FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 4

CUYAHOGA COUNTY, OHIO

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
BAY VILLAGE, CITY OF	390093	LYNDHURST, CITY OF	390113
BEACHWOOD, CITY OF	390094	MAPLE HEIGHTS, CITY OF	390114
BEDFORD HEIGHTS, CITY OF	390096	MAYFIELD, VILLAGE OF	390116
BEDFORD, CITY OF	390095	MAYFIELD HEIGHTS, CITY OF	390115
BENTLEYVILLE, VILLAGE OF	390682	MIDDLEBURG HEIGHTS, CITY OF	390117
BEREA, CITY OF	390097	MORELAND HILLS, VILLAGE OF	390118
BRATENAHL, VILLAGE OF	390734	NEWBURGH HEIGHTS, VILLAGE OF	390119
BRECKSVILLE, CITY OF	390098	NORTH OLMSTED, CITY OF	390120
BROADVIEW HEIGHTS, CITY OF	390099	NORTH RANDALL, VILLAGE OF	390736
BROOK PARK, CITY OF	390102	NORTH ROYALTON, CITY OF	390121
BROOKLYN HEIGHTS, VILLAGE OF	390101	OAKWOOD, VILLAGE OF	390122
BROOKLYN, CITY OF	390100	OLMSTED FALLS, CITY OF	390672
CHAGRIN FALLS, VILLAGE OF	390103	ORANGE, VILLAGE OF	390737
CLEVELAND, CITY OF	390104	PARMA, CITY OF OF	390123
CLEVELAND HEIGHTS, CITY OF	390105	PARMA HEIGHTS, CITY	390124
CUYAHOGA COUNTY (UNINCORPORATED AREAS)	390766	PEPPER PIKE, CITY OF	390125
CUYAHOGA HEIGHTS, VILLAGE OF	390654	RICHMOND HEIGHTS, CITY OF	390126
EAST CLEVELAND, CITY OF *	390106	ROCKY RIVER, CITY OF	395372
EUCLID, CITY OF	390107	SEVEN HILLS, CITY OF	390128
FAIRVIEW PARK, CITY OF	390108	SHAKER HEIGHTS, CITY OF	390129
GARFIELD HEIGHTS, CITY OF	390109	SOLON, CITY OF	390130
GATES MILLS, VILLAGE OF	390593	SOUTH EUCLID, CITY OF	390131
GLENWILLOW, VILLAGE OF	390735	STRONGSVILLE, CITY OF	390132
HIGHLAND HEIGHTS, CITY OF	390110	UNIVERSITY HEIGHTS, CITY OF *	390133
HIGHLAND HILLS, VILLAGE OF	390127	VALLEY VIEW, VILLAGE OF	390134
HUNTING VALLEY, VILLAGE OF	390594	WALTON HILLS, VILLAGE OF	390636
INDEPENDENCE, CITY OF	390111	WARRENSVILLE HEIGHTS, CITY OF	390135
LAKEWOOD, CITY OF	390112	WESTLAKE, CITY OF	390136
LINNDALE, VILLAGE OF	390069	WOODMERE, VILLAGE OF *	390157

*No Special Flood Hazard Areas Identified

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TABLE OF CONTENTS
Volume 1

		Page
SECTION 1.0 – INTRODUCTION		**1**
1.1	The National Flood Insurance Program	1
1.2	Purpose of this Flood Insurance Study Report	2
1.3	Jurisdictions Included in the Flood Insurance Study Project	2
1.4	Considerations for using this Flood Insurance Study Report	13
SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS		**26**
2.1	Floodplain Boundaries	26
2.2	Floodways	41
2.3	Base Flood Elevations	42
2.4	Non-Encroachment Zones	43
2.5	Coastal Flood Hazard Areas	43
	2.5.1 Water Elevations and the Effects of Waves	43
	2.5.2 Floodplain Boundaries and BFEs for Coastal Areas	46
	2.5.3 Coastal High Hazard Areas	46
	2.5.4 Limit of Moderate Wave Action	48
SECTION 3.0 – INSURANCE APPLICATIONS		**48**
3.1	National Flood Insurance Program Insurance Zones	48
3.2	Coastal Barrier Resources System	51
SECTION 4.0 – AREA STUDIED		**51**
4.1	Basin Description	51
4.2	Principal Flood Problems	52
4.3	Non-Levee Flood Protection Measures	56
4.4	Levees	59
SECTION 5.0 – ENGINEERING METHODS		**59**
5.1	Hydrologic Analyses	59
5.2	Hydraulic Analyses	74
5.3	Coastal Analyses	89
	5.3.1 Total Stillwater Elevations	90
	5.3.2 Waves	95

Figures

	Page
Figure 1: FIRM Index	16
Figure 2: FIRM Notes to Users	19
Figure 3: Map Legend for FIRM	22
Figure 4: Floodway Schematic	42
Figure 5a: Wave Runup Transect Schematic	45
Figure 5b: Wave Overtopping Schematic	45
Figure 6: Coastal Transect Schematic	47

Figures *(continued)*

Page

Figure 7: Frequency Discharge-Drainage Area Curves 72
Figure 8: 1-Percent Annual Chance Total Stillwater Elevations for Coastal Areas 92

Tables

Page

Table 1: Listing of NFIP Jurisdictions 3
Table 2: Flooding Sources Included in this FIS Report 28
Table 3: Flood Zone Designations by Community 49
Table 4: Coastal Barrier Resources System Information 51
Table 5: Basin Characteristics 51
Table 6: Principal Flood Problems 52
Table 7: Historic Flooding Elevations 54
Table 8: Non-Levee Flood Protection Measures 56
Table 9: Levees 59
Table 10: Summary of Discharges 61
Table 11: Summary of Non-Coastal Stillwater Elevations 74
Table 12: Stream Gage Information used to Determine Discharges 74
Table 13: Summary of Hydrologic and Hydraulic Analyses 76
Table 14: Roughness Coefficients 88
Table 15: Summary of Coastal Analyses 90
Table 16: Water Level Station Analysis Specifics 94

