDC identifies 28 storm surge events that have occurred on Lake Erie. However, none of the events are recorded as having impacted Cuyahoga County. It should be noted that the NCDC data regarding storm surges covers only a brief period in the late 1990's. There is, however, a report of a 1942 storm surge that killed 7 people from Bay Village to Ashtabula when a wall of water slammed into the shore.

### **Seiche**

A Seiche can be defined as a standing wave in an enclosed or partially enclosed body of water which can result in coastal flooding. The most common cause of seiches in Lake Erie is a strong, constant wind blowing over the surface of the water forcing it to accumulate at the down-wind shore. When the wind diminishes the water level will begin to return to its original equilibrium through a series of broad oscillations across the entire body. Often referred to as the bathtub effect, seiches cause the water levels to rise and fall along the shorelines repeatedly until equilibrium is restored. The NCDC lists only one seiche that occurred in Lake Erie in 1998. This event is not documented to have impacted Cuyahoga County.



# APPENDIX 7 – Problem Statements, Overall Goals, and Mitigation Actions

## Problem Statements

### **Severe Storms**

Based on the results of the Hazard and Vulnerability Assessment Matrix, Severe Storms is Cuyahoga County's 1st priority hazard. The current state of severe storms in Cuyahoga County is that they continue to occur throughout the year, and historically have had dramatic, repetitive effects on the communities of the County.

- Due to the unpredictability of storm events, reaction time and relay of information to the general public is lacking.
- Cuyahoga County communities have difficulty responding to the needs of sensitive populations (i.e. elderly, foreign languages) during and after severe storm events.
- Cuyahoga communities do not know where all of their critical facilities are located countywide.
- Due to the location and elevation of Cuyahoga County, susceptibility to severe weather can differ dramatically based on the location within the County. This makes it difficult to release appropriate warnings and notices of severe events.
- Cuyahoga residents are accustomed to dealing with severe storms, which creates some apathy as it relates to the seriousness of an event.
- Areas of Cuyahoga County have problems with their utilities during and after severe storm events (i.e. well water, septic systems and long-term power outages).
- All communities located in Cuyahoga County may not be able to communicate with each other based on the type of communication utilized within a particular community (i.e. actual equipment used, radios, etc.).
- The older communities within Cuyahoga County (such as Chagrin Falls and Cleveland) have severe problems with sewage back-ups during severe storm events, which cause ecological, environmental and health issues.
- The local community bears "sole financial burden" when cleaning up after a severe storm event.
- There is a lack of law enforcement in securing areas affected by some severe storm events, which can lead to looting issues that further burden emergency response services.

- Critical lights and critical utilities (charged power lines down) can become a problem after a severe storm event.
- Severe storm events have the potential to cause dramatic effects on traffic and transportation, and there are no contingency plans for diverting traffic to avoid storm damage.

Overall goal: To reduce the effects of severe storms on Cuyahoga County by better preparation for each severe storm event.

## **Flooding**

Based on the results of the Hazard and Vulnerability Assessment Matrix, Flooding is Cuyahoga County's 2nd priority hazard. The current state of flooding in Cuyahoga County is that floods continue to occur throughout the year and historically have had dramatic effects on the communities within the County.

### *Flash Flooding*

- People drive through floodwaters.
- The undersized infrastructure is unable to handle the storm water in some areas of the County.
- Other communities within the watershed who are unable to handle their runoff, directly affect communities of Cuyahoga County.
- Youth play in highly hazardous areas in relation to flash floods. There is a need for further education focused on youth about the potential for danger.
- There is not sufficient warning time as it relates to flash flooding in some areas of Cuyahoga County.

Overall goal: To concentrate on making the general public more aware of flash flood events and those areas of high hazard potential.

### *100-Year Floodplain Flooding*

- The Flood Insurance Rate Maps for most of Cuyahoga County are outdated, some as much as 20-30 years old.
- Due to the northern location of Cuyahoga County, secondary effects of winter flooding are a problem. Debris clean-up and dealing with ice are sometimes as bad a problem as flooding.
- Most communities in Cuyahoga County follow the minimum NFIP standards and still allow new structures to be built in the 100-year floodplain.
- There is an overall issue as it relates to infrastructure problems. Underutilized utilities and roadways are directly affected by flood events.
- There is a lack of coordination in evaluating higher standards for residential and commercial development within the 100-year floodplain.

- Within Cuyahoga County, there are 59 individual communities, which means 59 interpretations of the NFIP regulations. There is a communication problem among the communities about what other districts are doing and how there can be more continuity.

Overall goal: To coordinate efforts, where feasible, regulating the 100-year floodplains and to learn from each other how each community utilizes and enforces their regulations.

#### *Non-Flood Zone Flooding*

- There is a lack of accurate and updated NFIP maps for Cuyahoga County. There is a great concern about areas that flood but have no related NFIP maps.
- There is generally a lack of awareness as it relates to non-flood zone flooding in the County, and there are currently no initiatives to educate residents of these occurrences.

Overall goal: To save lives and property, reduce flood damage and increase educational awareness of flooding in the communities within Cuyahoga County.

#### **Severe Winter Weather**

Based on the results of the Hazard and Vulnerability Assessment Matrix, Severe Winter Weather is Cuyahoga County's 3rd priority hazard. The current state of severe winter weather in Cuyahoga County is that it regularly occurs each year during the winter months and had can significantly impact communities throughout the County.

- Heavy ice and/or snow loads can cause fallen trees and limbs, roof collapses, damage to telephone poles and power outages
- Severe winter weather causes dangerous driving conditions and an increased amount of traffic accidents
- Ice storms have dramatic effects on communities within Cuyahoga County, in relation to public utilities.
- Communities within Cuyahoga County have difficulty predicting resources needed to respond to severe storm events, such as the need for salt during the winter season.

Overall goal: To mitigate the effects of severe winter weather by increasing awareness of the dangers associated with winter storms.

## **Tornadoes**

Based on the results of the Hazard and Vulnerability Assessment Matrix, Tornadoes are Cuyahoga County's 4th priority hazard. The current state of tornadoes in Cuyahoga County is that they continue to occur throughout the year and historically have had dramatic effects on the communities of the County.

- There is a lack of warning sirens throughout Cuyahoga County.
- Communities that do not have siren systems typically have stand-alone systems that are not able to communicate with other areas. Each community has its own method of distributing warnings.
- There are no tornado shelters in public areas or parks within Cuyahoga County.

Overall goal: To increase public educational awareness about the effect of tornadoes on the community, and how to respond to warning sirens.

## **Temperature Extremes**

Based on the results of the Hazard and Vulnerability Assessment Matrix, Temperature Extremes are Cuyahoga County's 5th priority hazard. The current state of temperature extremes in Cuyahoga County is that they can occur at any given point throughout the year and can affect residents throughout the County, especially sensitive populations.

- There is a lack of awareness regarding the effect hot and cold temperature extremes can have on human health.
- Many citizens in the County may be unaware of resources and shelters that are made available during occurrences of temperature extremes

Overall goal: Increase public awareness of the dangers of temperature extremes as well as measures that can be taken to ensure safety.

## **Erosion and Landslides**

Based on the results of the Hazard and Vulnerability Assessment Matrix, Erosion is Cuyahoga County's 6th priority hazard. The current state of coastal and streambank erosion in Cuyahoga County is that erosion continues to occur and contributes to other hazards like landslides and flooding.

- Existing structures and the construction of new homes on the coastline are a potential disaster waiting to happen. The current water level does not pose an issue, but if/when the water level increases, there will be devastating effects on structures along the coastline.
- Streambank erosion has several peripheral issues that need to be further explored (i.e., maintenance of the waterways and drainage concerns).