Volume 2

SECTION 5.0 – ENGINEERING METHODS (CONTINUED) 96

5.3 Coastal Analyses (Continued) 96
5.3.3 Coastal Erosion 96
5.3.4 Wave Hazard Analyses 96
5.4 Alluvial Fan Analyses 106

SECTION 6.0 – MAPPING METHODS 106

6.1 Vertical and Horizontal Control 106
6.2 Base Map 107
6.3 Floodplain and Floodway Delineation 108
6.4 Coastal Flood Hazard Mapping 147
6.5 FIRM Revisions 149
6.5.1 Letters of Map Amendment 149
6.5.2 Letters of Map Revision Based on Fill 150
6.5.3 Letters of Map Revision 150
6.5.4 Physical Map Revisions 151
6.5.5 Contracted Restudies 151
6.5.6 Community Map History 151

Volume 2 *(Continued)*

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION 156

7.1 Contracted Studies 156
7.2 Community Meetings 163

SECTION 8.0 – ADDITIONAL INFORMATION 180

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES 184

Figures

Figure 9: Transect Location Map 105

Tables

Page

Table 17: Coastal Transect Parameters 99
Table 18: Summary of Alluvial Fan Analyses 106
Table 19: Results of Alluvial Fan Analyses 106
Table 20: Countywide Vertical Datum Conversion 107
Table 21: Stream-Based Vertical Datum Conversion 107
Table 22: Base Map Sources 107
Table 23: Summary of Topographic Elevation Data used in Mapping 108
Table 24: Floodway Data 109
Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams 147
Table 26: Summary of Coastal Transect Mapping Considerations 148
Table 27: Incorporated Letters of Map Change 151
Table 28: Community Map History 152
Table 29: Summary of Contracted Studies Included in this FIS Report 156
Table 30: Community Meetings 164
Table 31: Map Repositories 180
Table 32: Additional Information 184
Table 33: Bibliography and References 185

Volume 3

Exhibits

Flood Profiles Panel

Anthony Lane Tributary to Big Creek 01 P
Aurora Branch 02-04 P
Aurora Branch Tributary 2 05-07 P
Aurora Branch Tributary 3 08 P
Baker Creek 09-11 P
Baker Creek Tributary 1 12 P
Baldwin Creek 13-16 P
Bear Creek 17-20 P
Big Creek 21-25 P
Blodgett Creek 26 P
Cahoon Creek / Dover Ditch 27-34 P
Chagrin River 35-43 P

Volume 3 *(Continued)*

Flood Profiles *(Continued)* Panel

Chagrin River Tributary 1	44-46 P
Chagrin River Tributary 2	47-49 P
Chagrin River Tributary 2.1	50-51 P
Chippewa Creek	52-53 P
Countrymans Creek	54-56 P
Cuyahoga River	57-64 P
Cuyahoga River Tributary 1	65-66 P
Doan Brook	67-77 P
East Branch Rocky River	78-81 P
East Branch Rocky River Tributary 7	82 P
Euclid Creek	83 P

Volume 4

Exhibits

Flood Profiles Panel

Euclid Creek	84-86 P
Euclid Creek Tributary 1.5	87-88 P
Euclid Creek Tributary 1.5.1	89 P
Euclid Creek Tributary 1.6	90 P
Euclid Creek Tributary 2	91-93 P
Fitch Lateral	94-95 P
Hawthorne Creek	96-103 P
Kirk Lateral	104-105 P
Mill Creek	106-113 P
Nine Mile Creek	113b P
Pepper Creek	114-118 P
Plum Creek	119-120 P
Porter Creek (Huntington Creek) / Gifford Avon Ditch	121-122 P
Reservoir Creek	123-124 P
Rocky River	125-126 P
Roots Ditch	127-128 P
Rose Lateral	129 P
Sagamore Creek	130-131 P
Spencer Creek	132-134 P
Sperry Creek	135-137 P
Stone Water Creek	138 P
Stone Water Creek Tributary 1	139 P
Tinkers Creek	140-148 P
Tinkers Creek Tributary 1	149 P
Tinkers Creek Tributary 2	150-153 P
West Branch Rocky River	154-156 P
West Creek	157-158 P
Wilhelmy Creek	159 P
Wischmeyer Creek	160 P
Wood Creek	161-162 P

Published Separately

Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT
CUYAHOGA COUNTY, OHIO

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary Federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the Federal Government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60, *Criteria for Land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the Federal

Government. Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as “Post-FIRM” buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) Report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum Federal requirements. Contact your State NFIP Coordinator to ensure that any higher State standards are included in the community’s regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Cuyahoga County, Ohio.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the United States Geological Survey (USGS) 8-digit Hydrologic Unit Code (HUC-8) sub-basins affecting each, are shown in Table 1. The FIRM panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

The location of flood hazard data for participating communities in multiple jurisdictions is also indicated in the table.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Bay Village, City of	390093	04110001, 04120200	39035C0038F, 39035C0039F, 39035C0126E, 39035C0127F, 39035C0131F, 39035C0132F, 39035C0151F	
Beachwood, City of	390094	04110002, 04110003	39035C0094E, 39035C0113E, 39035C0206E, 39035C0207E, 39035C0208E, 39035C0209E, 39035C0226E, 39035C0228E	
Bedford Heights, City of	390096	04110002	39035C0217E, 39035C0219E, 39035C0236E, 39035C0238E, 39035C0332E[1], 39035C0351E	
Bedford, City of	390095	04110002	39035C0214E, 39035C0216E, 39035C0217E, 39035C0218E, 39035C0219E, 39035C0331E, 39035C0332E[1]	
Bentleyville, Village of	390682	04110003	39035C0241E, 39035C0242E, 39035C0243E, 39035C0244E	
Berea, City of	390097	04110001	39035C0144E, 39035C0163E, 39035C0164E, 39035C0257E, 39035C0276E, 39035C0277E	
Bratenahl, Village of	390734	04110003, 04120200	39035C0067F, 39035C0078F, 39035C0079F, 39035C0086F, 39035C0087E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Brecksville, City of	390098	04110001, 04110002	39035C0307E[1], 39035C0308E, 39035C0309E, 39035C0316E[1], 39035C0317E, 39035C0318E[1], 39035C0319E[1], 39035C0326E, 39035C0327E, 39035C0328E, 39035C0329E, 39035C0336E, 39035C0337E, 39035C0338E[1], 39035C0339E	
Broadview Heights, City of	390099	04110001, 04110002	39035C0302E, 39035C0304E, 39035C0306E, 39035C0307E[1], 39035C0308E, 39035C0309E, 39035C0312E, 39035C0314E, 39035C0316E[1], 39035C0318E[1]	
Brook Park, City of	390102	04110001, 04110002	39035C0142E, 39035C0144E, 39035C0161E, 39035C0162E, 39035C0163E, 39035C0164E, 39035C0166E, 39035C0167E, 39035C0168E	
Brooklyn Heights, Village of	390101	04110002	39035C0191E, 39035C0192E	
Brooklyn, City of	390100	04110002	39035C0159E, 39035C0167E, 39035C0178E, 39035C0186E	
Chagrin Falls, Village of	390103	04110003	39035C0234E, 39035C0242E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Cleveland Heights, City of	390105	04110003	39035C0087E, 39035C0088E, 39035C0089E[1], 39035C0091E, 39035C0092E, 39035C0093E[1], 39035C0201E, 39035C0202E, 39035C0206E	
Cleveland, City of	390104	04110001, 04110002, 04110003, 04120200	39035C0064F, 39035C0066F, 39035C0067F, 39035C0068F, 39035C0069F, 39035C0079F, 39035C0081F, 39035C0083F, 39035C0086F, 39035C0087E, 39035C0088E, 39035C0089E[1], 39035C0091E, 39035C0144E, 39035C0152F, 39035C0153E, 39035C0154E, 39035C0156F, 39035C0157F, 39035C0158E[1], 39035C0159E, 39035C0161E, 39035C0162E, 39035C0163E, 39035C0164E, 39035C0166E, 39035C0167E,	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Cleveland, City of *(Continued)*	390104	04110001, 04110002, 04110003, 04120200	39035C0176F, 39035C0177F, 39035C0178E, 39035C0179E, 39035C0181F, 39035C0182E1, 39035C0183E, 39035C0184E, 39035C0186E, 39035C0187E, 39035C0191E, 39035C0192E, 39035C0201E, 39035C0202E, 39035C0203E, 39035C0204E, 39035C0208E, 39035C0211E, 39035C0212E, 39035C0216E	
Cuyahoga County, Unincorporated Areas	390766	04110001, 04110003	39035C0138E[1], 39035C0139E, 39035C0143E, 39035C0144E, 39035C0233E, 39035C0234E, 39035C0242E, 39035C0251E[1], 39035C0252E[1], 39035C0256E, 39035C0257E	
Cuyahoga Heights, Village of	390654	04110002	39035C0183E, 39035C0184E, 39035C0191E, 39035C0192E	
East Cleveland, City of [2]	390106	04110003	39035C0087E, 39035C0088E, 39035C0089E[1], 39035C0091E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Euclid, City of	390107	04110003, 04120200	39035C0013F, 39035C0081F, 39035C0082F, 39035C0083F, 39035C0084E, 39035C0091E, 39035C0092E, 39035C0101F, 39035C0103E	
Fairview Park, City of	390108	04110001	39035C0142E, 39035C0153E, 39035C0154E, 39035C0161E, 39035C0162E	
Garfield Heights, City of	390109	04110002	39035C0184E, 39035C0192E, 39035C0203E, 39035C0204E, 39035C0211E, 39035C0212E, 39035C0213E, 39035C0214E	
Gates Mills, Village of	390593	04110003	39035C0108E, 39035C0109E[1], 39035C0114E, 39035C0116E, 39035C0117E[1], 39035C0118E, 39035C0119E	
Glenwillow, Village of	390735	04110002	39035C0238E, 39035C0351E, 39035C0352E	
Highland Heights, City of	390110	04110003	39035C0103E, 39035C0104E, 39035C0111E, 39035C0112E, 39035C0113E, 39035C0114E	
Highland Hills, Village of	390127	04110002, 04110003	39035C0208E, 39035C0209E, 39035C0228E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Hunting Valley, Village of	390594	04110003	39035C0114E, 39035C0118E, 39035C0119E, 39035C0227E, 39035C0229E, 39035C0231E, 39035C0232E, 39035C0233E, 39035C0234E	
Independence, City of	390111	04110002	39035C0191E, 39035C0192E, 39035C0193E, 39035C0194E, 39035C0213E, 39035C0306E, 39035C0307E[1], 39035C0326E	
Lakewood, City of	390112	04110001, 04120200	39035C0152F, 39035C0154E, 39035C0156F, 39035C0157F, 39035C0158E[1]	
Linndale, Village of	390069	04110002	39035C0159E	
Lyndhurst, City of	390113	04110003	39035C0092E, 39035C0094E, 39035C0111E, 39035C0113E	
Maple Heights, City of	390114	04110002	39035C0212E, 39035C0214E, 39035C0216E, 39035C0217E, 39035C0218E	
Mayfield Heights, City of	390115	04110003	39035C0112E, 39035C0113E, 39035C0114E, 39035C0116E, 39035C0118E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Mayfield, Village of	390116	04110003	39035C0104E, 39035C0108E, 39035C0112E, 39035C0114E, 39035C0116E	
Middleburg Heights, City of	390117	04110001, 04110002	39035C0163E, 39035C0164E, 39035C0168E, 39035C0276E, 39035C0277E, 39035C0281E	
Moreland Hills, Village of	390118	04110003	39035C0229E, 39035C0233E, 39035C0234E, 39035C0237E, 39035C0241E, 39035C0242E	
Newburgh Heights, Village of	390119	04110002	39035C0183E, 39035C0184E	
North Olmsted, City of	390120	04110001	39035C0134E, 39035C0136E[1], 39035C0137E, 39035C0138E[1], 39035C0139E, 39035C0141E, 39035C0142E, 39035C0143E, 39035C0144E, 39035C0153E, 39035C0161E	
North Randall, Village of	390736	04110002	39035C0208E, 39035C0209E, 39035C0216E, 39035C0217E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
North Royalton, City of	390121	04110001, 04110002	39035C0281E, 39035C0282E, 39035C0283E, 39035C0284E, 39035C0291E, 39035C0292E, 39035C0293E, 39035C0294E, 39035C0301E, 39035C0302E, 39035C0303E, 39035C0304E, 39035C0311E, 39035C0312E, 39035C0313E, 39035C0314E	
Oakwood, Village of	390122	04110002	39035C0219E, 39035C0238E, 39035C0332E[1], 39035C0351E	
Olmsted Falls, City of	390672	04110001	39035C0143E, 39035C0144E, 39035C0256E, 39035C0257E	
Orange, Village of	390737	04110002, 04110003	39035C0228E, 39035C0229E, 39035C0236E, 39035C0237E	
Parma Heights, City of	390124	04110001, 04110002	39035C0168E, 39035C0169E, 39035C0188E, 39035C0281E, 39035C0282E, 39035C0301E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Parma, City of	390123	04110001, 04110002	39035C0166E, 39035C0167E, 39035C0168E, 39035C0169E, 39035C0186E, 39035C0187E, 39035C0188E, 39035C0189E, 39035C0191E, 39035C0193E, 39035C0281E, 39035C0282E, 39035C0301E, 39035C0302E, 39035C0306E	
Pepper Pike, City of	390125	04110003	39035C0113E, 39035C0114E, 39035C0226E, 39035C0227E, 39035C0228E, 39035C0229E	
Richmond Heights, City of	390126	04110003	39035C0084E, 39035C0092E, 39035C0103E, 39035C0111E	
Rocky River, City of	395372	04110001, 04120200	39035C0151F, 39035C0152F, 39035C0153E, 39035C0154E	
Seven Hills, City of	390128	04110002	39035C0191E, 39035C0193E, 39035C0306E	
Shaker Heights, City of	390129	04110002, 04110003	39035C0202E, 39035C0204E, 39035C0206E, 39035C0207E, 39035C0208E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Solon, City of	390130	04110002, 04110003	39035C0236E, 39035C0237E, 39035C0238E, 39035C0239E, 39035C0241E, 39035C0243E, 39035C0244E, 39035C0351E, 39035C0352E, 39035C0356E, 39035C0357E	
South Euclid, City of	390131	04110003	39035C0091E, 39035C0092E, 39035C0093E[1], 39035C0094E	
Strongsville, City of	390132	04110001	39035C0257E, 39035C0259E, 39035C0267E, 39035C0269E, 39035C0276E, 39035C0277E, 39035C0278E, 39035C0279E, 39035C0281E, 39035C0283E, 39035C0286E, 39035C0287E, 39035C0288E, 39035C0289E, 39035C0291E, 39035C0293E	
University Heights, City of [2]	390133	04110003	39035C0093E[1], 39035C0094E, 39035C0206E, 39035C0207E	
Valley View, Village of	390134	04110002	39035C0192E, 39035C0194E, 39035C0211E, 39035C0213E, 39035C0214E, 39035C0326E, 39035C0327E	