- Natural areas around some of the waterways (specifically Brecksville and Bedford) have been affected by stormwater and streambank erosion in recent years.
- There is a lack of consistent riparian area regulations in Cuyahoga County. The more defined regulations of some areas are virtually unknown to most citizens.
- Outlying areas (i.e., Brecksville and Olmsted Township) are building out and causing dramatic effects on stream erosion.
- There are infrastructure issues relating to roadways falling in, debris, redirecting traffic and cleanup.

Overall goal: To increase educational awareness of coastal and streambank erosion in the communities affected, as well as to learn about different techniques communities are using to control erosion.

*Due to lesser frequency of occurrence and/or lesser impact, the following hazards were not included in the Mitigation Action Table:*

### **Drought and Wildland Fires**

The current state of this hazard is that droughts will continue to occur, and the County has several options to prepare for a drought and the other potential disasters that could follow, such as wildland fires.

- Wildland fires are a secondary effect of droughts. There is a potential lack of equipment and/or accessibility to fighting wild land fires.
- An urban wild land interface map (public parks vs. homes) is needed to illustrate where boundaries meet.
- Sensitive population concerns (elderly and children) about where they are located, in relation to drought and heat distress.
- There is a lack of educational awareness about how droughts can affect a community and how to react when one occurs.
- There is a lack of awareness about how droughts can lead to fires and how flash floods can exacerbate the problem.

Overall goal: To reduce the potential damage of droughts by public awareness of the long-terms effects of a drought.

### **Earthquakes**

The current state of earthquakes in Cuyahoga County considers that in the entire State of Ohio, the Cuyahoga area has had the most activity in recent years.

- There are little to no public awareness campaigns occurring in the County as it relates to the seriousness of earthquakes and how an earthquake could affect the community as a whole.
- There are no building standards that address earthquake resistance.
- Lack of weather radios in rural areas to notify residents of disasters.

Overall goal: To reduce the potential damage of earthquakes and to increase awareness.

### **Coastal Flooding (Storm Surge and Seiche)**

Due to its location on the shore of Lake Erie, Cuyahoga County is susceptible to coastal flooding resultant from storm surges and seiches.

- Properties on the coastline could be damaged by storm surges and seiches.
- There is a general lack of awareness of storm surges and seiches in the County

Overall goal: Increase public awareness of the potential dangers of coastal flooding.

## **Mitigation Actions**

### **Severe Storms**

- Seek funding to develop a countywide public notification/warning system
- PSAs that reflect the “special needs” of sensitive populations and identifying where the special needs population resides.
- Mapping of critical facilities of every community with the County.
- Innovative PSAs on the susceptibility of certain locations within the County to severe weather.
- PSAs on dealing with severe storms via mass mailing and community papers.
- Backup generators for critical facilities and residences (i.e. Orange Village and Olmsted Township); evaluate pumping stations.
- Evaluate countywide communication interoperability.
- Evaluate other communities on how they mitigated sewage backup (back flow prevention).
- Participate in coordinating efforts in the mitigation process so that local communities do not bear sole financial burden when cleaning up after a severe storm.
- Increase awareness of existing mutual aid resource for post-storm law enforcement.

- Backups for critical lights and critical utilities. Underground utilities regulations required for local communities who seek funding.
- Intelligent traffic transportation system.
- Develop social media programs to provide severe weather preparedness information to citizens
- Develop strategic outreach to promote a program for regional NWS Sky Warn classes to educate identified community/voluntary organizations (e.g. Neighborhood Watch, CERT, etc.).
- Develop outreach educating citizens on the responsibility of tree maintenance and removal with regard to power outages caused by severe weather.

## **Flooding**

### *Flash Flooding*

- Evaluate installing elevation markers or gates related to high hazard areas.
- Identify those geographic areas with undersized infrastructure and increase the pipe size.
- Develop partnerships to enhance stormwater regulations countywide. Phase II stormwater utilities. Cooperational planning.
- Outreach to school aged children regarding the dangers of playing in highly hazardous areas in relation to flash floods.
- NOAA weather radios in all critical facilities, schools and hospitals. Basin planning.
- Seek funding to install diversion devices on roadways prone to flash flooding throughout the County. The devices would be intended to either dissuade or inhibit drivers from attempting to navigate flooded roadways.
- Develop outreach to educate citizens on the importance of having a NOAA weather radio at home and work.

### *100-Year Floodplain Flooding*

- Secure funding to update FEMA maps.
- Preventative PSAs about responsibility of debris cleanup. Develop debris management program and plan.
- Develop riparian setback ordinance in relation to Phase II communities, 25-300 feet. Revise 100-year floodplain maps. Evaluate the fully developed watershed concept (Chagrin River Watershed). Coordinate with other counties on facilitating mapping and regulations.
- Modify infrastructure to handle bigger storm events. Evaluate and rank infrastructure problems. Determine areas of vulnerability for both utilities and roadways and seek funding to permanently mitigate.
- Coordinate and facilitate Community Rating System (CRS). Determine benefits and costs of the program for all communities.



- Develop and implement an outreach strategy targeting communities in the County that have repetitive loss properties.
- Evaluate and implement USGS program that incorporates additional stream gauges with historical data to develop web based interactive flood-inundation maps.

#### *Non –Flood Zone Flooding*

- Seek funding for non-flood zone areas (Millcreek and I-77 at Fleet and Grant).
- PSAs about non-flood zone flooding awareness.
- Evaluate a program to install stream gauges in creeks and tributaries that cause flooding in areas not considered to be in the 100 year flood zone.

#### **Severe Winter Weather**

- Develop Public Service Announcements (PSAs) on the effects of ice storms. Seek funding for alternative systems such as underground utilities.
- Plan for future resource (i.e. salt) use by using “worst case scenario.”
- Refer to Severe Storms actions. Many of the actions identified for severe storms are relevant for severe winter weather as well.
- Produce/distribute family and traveler emergency preparedness information relating to severe winter weather hazards.

#### **Tornadoes**

- Seek funding for to develop a countywide public notification/warning system.
- Large PSAs countywide. Evaluate other communities with existing systems.
- Evaluate Metro Park shelter system, mobile home parks, schools, out-door athletic events.
- Develop Social Media programs to provide weather information to citizens.
- Identify funding to purchase Preliminary Damage Assessment (PDA) Field Guides to disseminate among first responders.

#### **Temperature Extremes**

- Organize outreach to vulnerable populations during periods of extreme temperature, including promoting accessible heating or cooling centers in the communities.

#### **Erosion and Landslides**

- High erosion zone of enforcement. Education. Determine areas of concern along Lake Erie coastline and develop overlay zone to prohibit or restrict development.

- Seek funding to remove structures affected by erosion. Evaluate streambank erosion to determine cause.
- Incorporate riparian setback requirements for new builds. Work with watershed groups to evaluate causes of erosion and seek funding to create an action plan to reduce it.
- Seek funding to remove structures affected by erosion. Seek funding to permanently mitigate infrastructure that is being affected by streambank erosion.
- Disseminate model ordinances addressing streambank erosion to establish increased continuity among communities.

### ***Droughts and Wildland Fires***

- Seek funding for equipment to fight wild land fires.
- Create a map of the urban wild land interface.
- Create a map of the locations of sensitive populations.
- PSAs on how droughts can affect a community.
- PSAs on how droughts can lead to fires and how flash floods can exacerbate the problem.