Table 1: Listing of NFIP Jurisdictions *(Continued)*

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Walton Hills, Village of	390636	04110002	39035C0214E, 39035C0218E, 39035C0327E, 39035C0331E, 39035C0332E[1]	
Warrensville Heights, City of	390135	04110002	39035C0208E, 39035C0209E, 39035C0216E, 39035C0217E, 39035C0228E, 39035C0236E	
Westlake, City of	390136	04110001	39035C0126E, 39035C0127F, 39035C0128E, 39035C0129E, 39035C0131F, 39035C0132F, 39035C0133E, 39035C0134E, 39035C0136E[1], 39035C0137E, 39035C0141E, 39035C0142E, 39035C0151F, 39035C0153E	
Woodmere, Village of [2]	390157	04110003	39035C0228E	

[1] Panel Not Printed

[2] No Special Flood Hazard Areas Identified

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages State and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1-percent annual chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1-percent annual chance and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report. Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 31, "Map Repositories," within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

  The initial Countywide FIS Report for Cuyahoga County became effective on December 3, 2010. Refer to Table 28 for information about subsequent revisions to the FIRMs.

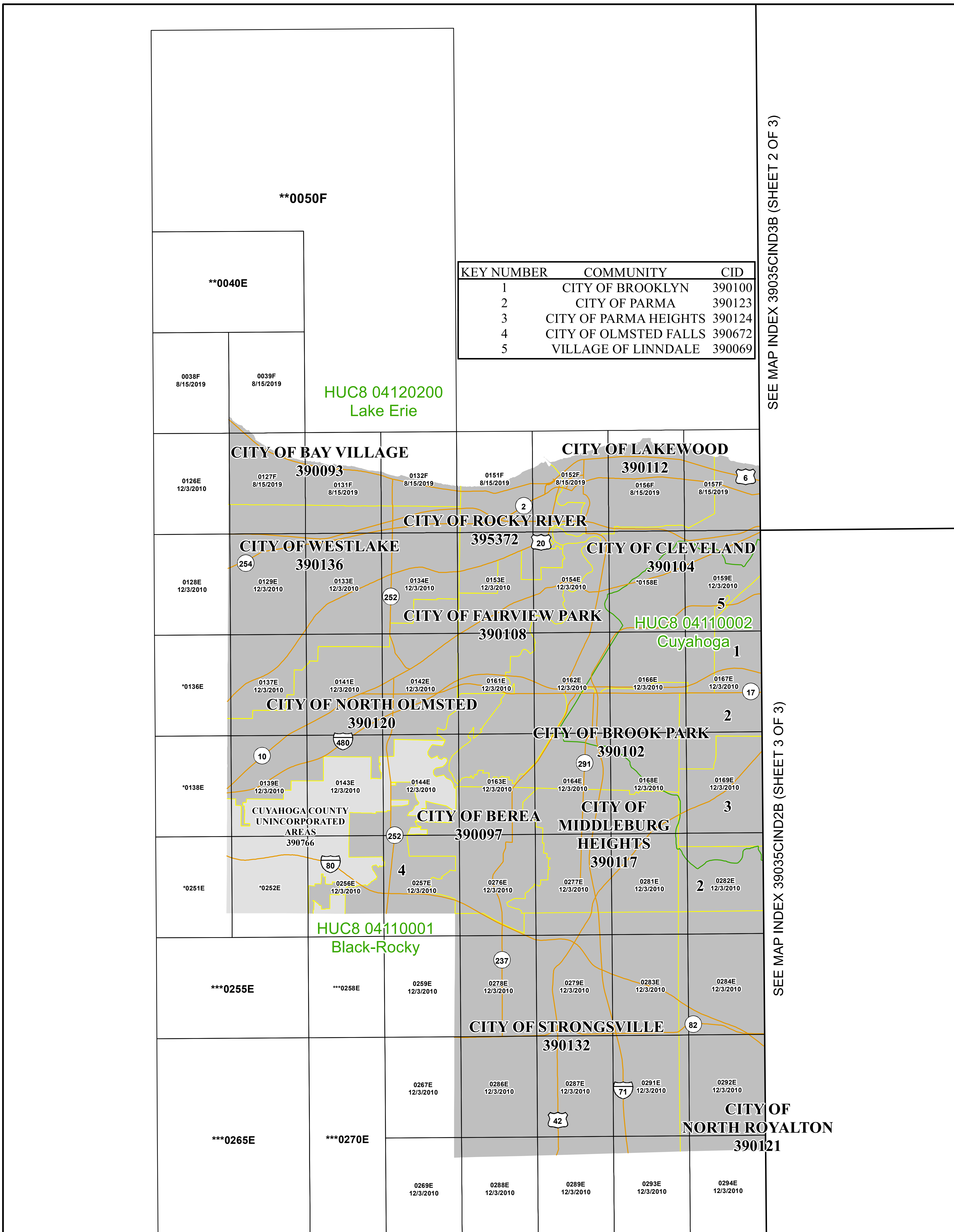
- FEMA does not impose floodplain management requirements or special insurance ratings based on Limit of Moderate Wave Action (LiMWA) delineations at this time. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. If the LiMWA is shown on the FIRM, it is being provided by FEMA as information only. For communities that do adopt Zone VE building standards in the area defined by the LiMWA, additional Community Rating System (CRS) credits are available. Refer to Section 2.5.4 for additional information about the LiMWA.

  The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Visit the FEMA Web site at www.fema.gov/national-flood-insurance-program-community-rating-system or contact your appropriate FEMA Regional Office for more information about this program.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at www.fema.gov/online-tutorials.

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Cuyahoga County, and also displays the panel number and effective date for each FIRM panel in the county. Other information shown on the FIRM Index includes community boundaries, flooding sources, watershed boundaries, and USGS HUC-8 codes.

Figure 1: FIRM Index (Page 1 of 3)



KEY NUMBER	COMMUNITY	CID
1	CITY OF BROOKLYN	390100
2	CITY OF PARMA	390123
3	CITY OF PARMA HEIGHTS	390124
4	CITY OF OLMSTED FALLS	390672
5	VILLAGE OF LINNDALE	390069

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before August 15, 2019.

N

1 inch = 10,833 feet 1:130,000

0 3,050 6,100 12,200 18,300 24,400 feet

Map Projection:
State Plane Ohio North, FIPS 3401;
North American Datum 1983

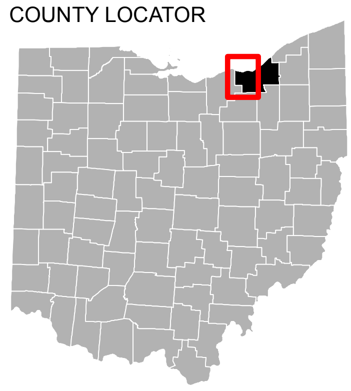
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
** PANEL NOT PRINTED - OPEN WATER AREA
*** PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

CUYAHOGA COUNTY, OHIO and Incorporated Areas
SHEET 1 OF 3

PANELS PRINTED:
0038, 0039, 0126, 0127, 0128, 0129, 0131, 0132, 0133, 0134, 0137, 0139, 0141, 0142, 0143, 0144, 0151, 0152, 0153, 0154, 0156, 0157, 0159, 0161, 0162, 0163, 0164, 0166, 0167, 0168, 0169, 0256, 0257, 0259, 0267, 0269, 0276, 0277, 0278, 0279, 0281, 0282, 0283, 0284, 0286, 0287, 0288, 0289, 0291, 0292, 0293, 0294