### ***Earthquakes***

- PSAs on seriousness of earthquakes.
- Evaluate the regulations for wind resistance and earthquake resistance. Work with Building Department to develop standards to mitigate potential damage during and after an earthquake.
- Seek funding for NOAA radios and notification devices (countywide).
- Most buildings and infrastructure in Cuyahoga County are not constructed to withstand strong earthquakes (6.0 magnitude or greater). Identify buildings and infrastructure that may be particularly vulnerable to strong earthquakes.

### ***Coastal Flooding (Storm Surge and Seiche)***

- Analyze/monitor coastal flooding in relation to areas of significant coastal erosion.

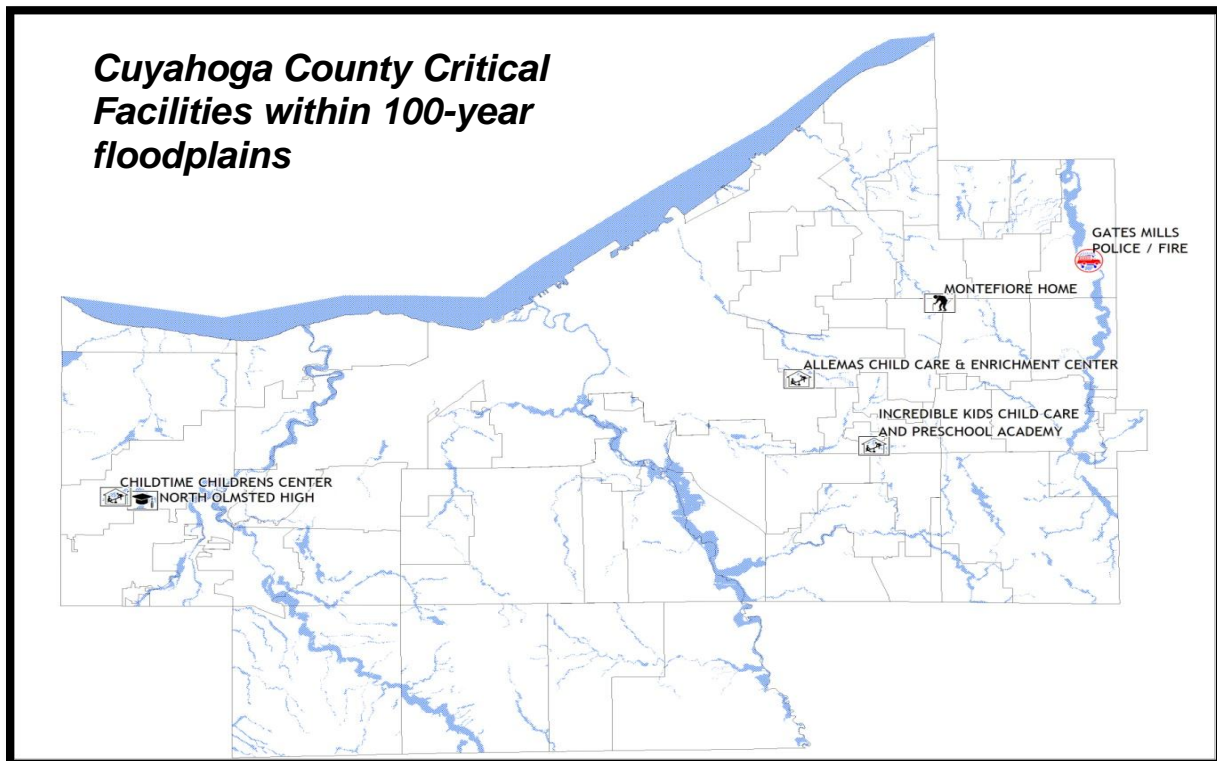
# APPENDIX 8 – At-Risk Critical Facilities

The table below provides detail on the critical facilities in Cuyahoga County located within 100-year floodplains. The information is presented in terms of type, location and potential loss. Reference the flooding Hazard Assessment on page 48 to obtain information regarding the method utilized to identify at-risk structures and calculate potential loss.

<b>Critical Facilities within 100-Year Floodplains</b>		
<b>Community</b>	<b>Type</b>	<b>Building Value</b>
North Olmsted	School	\$16,763,300*
Beachwood	Nursing Home	\$8,050,900
North Olmsted	Day Care	**
Shaker Heights	Day Care	\$1,815,500
North Randall	Day Care	\$716,100
Gates Mills	Police/Fire	\$1,086,100
<b>Total Potential Loss:</b>		<b>\$28,431,900</b>

\*Building value for school includes other buildings on parcel but outside of flood zone

\*\*A building value for one of the Day Care facilities could not be identified at time of the Plan update



# APPENDIX 9 – Valley View Success Story

**HAZARD MITIGATION ASSISTANCE (HMA)**  
 FEMA Hazard Mitigation Assistance (HMA) programs present a critical opportunity to reduce risk to individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds.

**DR-1651 HAZARD MITIGATION GRANT PROGRAM (HMGP)**  
 As a result of the federal disaster declaration FEMA-DR-1651-OH declared on July 2, 2006, funding was made available through the Hazard Mitigation Grant Program (HMGP) to provide grants to local governments to fund long-term mitigation measures. The declaration was based on damage resulting from severe storms, tornadoes, straight line winds, and flooding during the period of June 21-23, 2006.

## Hazard Mitigation Assistance (HMA) Valley View - Success Story



Murray Road - Elevated structure during the February 28, 2011 flood event.

The Valley View DR-1651-HMGP project elevated 9 structures and will acquire one property and the associated structure. The finished floor elevations of the nine structures are two feet above the 1% annual-chance flood elevation. The structure on the property that is acquired will be demolished, and the property will be deed restricted and maintained by the Village of Valley View as open space in perpetuity.

### Project Highlights:

- Benefit Cost Ratio (BCR): 1.19
- Project Benefits: \$1,710,625
- Project Cost: \$1,437,500
  - Federal: \$1,078,125 (75%)
  - State: \$159,375 (11.1%)
  - Local: \$200,000 (13.9%)(Local Cost Breakdown – 120K Increased Cost of Compliance Funds, 50K In-kind project management, 30K Cash)
- 6 of the 10 properties are on the NFIP repetitive loss list
- Structures account for 25 flood insurance claims with a combined payout of \$462,207.95

The original scope of work for this project included the acquisition of two structures, and the elevation of up to twenty-one structures. The number of properties to be mitigated was reduced due to higher than projected costs to elevate the split-level structures in this project. The benefit cost analysis for the project was recalculated based on the new scope of work.

Ohio Emergency Management Agency



## Additional Photographs

### FUTURE PROJECTS

Approved September 17, 2010, under the Pre-Disaster Mitigation (PDM) program to elevate up to 13 structures. Once elevated, the finished floor of the structures will be two (2) feet above the 100 year (1% annual chance) flood elevation.

#### Project Funding Break-Down:

Federal \$1,173,600 (75%)

Local Share \$391,200 (25%)

The local share is being paid by the homeowners.



Murray Road Property – Before Elevation



Murray Road Property – Photo taken following February 28, 2011 flood event. Notice the high water mark.