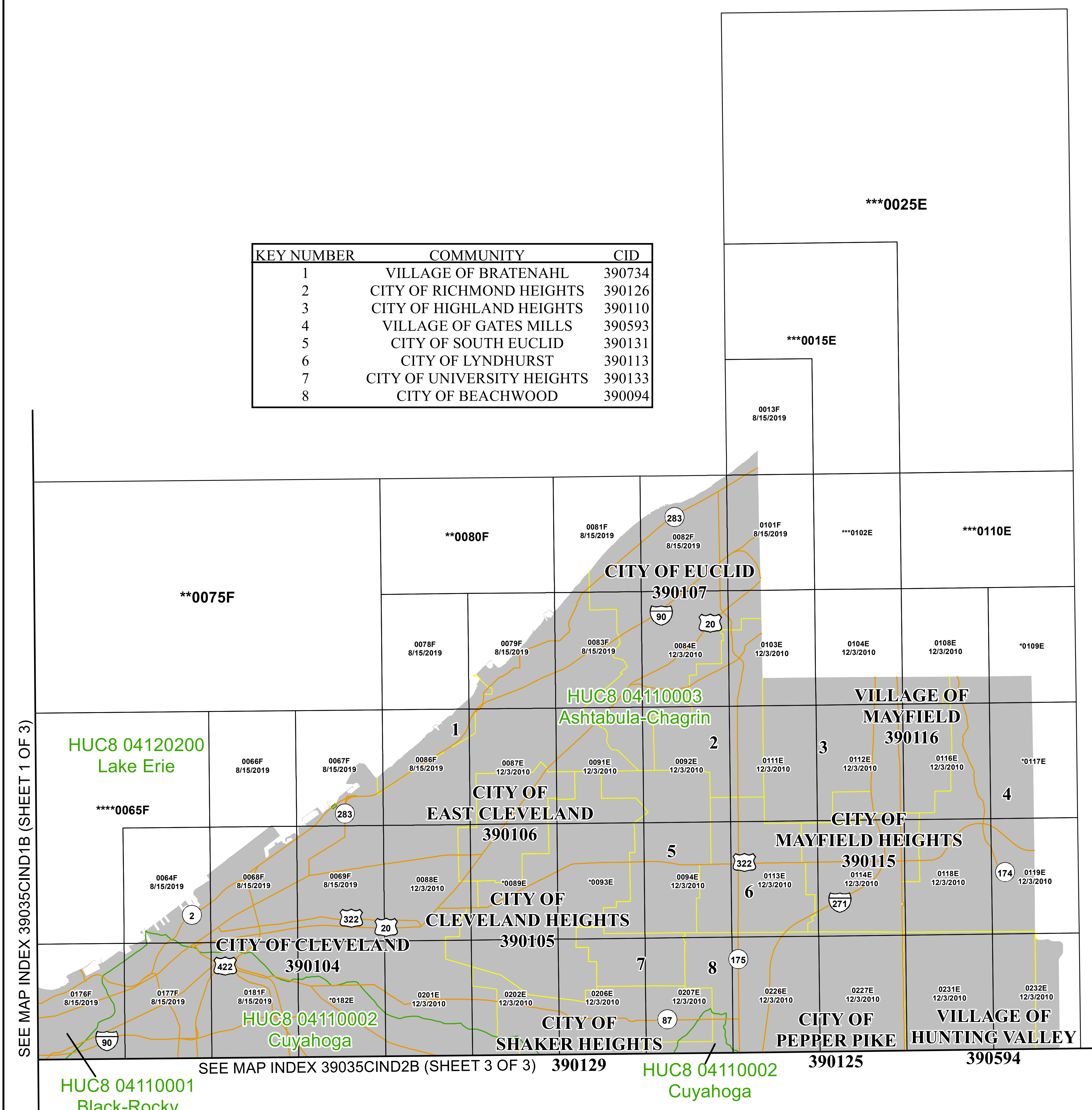
FEMA

MAP NUMBER
39035CIND1B

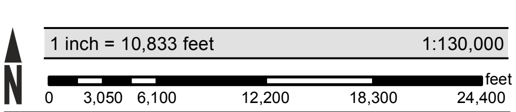
MAP REVISED
AUGUST 15, 2019

Figure 1: FIRM Index (Page 2 of 3)

KEY NUMBER	COMMUNITY	CID
1	VILLAGE OF BRATENAHL	390734
2	CITY OF RICHMOND HEIGHTS	390126
3	CITY OF HIGHLAND HEIGHTS	390110
4	VILLAGE OF GATES MILLS	390593
5	CITY OF SOUTH EUCLID	390131
6	CITY OF LYNDHURST	390113
7	CITY OF UNIVERSITY HEIGHTS	390133
8	CITY OF BEACHWOOD	390094



ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before August 15, 2019.



Map Projection:
State Plane Ohio North, FIPS 3401;
North American Datum 1983

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
** PANEL NOT PRINTED - OPEN WATER AREA
*** PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY
**** PANEL NOT PRINTED - AREA ALL WITHIN ZONE VE (EL 579)

COUNTY LOCATOR

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

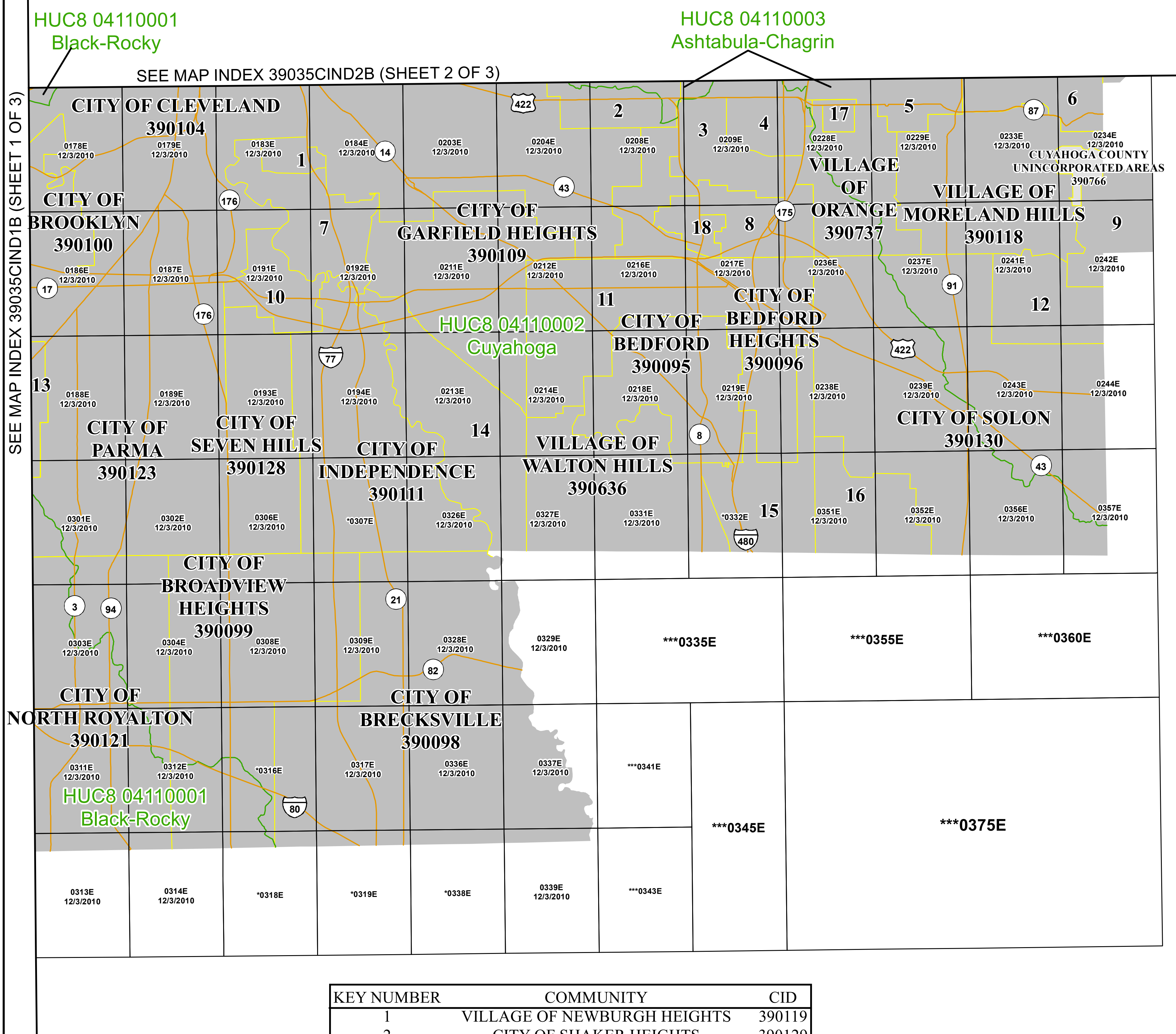
CUYAHOGA COUNTY, OHIO and Incorporated Areas
SHEET 2 OF 3

PANELS PRINTED:
0013, 0064, 0066, 0067, 0068, 0069, 0078, 0079, 0081, 0082, 0083, 0084, 0086, 0087, 0088, 0091, 0092, 0094, 0101, 0103, 0104, 0108, 0111, 0112, 0113, 0114, 0116, 0118, 0119, 0176, 0177, 0181, 0201, 0202, 0206, 0207, 0226, 0227, 0231, 0232

FEMA

MAP NUMBER
39035CIND2B

MAP REVISED
AUGUST 15, 2019



KEY NUMBER	COMMUNITY	CID
1	VILLAGE OF NEWBURGH HEIGHTS	390119
2	CITY OF SHAKER HEIGHTS	390129
3	VILLAGE OF HIGHLAND HILLS	390127
4	CITY OF BEACHWOOD	390094
5	CITY OF PEPPER PIKE	390125
6	VILLAGE OF HUNTING VALLEY	390594
7	VILLAGE OF CUYAHOGA HEIGHTS	390654
8	CITY OF WARRENSVILLE HEIGHTS	390135
9	VILLAGE OF CHAGRIN FALLS	390103
10	VILLAGE OF BROOKLYN HEIGHTS	390101
11	CITY OF MAPLE HEIGHTS	390114
12	VILLAGE OF BENTLEYVILLE	390682
13	CITY OF PARMA HEIGHTS	390124
14	VILLAGE OF VALLEY VIEW	390134
15	VILLAGE OF OAKWOOD	390122
16	VILLAGE OF GLENWILLOW	390735
17	VILLAGE OF WOODMERE	390157
18	VILLAGE OF NORTH RANDALL	390736

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before August 15, 2019.

N

1 inch = 10,833 feet 1:130,000

0 3,050 6,100 12,200 18,300 24,400 feet

Map Projection:
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SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

*PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
***PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY

COUNTY LOCATOR

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

CUYAHOGA COUNTY, OHIO and Incorporated Areas
SHEET 3 OF 3

PANELS PRINTED:

0178, 0179, 0183, 0184, 0186, 0187, 0188, 0189, 0191, 0192, 0193, 0194, 0203, 0204, 0208, 0209, 0211, 0212, 0213, 0214, 0216, 0217, 0218, 0219, 0228, 0229, 0233, 0234, 0236, 0237, 0238, 0239, 0241, 0242, 0243, 0244, 0301, 0302, 0303, 0304, 0306, 0308, 0309, 0311, 0312, 0313, 0314, 0317, 0326, 0327, 0328, 0329, 0331, 0336, 0337, 0339, 0351, 0352, 0356, 0357

FEMA

MAP NUMBER
39035CIND3B

MAP REVISED
AUGUST 15, 2019

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. Figure 2 contains the full list of these notes.

Figure 2: FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 28 in this FIS Report.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

Figure 2: FIRM Notes to Users *(Continued)*

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Non-Coastal Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

Coastal Base Flood Elevations shown on the map apply only landward of the zero elevation referenced to Low Water Datum of Lake Erie, administratively established by the National Oceanic and Atmospheric Administration at 173.5 meters (569.2 feet) above zero point International Great Lakes Datum of 1985. This elevation is generally accepted to be equal to an elevation of 569.4 feet North American Vertical Datum of 1988 (NAVD 88). Coastal flood elevations are also provided in the Coastal Transect Parameters table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Coastal Transect Parameters table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was State Plane Ohio North, FIPS 3401. The horizontal datum was the North American Datum of 1983 NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov.

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 31 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by Cuyahoga County, dated 2016. For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

Figure 2: FIRM Notes to Users *(Continued)*

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Cuyahoga County, Ohio, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Cuyahoga County, Ohio, effective August 15, 2019.

COASTAL BARRIER RESOURCES System (CBRS): This map includes approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see www.fws.gov/cbra, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between Zone VE and the LiMWA (or between the shoreline and the LiMWA for areas where Zone VE is not identified) will be similar to, but less severe than, those in Zone VE.

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Cuyahoga County.

Figure 3: Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: *The 1-percent annual chance flood, also known as the base flood or 100-year flood, has a 1-percent chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1-percent annual chance flood. The Base Flood Elevation is the water surface elevation of the 1-percent annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

	Special Flood Hazard Areas subject to inundation by the 1-percent annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1-percent annual chance floodplains. No base (1-percent annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1-percent annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1-percent annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.

Figure 3: Map Legend for FIRM *(Continued)*

Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.
	Regulatory Floodway determined in Zone AE.
	Non-encroachment zone (see Section 2.4 of this FIS Report for more information)
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2-percent annual chance flood hazards and areas of 1-percent annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1-Percent Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1-percent annual chance flood.
	Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1-percent annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
NO SCREEN	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet

Figure 3: Map Legend for FIRM *(Continued)*

GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
Bridge	Bridge
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*	
CBRS AREA **09/30/2009**	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
OTHERWISE **PROTECTED AREA** **09/30/2009**	Otherwise Protected Area
REFERENCE MARKERS	
22.0	River Mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.

Figure 3: Map Legend for FIRM *(Continued)*

	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and Cuyahoga County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1-percent annual chance flood elevations; elevations corresponding to other floods (e.g. 10-, 4-, 2-, 0.2-percent annual chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1-percent and 0.2-percent annual chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1-percent annual chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1-percent and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary is shown on the FIRM. Figure 3, “Map Legend for FIRM”, describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Cuyahoga County, respectively.

Table 2, “Flooding Sources Included in this FIS Report,” lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1-percent annual chance floodplain corresponds to the SFHAs. The 0.2-percent annual chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Anthony Lane Tributary to Big Creek	Parma Heights, City of	Confluence with Big Creek	150 feet upstream of Anthony Lane	04110002	0.14	Y	AE	1980
Aurora Branch	Bentleyville, Village of	Confluence with Chagrin River	3300 feet upstream of confluence with Aurora Branch Tributary 3	04110003	2.48	Y	AE	2000
Aurora Branch Tributary 1	Bentleyville, Village of; Solon, City of	Confluence with Aurora Branch	About 675 feet upstream of Cannon Road	04110003	1.52	N	A	2010
Aurora Branch Tributary 2	Bentleyville, Village of	Confluence with Aurora Branch	About 700 feet upstream of Pheasant Court	04110003	1.40	Y	AE	1979
Aurora Branch Tributary 3	Bentleyville, Village of	Confluence with Aurora Branch	About 1500 feet upstream	04110003	0.28	Y	AE	1979
Baker Creek	Strongsville, City of	About 4500 feet downstream of confluence with Baker Creek Tributary 1	1480 feet upstream of Royalton Road	04110001	2.73	Y	AE	1977
Baker Creek Tributary 1	Strongsville, City of	Confluence with Baker Creek	About 1750 feet upstream of Royalton Road	04110001	0.67	Y	AE	1977
Baker Creek Tributary 2	Strongsville, City of	Confluence with Baker Creek	About 40 feet upstream of Pearl Road	04110001	1.14	N	A	2010