Above: Fosdick Road Property – Photos taken April 6, 2010



Right: Fosdick Road Property – Photos taken during February 28, 2011 flood event



## APPENDIX 10 – Community Mitigation Activities

Community	Completed Mitigation Activities Post 2004	Current Mitigation Activities	Future Mitigation Activities
Bay Village		Bay Village is currently working with the US EPA, completing a study to eliminate sewer overflows and relieve flooding of residential basements	
Bedford Heights	Replacement of Randolph Road 60" diameter storm sewer (2009) - the project consisted of the replacement of a crushed corrugated metal pip with a concrete sewer. The project was successful.		
Brecksville	Constructed the Edgerton Road Regional Storm Water Management Facility; upsized the Tamarack Trail culvert; installed/increased storm sewers along Greenhaven Parkway; dredged the drainage channel from Riverview Road into National Park Service at Greenhaven Parkway.	Drainage channel reconstruction from Riverview Road into Bational Park Service at Wiese Road; Picha Lake/Timber Trail Storm Water Management Facility restoration	
Brook Park	Various ditch cleaning projects completed- intended to restore ditches hydraulic characteristics, Smith Road Sanitary Relief Sewer- Phase 1 and Phase 2 - provide		Possible future municipal stormwater detention basin

Community	Completed Mitigation Activities Post 2004	Current Mitigation Activities	Future Mitigation Activities
	additional sanitary sewer capacity for large portion of community		
Brooklyn Heights	We have fixed the flooding problem at Lancaster and Ganger and have rebuilt the culvert	Resurfacing Lancaster and fixing sewers	
Chagrin Falls		Modification of Lower Ivex Dam	
Cleveland Heights	Stormwater Management Plan	Stormwater Management Plan	
Cleveland		We are in the process of working with 4900 W. 150 <sup>th</sup> Street, Shelly Company, to resolve flooding issues that occurred due to a culvert placed by the residents.	
Cuyahoga Heights	Installed tornado sirens		Nicky Boulevard Landfill Storm Sewer Improvements
Euclid	Adopted an Emergency Operations Plan, but have not done anything in regards to Floodplains		
Garfield Heights		Catch basin repair 2011	
Glenwillow	Erosion Control, Tinkers Creek Bank Stabilization at Pettibone Road		
Independence	Granger Road Building Demolitions within Flood Zone - 2008, Lower Brookside North Channel Sediment Removal Project – 2008/2009	Section 205 ACOE Flood Study (Independence and Valley View), Lower Brookside Watershed Study (EPA WPCLF Loan), Backflow Valve installations at four residences on Elmwood Avenue,	Potential mitigation projects as determined by and as a result of the section 205 Flood Study, Lower Brookside Watershed Study and Sunset/Chestnut Sewer



Community	Completed Mitigation Activities Post 2004	Current Mitigation Activities	Future Mitigation Activities
		Josephine/Chesnut/Wood/Sunset Sewer Flow Monitoring	flow monitoring investigation.
Maple Heights	Philip and Clement Sewer Replacement Project- reduced occurrence of basement flooding		
Mayfield Heights	Eliminated low spot on Mayfield Road w/new storm sewers, Creation of "All Hazard Emergency Operations Base Plan"	Storm Water Infrastructure Fund Demonstration Project – Green Infrastructure installation for educational purposes	Working with Cuyahoga County Engineers office to improve storm and sanitary sewers to reduce basement back-ups.
Newburgh Heights	East 38 <sup>th</sup> Street – Sanitary Sewer Separation Brow Avenue and East 53 <sup>rd</sup> Street – Sanitary Separation Bridgeview and Washington Park Blvd. – No longer a problem		
North Olmsted		WWTP & Collection System Improvements currently in design	Yes, currently in assessment & planning stages.
North Royalton		*See information at end of table	
Olmsted Falls	The City has completed a storm sewer replacement project along Lindberg Blvd (south of West Rd) in 2009.	The City has reviewed storm sewer problems in the area of Mapleway Drive (South of Bagey Rd and is in the process of final design of the system placement.	Pending the resolution of funding, the City is considering the replacement of storm sewer in the area of Cook Rd, Cranage, Mapleway, (North of Elm Street) and Clark

Community	Completed Mitigation Activities Post 2004	Current Mitigation Activities	Future Mitigation Activities
			Street.
Orange	Bioretention was installed along Sterncrest Rd to prevent road flooding		
Parma	<p>2003-2004 Terry Greathouse Wetlands – constructed wetlands to help improve water quality</p> <p>2005 Sterns Farm – 1000 ft of stream restoration – to help improve water quality and flood capacity</p> <p>2009 Site 11 (ODNR) – Stream Restoration - to help improve water quality and flood capacity</p> <p>2005-2006 West Creek Preservation Committee constructed the "Washout Project" at the Sprague-Keystone Interceptor.</p>	<p>The City is working with the Cleveland Metroparks to construct the New Stewardship Center in the West Creek Reservation which includes various wetland mitigations and the restoration of Creek 55. The City is currently engaged in the design and construction of a detention basin to help alleviate flooding in the Abraham /Gabriella Area.</p>	<p>The West Creek Preservation Committee will be constructing a 1000 ft of stream restoration and two acres of wetland through the Site 14 project. Additionally, the revegetation of Snake Hill may be planned. West Creek Preservation Committee is also planning to construct an Urban Stormwater Retrofit through the disconnection of down spouts and the directing of discharge to bio-swales on a conservation easement.</p>
Pepper Pike			Yes. Pepper Pike continues to look for low-cost opportunities to reduce flooding and

Community	Completed Mitigation Activities Post 2004	Current Mitigation Activities	Future Mitigation Activities
			provide infrastructure improvements that benefit the property owners of Pepper Pike.
Rocky River	*See information at end of table	The six projects listed for 2011 are under way or soon to get under way.	The City of Rocky River plans to pursue sewer corrections until all problem sewers have been repaired or replaced.
Solon	The city approved the demolition of existing structures at 29300 Cannon Road which were within the 100yr floodplain and have now been turned back to their natural state.		The city will look into and pursue mitigation opportunities as they may present themselves.
South Euclid	Nine Mile Creek/Langerdale Retention Basin Project-2007	Rehabilitation of sewer system to reduce basement flooding and enhance pavement drainage- ongoing effort	Similar to projects referenced before
Valley View	Installed tornado sirens	Yes, elevation of homes above the Base Flood Elevation, Acquisition/Demolition of a home in the Special Flood Hazard Area	Elevation of homes above the Base Flood Elevation, Check valves on storm culverts, storm sewer replacement, storm sewer repairs
Warrensville Heights		Cuyahoga County Health Department currently working on a creek stabilization project along Bear Creek near	Only if funding is available

Community	Completed Mitigation Activities Post 2004	Current Mitigation Activities	Future Mitigation Activities
		Clarkwood Avenue	
Westlake	I & I Reduction Program Citywide	I & I Reduction 2011	Yes I & I Reduction

North Royalton:

*Pamela Drive Storm Sewer Improvements (FEMA grant)*

- Alleviated flooding of homes by installing a parallel storm sewer system to handle the surface drainage

*Maple Lane Drainage Improvements*

- Upsized culvert under roadway and provided better drainage for this area subject to frequent flooding

*Gregory Lane Drainage Improvements*

- Redefined drainage swales in the right of way and rear yards to help alleviate frequent flooding in this area

*Biro Ditch Rehabilitation*

- Redefine and reestablish design cross sections of this man-made ditch to help water flow

*Chesapeake Regional Detention Basin*

- Creation of a large regional detention basin to mitigate flows downstream in the York Road area, north of Albion Road

*Multiple Property Acquisitions (FEMA grant)*

- Acquire and demolish 6 properties throughout the City that were prone to flooding and allow the area to return to its natural floodplain

*Abbey Road Retrofits (FEMA grant)*

- Retrofit 4 homes along Abbey Road with floodproofing, backflow valves and sump pumps to help alleviate frequent flooding of these structures

*Culvert Removal (5228 Edgerton)*

- Removal of this undersized culvert to allow storm water flow to the newly installed bridge at Edgerton Road (East Branch of the Rocky River)

Rocky River:

19 sewer remediation projects since 2004 have reduced infiltration of storm water into the sanitary sewer system reducing basement flooding due to overtaxed sanitary sewers in heavy rainfall/snow melt conditions:

Wagar Rd Morewood to north of the RR tracks Storm/Sanitary 2001  
Wagar Rd Hilliard to Center Ridge Storm/Sanitary 2002  
Inglewood Wooster to Winfield Storm/Sanitary 2004  
Northview Hilliard to Westway Storm/Sanitary 2004  
Hilliard Wagar to Northview Storm 2004  
Hilliard Forestview to Northview Sanitary 2004  
Hilliard West Corp. to Spencer Creek N. side Storm 2004  
Hilliard West Corp. to Tonawanda S. side Sanitary 2004  
Pocono Goldwood to Tonawanda Sanitary 2004  
Tonawanda Pocono to Hilliard Sanitary 2004  
Aberdeen Parklawn to Wagar Storm/Sanitary 2004  
Wooster Wooster Pkwy to and into Fairview Storm/Sanitary 2004  
Westover Wooster west to Linden Park Storm/Sanitary 2007  
Roslyn Frazier to Argyle Storm/Sanitary 2007  
Elmwood Erie to North of the RR tracks Storm/Sanitary 2010  
Lake Rd Morewood to E. of Linda St. Storm/Sanitary 2011  
Valley View All - including pipe in the Metro Park Storm/Sanitary 2011  
Edgewood All - Valley View to the Western end Storm/Sanitary 2011  
High Pkwy From E. Shoreland west to 18500 Storm/Sanitary 2011  
E. Shoreland Valley View west to 18820 Storm/Sanitary 2011  
Winfield All - E. Shoreland to Valley View Storm/Sanitary 2011

# APPENDIX 11 – Comprehensive Listing of Streambank Erosion Areas

Streambank Erosion Areas*			
Community	Problem Description	Potential Solution**	Estimated 2010 Construction Cost
Bedford	Streambank erosion and flooding along Wood Creek, from the northern border of Bedford to Conrail. City would like the culverts/bridges along Wood Creek to be replaced or repaired.	Construct 4530 LF of 9' high eathern flood berm; includes 8 acres clearing/grubbing, 7725 CY unsuitable material removal and 1 detention facility control structure.	\$3,966,536.77
Bedford Hts., North Randall, Warrensville Hts.	Streambank erosion from I-271 to a point approximately 100' downstream of the Conrail Railroad.	Construct additional pipe culverts at Conrail, Green Road, and Miles Road crossings of Tinkers Creek Tributary 3.	\$2,378,961.49
Bedford Hts., North Randall, Warrensville Hts.	Streambank erosion from Miles Rd. to Libby Rd. There are flooding and erosion problems along all of Bear Creek in these communities.	Construct an additional culvert, using trenchless technology, at the I-480 crossing of Bear Creek Main Branch.	\$4,070,038.09
Bedford Hts., North Randall, Warrensville Hts.	Streambank erosion from Miles Rd. to Libby Rd. There are flooding and erosion problems along all of Bear Creek in these communities.	Widen channel upstream of I-480 in Bear Creek Main Branch.	\$934,062.13
Bedford Hts., North Randall, Warrensville Hts.	Streambank erosion from Miles Rd. to Libby Rd. There are flooding and erosion problems along all of Bear Creek in these communities.	Replace service bridge upstream of I-480 in Bear Creek Main Branch.	\$401,936.08
Bratenahl	Erosion and flooding from Conrail railroad to the mouth of Nine Mile Creek. The community confirmed flooding in this area.	No solution has been suggested at this time	

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
Brecksville	Railroad flooding and channel erosion from downstream of Riverview Rd., to the Brecksville/Sagamore Hills community boundary.	No solution has been suggested at this time.	
Brecksville	Channel erosion from a point 400' south of the intersection of Bradford Ln. and Chippewa Creek Dr. to Riverview Rd.	No solution has been suggested at this time.	
Brecksville	Undersized channel and erosive flow from Chippewa Creek Dr to Brecksville Rd. From Brecksville Rd to the corp line, there is flooding the City would like to be addressed the SMP. The flooding is from overland flow to Chippewa Creek. Structures are extremely close to the streambank in this area.	Construct concrete encasements around exposed utilities from intersection of Harris Rd. and Old Royalton Rd. to 1,500' upstream of Brecksville Rd.	\$88,133.28
Brecksville	Undersized channel and erosive flow from Chippewa Creek Dr to Brecksville Rd. From Brecksville Rd to the corp line, there is flooding the City would like to be addressed the SMP. The flooding is from overland flow to Chippewa Creek. Structures are extremely close to the streambank in this area.	Purchase 1 structure, construct three concrete floodwalls, 2', 3', and 6' in height and construct three earthen flood berms, 2', 3', and 6' in height from the confluence 1000' upstream of Old Royalton Rd. to Brecksville Rd.	\$1,209,142.27
Broadview Hts.	Severe inflow & infiltration due to an exposed sewer. There is heavy erosion and debris along this stretch of Chippewa Creek.	Construct concrete encasement around exposed utilities 1000' upstream of Avery, 4500' upstream of I-77 and 800' downstream of I-77, construct 250 L.F. of 6' concrete floodwall	\$1,487,200.00



<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
		500' upstream of Avery Rd to protect one structure from flooding.	
Broadview Hts.	Arterial road flooding and erosion along Chippewa Creek from W. Royalton Rd. to the confluence with South Branch 7.	No solution has been suggested at this time.	
Brook Park	Street flooding and potential erosion from Holland Rd to the Main Branch of Abram Creek, east of Hayes Industrial Park. Sheldon Rd floods in this area, isolating Haviland Dr. and Wedgewood Dr, south of this branch. This may be due to streambed having been raised through a peat bed.	Raise 1 section of roadway, and replace/repair 1 driveway entrance on Holland Dr, east of Eastland Dr.	\$526,373.30
Brook Park	Structure, local street and arterial street flooding and channel erosion in Big Creek, south of Brookpark Road and W. 140th St. West 130th Street and Softball World have been subject to occasional flooding. The City believes that there is a large 5-6' CMP culvert located in Holy Cross Cemetery that is failing and may be source of the problem.	Construct 1,000' of culvert (replacing the sewer) under Brookpark Road. (This may or may not address the possible cemetery culvert failure.)	\$1,681,833.92
Brooklyn	Building flooding and channel erosion along Big Creek, from Biddulph to Memphis Rd. There is some yard flooding in this area, and concern about proximity of dwellings to Big Creek	Construct 300 LF of 2'-5' earthen flood berm to protect 1 apartment building (includes 300 LF land/easement acquisition).	\$93,352.90

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
Brooklyn	Road flooding and channel erosion immediately downstream of Ridge Rd. to just upstream of Biddulph Rd.	Replace culvert at Ridge Rd.	\$5 226 873 10
Brooklyn Hts., Seven Hills	The immediate area off of Belmont Drive - in Seven Hills and Brooklyn Heights is in a Zone A Flood Area. Seven Hills reports no problem there. Brooklyn Heights has a severe erosion/undermining problem at the cul-de-sac in Belmont Dr. The culvert under I-480 may be undersized. Soccer fields in area never dry out.	No solution has been suggested at this time.	
Brooklyn Hts.	Channel erosion from I-480 to stilling basin and West Creek tributaries S05 and N01. This erosion threatens structures on Resource Dr.	Repair Lancaster Rd culvert, construct stilling basin and stabilize bank with rip rap and vegetation in West Creek Main Branch just downstream of Lancaster Rd.	\$695,000.27
Brooklyn Hts., Seven Hills	Channel erosion from I-480 to stilling basin and West Creek tributaries S05 and N01. This erosion threatens structures on Resource Dr.	Complete 950 LF of channel widening and streambank stabilization in West Creek Tributary S05, north of Rockside Rd.	\$591,807.73
Brooklyn, Parma	Building, property and road flooding, and channel erosion from the railroad south of I-480 to Westview Dr. Parma confirmed flooding of an apartment building at the north corpline.	Channel widening and culvert replacement south of Brookpark Rd. to north of railroad on East Branch.	\$5,614,239.97
Cleveland	Flooding and erosion along Doan Brook confirmed by the City.	Comprehensive solution redesign of 12,000 LF of open channel, redesign of detention	\$11,522,785.58

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
		facility outlet structure and bioengineering of 8,000 LF of open channel.	
Cleveland	Bankfull conditions and potential erosion south of the Conrail yard at the double culvert split.	Construct a ravine storage facility along Green Rd., south of Euclid Ave.	\$1,214,008.76
Cleveland	Road, building and property flooding, and channel erosion near the Metroparks Zoo. The Zoo has regraded around Big Creek to relieve some of the flooding and erosion.	No solution has been suggested at this time.	
Cleveland	Road, building and railroad flooding, and channel erosion from Jennings Rd. to the railroad tracks. The City of Cleveland confirmed this erosion	Erosion measures along south bank of Big Creek Main Branch west of Jennings Rd.	\$23,364.16
Cleveland	Road, building and railroad flooding, and channel erosion from Jennings Rd. to the railroad tracks. The City of Cleveland confirmed this erosion.	Erosion measures on the north bank of Big Creek Main Branch, north of Valley Rd, between Jennings and Pearl.	\$933,528.96
Cleveland	Road, building and railroad flooding, and channel erosion from Jennings Rd. to the railroad tracks. The City of Cleveland confirmed this erosion.	Purchase 4 properties near Big Creek Main Branch, east of Cleveland Metroparks Zoo.	\$1,421,322.85
Cleveland	Building and road flooding and channel erosion from Biddulph Ave. to Bader Ave. There is confirmed erosion at Biddulph and RR flooding near I-480.	Construct 22.0 MG of detention upstream of Stickney Branch in Walter's Grove Park in Parma.	\$3,294,933.24
Cleveland	Building and road flooding and erosion from Emery Ave. to Puritas Ave. The	Divert 110 cfs to Big Creek East Branch north of I-480.	\$3,434,423.41

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	City plans to replace 8 culverts and install detention in 2010-2011 for \$3.6 mil/ \$2-2.5 mil, respectively.		
Cleveland	Building and road flooding and erosion from Emery Ave. to Puritas Ave. The City plans to replace 8 culverts and install detention in 2010-2011 for \$3.6 mil/ \$2-2.5 mil, respectively.	Replace or repair 11 culverts (~11 each x 40' = 440 feet per City of Cleveland) and restore lower channel from Emery to Carrington.	\$4,181,987.47
Cleveland, Parma	Big Creek - Chevy Branch flooding and erosion	Construct 2 dry detention basins. Preliminary design is complete.	\$3,785,600.00
Cleveland Hts.	Serious erosion along Randolph Rad affecting some homes from Quilliams Rd to Woodview Rd. Structures (garages) are threatened in this area. Debris in the ravine needs cleaning as well.	Construct a 20 MG dry detention basin.	\$2,386,102.62
East Cleveland	There are erosion problems in Nine Mile Creek along Superior Road at Lambert Street and through Forest Hills Park Flooding at Lambert. Erosion is due to rerouting of stream around debris buildup on trash rack in park.	No solution has been suggested at this time.	
East Cleveland	Flooding of Nine Mile Creek in the area of Terrace Road, Euclid Ave and Shaw Ave. Erosion along Stanwood Road is threatening the roadway. There was a sinkhole in a resident's backyard on Taylor Rd.that the City	Construct a 6.5 MG impoundment for stormwater in the ravine north of Dresden Rd, in Cleveland Heights.	\$906,846.97

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	repaired with emergency funds.		
Garfield Hts.	Channel erosion along Mill Creek	Culvert Replacement at Broadway Ave. at the North Branch 45 crossing.	\$2,392,501.36
Garfield Hts.	Mill Creek flooding and erosion problems from near the Chaincraft Rd culvert upstream to Broadway Ave. According to the tech memo, there is severe erosion at Clearview Rd. This problem is specifically the flooding of three commercial buildings south of the I-480 ramp.	Construct 1,167 LF of 5'-7' concrete floodwall along Broadway Ave downstream of McCracken Rd.	\$205,348.25
Garfield Heights/ Cuyahoga Heights	Mill Creek erosion threatens Warner Road.	Stream Restoration (approximately 500' or less).	\$3,785,600.00
Highland Hills	Streambank erosion in Mill Creek, 2 exposed utilities, near Alameda.	2,300 SY rock stabilization and 4 pier replacements. The community interview referenced an Alameda project, which is in the area of the problem.	\$386,248.01
Independence	There is erosion on approx. 2000 feet of the Cuyahoga River along Lower Brookside Road south of Pleasant Valley Road.	No solution has been suggested at this time.	
Lyndhurst	Street and structure flooding and erosion of Euclid Creek from Brainard Rd to Thornbury Blvd/Parkview Dr. Hydraulic issues, some basement flooding; there may still be cross-	Widen and restore 500 LF channel, install 60 LF culvert, install 5290 LF storm sewer. 5,700 SF roadway raising and 2650 SF driveway/sidewalk replament may be integral to this plan.	\$11,476,424.96

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	connections along reach. This problem is erosion only.		
Lyndhurst	Street and structure flooding and erosion of Euclid Creek from Brainard to Thornbury/Parkview. Hydraulic issues, some basement flooding; there may still be cross-connections along reach.	5700 SF of roadway raising, including 2650 SF driveway and sidewalk replacement.	\$89,989.12
Mayfield	Immediately west of SOM Center Rd, there is erosion and high stream velocity, from this area to the upstream end of Beechers Brook. The Village constructed a waterfall at this location to help control velocity.	No solution has been suggested at this time.	
Mayfield	Debris and maintenance issues coupled with several in-series culverts leads to severe flooding and erosion by Beechers Brook in the area of Worton Park Dr.	Construct 205 L.F. of floodwall along Worton Park Road and construct a 15.15 MG extended detention basin including 1.14 MG extended detention for WQ. Incl 5.81 acres land/ease acq & 6 acres clearing & grubbing.	\$3,137,078.05
Mayfield	Yard flooding along Beechers Brook, as well as erosion and sediment problems.	Construct a 10.4 MG dry detention basin, including 2.22 MG extended detention for water quality (incl. 3.19 acres land/ease acq).	\$2,011,250.34
Middleburg Hts., Parma	Flooding and widespread erosion along this stretch of Baldwin Creek, in Middleburgh Heights and	Raise 10,000 SF of roadway, incl. replacing 300 SF driveway/sidewalk and construct of 1,150 LF of	\$381,487.89

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	Parma.	flood berm.	
Middleburg Hts.	Potential erosion and structure flooding upstream of Webster Rd.	Construct a 515 LF earthen flood berm on the southeast side of the intersection of Baldwin Creek and Webster Ave. The City is currently constructing a retaining wall in approximately this location.	\$193,596.12
Middleburg Hts.	Potential erosion and structure flooding upstream of Webster Rd.	Construct an 890 LF concrete floodwall along the north side of Baldwin Creek, from west of Bagley Rd to approximately Glenridge Ave.	\$202,394.26
Middleburg Hts., Strongsville	Bankfull conditions, potential erosion, and structure flooding from downstream of Lucerne Dr. to downstream of the Pearl Rd culvert. The communities reported no major problems in this area. Strongsville received a complaint from a Middleburg Heights resident.	Construct 1 concrete floodwall at the Strongsville Treatment Plant Property.	\$266,018.71
North Royalton	Flooding and erosion along Bunker Rd & Oakridge Dr.	No solution has been suggested at this time.	
North Royalton	Bankfull conditions, potential erosion, and structure flooding from the Baldwin Creek confluence with tributary East Branch No. 4 downstream to W. Sprague Rd.	Construct a 460 LF earthen berm to protect residential property on the west side of Abbey Rd, south of Sprague Rd.	\$317,927.73
North Royalton	Flooding and erosion of	Install 60 LF of culvert and	\$345,895.68



Streambank Erosion Areas*			
Community	Problem Description	Potential Solution**	Estimated 2010 Construction Cost
	Baldwin Creek from approximately Lynn Dr to Sprague Rd.	750 LF of flood berm.	
Olmsted Falls	Flooding and erosion along Bagley Road from I-80 to Columbia Rd.	Between Mill Street and Orchard Rd, replace Bagley Road culvert with 8' high, 50' span, 65' wide bridge. Also, replace railroad arch culverts with four 8' x 12' box culverts using trenchless installation.	\$2,103,311.13
Olmsted Falls	Flooding and erosion along Bagley Road from I-80 to Columbia Rd.	Reroute 900 LF of stream and stabilize 4 homes along previous stream location, at Usher Rd. between Brentwood Dr. and Kingswood Dr.	\$1,760,294.81
Olmsted Falls	Residential flooding and erosion of Plum Creek north of Sprague Rd. to I-80	Build a concrete flood wall to prevent Sprague Rd from flooding & revegetate bank along Sprague Road, between Jacquay and Usher Roads.	\$105,577.68
Omsted Township	Structure flooding and erosion in Busby Ditch, from I-80 to Carl Lane. Erosion in Busby Ditch along Schady Rd, 3100' east of Stearns Rd. There is also basement flooding in this area.	Widening and restoration of 1,585 LF of channel, near Skyline Dr and between Brentwood Dr. and Glenbrook Dr. (includes 2,140 CY excavation & 1.09 acres land/easement acquisition).	\$783,148.70
Parma Hts.	Erosion at the bend in the Big Creek near Anthony Ln. A resident installed railroad ties as bank stabilization and the City has not received complaints since that time.	No solution has been suggested at this time.	
Pepper Pike	Minor ongoing issues with erosion and debris.	No solution has been suggested at this time.	
Pepper Pike	Minor ongoing issues with	No solution has been	

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	erosion.	suggested at this time.	
Seven Hills	Stream debris from Rangeview Dr. between Kuenzer Dr. and N. Crossview Rd. There is significant erosion and some flooding in the area but the city has no easements to access the area.	Construct streambank stabilization using rip rap and vegetation in Tributary S05, near Resource Dr. and I-480.	\$133,034.36
Shaker Hts.	Erosion along the south branch of Doan Brook, east from Green Lake, through the golf course.	No solution has been suggested at this time.	
South Euclid	From Brainard Rd. to confluence of Euclid Creek at the intersection of Green Rd. and Anderson Rd., there is arterial and local street flooding, structure flooding (12 flooded basements), surface flooding, channel erosion, exposed pipe and heavy, natural debris. City installed backflow preventors to stop storm to sanitary backups.	Install 15 CY concrete encasement for exposed sanitary pipe perpendicular to Euclid Creek, directly south of Bryan Drive.	\$17,846.40
South Euclid	General erosion in the area; and an eroded headwall near Mcfarland Rd. and Haywood Dr.	No solution has been suggested at this time.	
South Euclid	General erosion in the area; and an eroded headwall near Mcfarland Rd. and Haywood Dr.	No solution has been suggested at this time.	
Strongsville, Middleburg Hts.	Bankfull conditions, potential erosion, and street and structure flooding from the	Install 193 CY compacted clay backfill and 167 SY rip rap with live facines, just downstream of Main St.	\$128,827.00

<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	confluence with SE branch of Baldwin Creek to approximately 1000' downstream of Main St.	culvert.	
Strongsville	Bankfull conditions, potential erosion, and street and structure flooding from the confluence with SE branch of Baldwin Creek to approximately 1000' downstream of Main St.	Construct an earthen flood berm to protect 1 residential property on the northwest side of the Main Street bridge over Baldwin Creek.	\$362,298.14
Strongsville	Bankfull conditions, potential erosion, and street and structure flooding from the confluence with SE branch of Baldwin Creek to approximately 1000' downstream of Main St.	Construct a 510 LF concrete floodwall along Main Street (Rocky River Drive).	\$420,088.03
Strongsville	Erosion problems in Blodgett Creek from Progress Dr to Prespect St	No solution has been suggested at this time.	
Valley View	Erosion and debris problems east of Canal Rd & south of Tinkers Creek Rd.	Encase 250 feet of exposed utility in concrete. Complete streambed stabilization/ regrading 100 feet upstream and downstream of pipe.	\$244,808.71
Valley View	Hub Parkway storm sewer work to address erosion problems.	No solution has been suggested at this time.	
Walton Hills	Structure and local street flooding and erosion of undersized channel of Tinkers Creek Main Branch in Walton Hills and Valley View. Undermining of CEI electrical tower.	Construct 1,350 LF of 2'-5' earthen floodberm and 300 LF of 2'-5' concrete floodwall (includes 1650 LF land/easement acquisition).	\$499,548.86
Walton Hills	Structure and local street	Purchase two properties.	\$1,111,344.00


<b>Streambank Erosion Areas*</b>			
<b>Community</b>	<b>Problem Description</b>	<b>Potential Solution**</b>	<b>Estimated 2010 Construction Cost</b>
	flooding and erosion of undersized channel of Tinkers Creek Main Branch in Walton Hills and Valley View. Some structures at the Astorhurst Center may be in the floodplain.		
Warrensville Hts.	Huge erosion problem-most pressing issue in the City. Backyards are being eroded away near Longbrook Rd. and Cricket Ln. along Mill Creek, south of South Pointe Hospital. Backyards undermined and washing away, exist. bank protection compromised. The City is unsure of how to advise affected residents.	The City might consider redevelopment options, perhaps as part of a master plan. Could purchase the affected homes. Mill Creek report suggests modification of gabioned sections with a step pool system.	\$1,487,200.00
<b>Sum of construction estimates (excluding maintenance): \$90,999,014.40</b>			

\*List based off of NEORS D Stormwater Management Program Preliminary Construction Planning. Not comprehensive: NEORS D does not serve Chagrin Falls, Chagrin Falls TWP, Bentleyville, Woodmere, Fairview Park, Rocky River, Bay Village, North Olmsted and Westlake.

\*\* Most of the potential solutions were developed during the Regional Intercommunity Drainage Evaluation conducted by NEORS D in 2001-2004 for the purpose of estimating the costs for a regional stormwater management program. Solutions have not been confirmed with the property owners.

# APPENDIX 12 – Identifiable Action Items Specific to Jurisdiction

ACTIONS ➔	Severe Storms							Flash Flooding					100 Year Floodplain Flooding				Non-Flood Zone Flooding			Severe Winter	Tornadoes				Temp Extrms	Erosion and Landslides			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Bay Village	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Beachwood	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bedford	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bedford Heights	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bentleyville	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Berea	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bratenahl	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Brecksville	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Broadview Heights	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Brooklyn	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Brooklyn Heights	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x
Brook Park	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Chagrin Falls	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Chagrin Township	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cleveland	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cleveland Heights	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cuyahoga Heights	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x
East Cleveland	x	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x
Euclid	x	x	x	x	x	x	x	x	x	x	x	x			x			x	x	x	x	x	x	x	x	x	x	x	x
Fairview Park	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x
Garfield Heights	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Gates Mills	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Glenwillow	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x
Highland Hills	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x
Highland Heights	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hunting Valley	x	x	x	x	x	x	x	x	x	x	x	x			x			x	x	x	x	x	x	x	x	x	x	x	x
Independence	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x
Lakewood	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Linndale	x	x	x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x
Lyndhurst	x	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x
Maple Heights	x	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x

ACTIONS 	Severe Storms							Flash Flooding					100 Year Floodplain Flooding				Non-Flood Zone Flooding			Severe Winter	Tornadoes					Temp Extrms	Erosion and Landslides			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Mayfield Heights	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Mayfield Village	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Middleburg Heights	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x		
Moreland Hills	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Newburgh Heights	x	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x		
North Olmsted	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
North Randall	x	x	x	x	x	x	x	x	x	x	x	x			x		x	x	x	x	x	x	x	x	x	x	x	x		
North Royalton	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Oakwood Village	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x		
Olmsted Falls	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Olmsted Township	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Orange Village	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x		
Parma	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Parma Heights	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x		
Pepper Pike	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Richmond Heights	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Rocky River	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Seven Hills	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x		
Shaker Heights	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x		
Solon	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x		
South Euclid	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x		
Strongsville	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
University Heights	x	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x		
Valley View	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		
Walton Hills	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x		
Warrensville Heights	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Westlake	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Woodmere	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x		

## APPENDIX 13 – Summary Table of Community Participation for 2011 Update

Community	2011 Survey	Hazard Assessment Matrix
Bay Village	X	
Beachwood	X	
Bedford	X	
Bedford Heights	X	X
Bentleyville	X	X
Berea	X	
Bratenahl	X	
Brecksville	X	X
Broadview Heights	X	
Brooklyn	X	X
Brooklyn Heights	X	
Brook Park	X	X
Chagrin Falls	X	X
Cleveland	X	
Cleveland Heights	X	
Cuyahoga Heights	X	X
East Cleveland	X	X
Euclid	X	
Fairview Park	X	
Garfield Heights	X	X
Gates Mills	X	
Glenwillow	X	X
Highland Hills	X	
Highland Heights	X	
Hunting Valley	X	
Independence	X	X
Lakewood	X	



<b>Community</b>	<b>2011 Survey</b>	<b>Hazard Assessment Matrix</b>
Linndale	X	
Lyndhurst	X	
Maple Heights	X	
Mayfield Heights	X	X
Mayfield Village	X	X
Middleburg Heights	X	
Moreland Hills	X	
Newburgh Heights	X	
North Olmsted	X	X
North Randall	X	
North Royalton	X	
Oakwood Village	X	
Olmsted Falls	X	
Olmsted Township	X	
Orange Village	X	
Parma	X	
Parma Heights	X	X
Pepper Pike	X	
Richmond Heights	X	X
Rocky River	X	X
Seven Hills	X	
Shaker Heights	X	
Solon	X	X
South Euclid	X	X
Strongsville	X	X
University Heights	X	
Valley View	X	
Walton Hills	X	X
Warrensville Heights	X	
Westlake	X	
Woodmere	X	

## APPENDIX 14 – Original Mitigation Core Group Members

2004 Mitigation Core Group Members	Organization
Paul Alsenas	Cuyahoga County Planning Commission
Dan Meaney	
Richard Sicha	
Howard Maier	Northeast Ohio Areawide Coordinating Agency
Ron Eckner	
Rich Connelly	Northeast Ohio Regional Sewer District
Rich Lavery	Cuyahoga County Engineer's Office
Tracey Nichols	Cuyahoga County Department of Development
Harry Conrad	
Kory Koran	Rocky River
Martin Baier	Cuyahoga County Board of Health (Cleveland, Lakewood and Shaker Hts. Boards of Health)
Terry Allan	
Mark Ricchiuto	Cleveland Department of Public Service
Deborah Sutherland	Mayors and City Managers Association
Ed Egut	Brecksville Fire Department
Ken Rybka	Bedford Fire Department
Ken Ledford	Bedford Heights Fire Department
Murray Withrow	Cuyahoga County Emergency Services
Jeanne Schmotzer	
Brigette Bouska	OEMA
Lt. John Dixon	Bay Village Police Dept.
Chief Patrick J. Kearns	Beachwood Fire Dept.
Chief Lee Ippolito	Broadview Heights Fire Dept.
Chief Paul Duchoslav	Brooklyn Fire Dept.
Chief Mark Schrade	Brooklyn Heights Fire Dept.
Asst. Chief Timothy O'Toole	Cleveland Fire Dept.
Acting Chief Ron Jonovich	East Cleveland Fire Dept.
Chief David Simon	Fairview Park Fire Dept.
Chief Anthony Collova	Garfield Heights Fire Dept.
Chief Lloyd Noles	Highland Hills Fire Dept.

2004 Mitigation Core Group Members	Organization
Chief Peter Nelson	Independence Fire Dept.
Chief Lawrence Mroz	Lakewood Fire Dept.
Chief William Fisher	Olmsted Falls Fire Dept.
Chief Fred Fritz	Orange Fire Dept.
Chief Chris Flynn	Rocky River Fire Dept.
Chief Richard Pietrick	Westlake Fire Dept.
Alan Finkelstein	Strongsville Fire Dept.
Chief Paul Haney	Strongsville Fire Dept.
Chief David Mohr	Mayfield Village Fire Dept.
Citris Kostura	Orange Village Police Dept.
Chief Don Barnes	Shaker Heights Fire Dept.

## APPENDIX 15 – Community NFIP Participation

Community	NFIP Participation
Bay Village	YES
Beachwood	YES
Bedford	YES
Bedford Heights	YES
Bentleyville	YES
Berea	YES
Bratenahl	YES
Brecksville	YES
Broadview Heights	YES
Brooklyn	YES
Brooklyn Heights	YES
Brook Park	YES
Chagrin Falls	YES
Chagrin Township	YES
Cleveland	YES
Cleveland Heights	YES
Cuyahoga Heights	YES
East Cleveland	N/A
Euclid	NO
Fairview Park	YES
Garfield Heights	YES
Gates Mills	YES
Glenwillow	YES
Highland Hills	NO
Highland Heights	YES
Hunting Valley	NO
Independence	YES
Lakewood	YES

<b>Community</b>	<b>NFIP Participation</b>
Linndale	NO
Lyndhurst	YES
Maple Heights	YES
Mayfield Heights	YES
Mayfield Village	YES
Middleburg Heights	N/A
Moreland Hills	YES
Newburgh Heights	NO
North Olmsted	YES
North Randall	YES
North Royalton	YES
Oakwood Village	YES
Olmsted Falls	YES
Olmsted Township	YES
Orange Village	YES
Parma	YES
Parma Heights	YES
Pepper Pike	YES
Richmond Heights	YES
Rocky River	YES
Seven Hills	NO
Shaker Heights	YES
Solon	YES
South Euclid	YES
Strongsville	YES
University Heights	N/A
Valley View	YES
Walton Hills	YES
Warrensville Heights	YES
Westlake	YES
Woodmere	YES

# APPENDIX 16 – Community Adoption of 2011 Updated Plan