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Baldwin Creek	North Royalton, City of; Parma, City of	1700 ft down stream of Lynn Drive	York Road	04110001	2.10	N	A	2010
Baldwin Creek	Parma, City of	130th Street	Sprague Road	04110001	1.60	Y	AE	1980
Baldwin Creek	Middleburg Heights, City of	Lucerne Drive	130th Street	04110001	2.25	Y	AE	1980
Baldwin Creek	North Royalton, City of	Sprague Road	3550 feet upstream of Abbey Road	04110001	0.77	Y	AE	1978
Baldwin Creek Tributary 2	Strongsville, City of	Confluence with Baker Creek	About 35 feet upstream of Pearl Road	04110001	2.52	N	A	2010
Baldwin Creek Tributary 7	North Royalton, City of	Confluence with Baldwin Creek	York Road	04110001	0.95	N	A	2010
Bear Creek	Bedford, City of	Confluence with Tinkers Creek	About 1940 upstream of Interstate Highway 480	04110002	1.53	Y	AE	1979
Big Creek	Cleveland, City of	About 600 feet downstream of Jennings Road	About 1600 feet upstream of Ridge Road	04110002	3.43	Y	AE	1977
Big Creek	Parma Heights, City of	About 1700 feet downstream Pearl Road	1800 feet upstream of Independence Boulevard	04110002	1.96	Y	AE	1980
Blodgett Creek	Strongsville, City of	Marks Road	Courtland Drive	04110001	0.89	Y	AE	1977
Cahoon Creek / Dover Ditch	Bay Village, City of	Confluence with Lake Erie	About 550 feet upstream of Oviatt Road	04110001	1.07	Y	AE	1976

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Cahoon Creek / Dover Ditch	Westlake, City of	About 650 feet upstream of Oviatt Road	About 1700 feet upstream of Cleveland Metro Park	04110001	5.47	Y	AE	1978
Chagrin River	Bentleyville, Village of	About 707 feet downstream of Miles Road	About 4745 feet downstream of Miles Road	04110003	1.29	Y	AE	2000
Chagrin River	Chagrin Falls Township; Cuyahoga County, Unincorporated Areas	About 3030 feet upstream of Woodland Road	About 1922 feet downstream of Chagrin Boulevard	04110003	0.94	N	AE	Unknown
Chagrin River	Chagrin Falls, Village of	About 4745 feet downstream of Miles Road	About 1 miles upstream of Cleveland Street	04110003	2.70	Y	AE	2002
Chagrin River	Gates Mills, Village of; Hunting Valley, Village of	About 60 feet downstream of Rogers Road	1700 feet upstream of Woodland Road	04110003	10.97	Y	AE	1976
Chagrin River Tributary 1	Mayfield, Village of	Interstate 271	Som Center Road	04110003	0.57	Y	AE	Unknown
Chagrin River Tributary 2	Mayfield, Village of	About 1100 feet downstream of Som Center Road	About 1750 feet upstream of Som Center Road	04110003	0.52	Y	AE	Unknown
Chagrin River Tributary 2.1	Mayfield, Village of	Worton Park Drive	Ridgebury Boulevard	04110003	0.38	Y	AE	Unknown

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Chippewa Creek	Brecksville, City of	About 200 feet downstream of Old Royalton Road	About 4500 feet upstream of Chippewa Road	04110002	1.29	Y	AE	1979
Countrymans Creek	Cleveland, City of	From Interstate 71	Brookpark Road	04110002	4.58	Y	AE	1977
Cuyahoga River	Brooklyn Heights, Village of; Cuyahoga Heights, Village of; Independence, City of	Denison Avenue	Pleasant Valley Road	04110002	6.53	Y	AE	1998
Cuyahoga River	Cleveland, City of	Confluence with Lake Erie	Denison Avenue	04110002	8.23	Y	AE	1977
Cuyahoga River	Valley View, Village of	About 890 feet downstream of Granger Road	Pleasant Valley Road	04110002	2.15	Y	AE	1979
Cuyahoga River Tributary 1	Independence, City of	Brecksville Road	The northbound lane of Interstate Route 77	04110002	0.79	Y	AE	1979
Cuyahoga River Tributary 1	Independence, City of; Seven Hills, City of; Valley View, Village of	Confluence with Cuyahoga River, about 265 feet downstream of northbound I-77 Interstate Highway	About 190 feet upstream of Brecksville Road, about 2000 feet upstream of Hillside Road	04110002	3.47	N	A	2010

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Doan Brook	Cleveland, City of	About 1550 feet downstream of Martin Luther King Drive	About 850 feet upstream of Martin Luther King Drive	04110003	0.41	Y	AE	1977
Doan Brook	Shaker Heights, City of	About 2300 feet downstream of Fairhill Road	About 4350 feet upstream of Torrington Road	04110003	3.99	Y	AE	1980
East Branch Rocky River	Berea, City of; Middleburg Heights, City of; Strongsville, City of	About 3,850 feet downstream of Valley Parkway	About 2,400 feet upstream of Royal View Lane	04110001	10.89	N	A	2010
East Branch Rocky River	North Royalton, City of	Bennett Road	Boston Road	04110001	2.70	Y	AE	1978
East Branch Rocky River	North Royalton, City of	70 feet downstream of Edgerton Road	360 feet upstream of Royalton Road	04110001	1.67	Y	AE	1978
East Branch Rocky River Tributary 1	Strongsville, City of	Confluence with East Branch Rocky River	About 2,340 feet upstream of Progress Drive	04110001	1.65	N	A	2010
East Branch Rocky River Tributary 2	Strongsville, City of	About 480 feet upstream of Pearl Road	About 2,250 feet upstream of Forest View Drive	04110001	2.99	N	A	2010

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
East Branch Rocky River Tributary 2.1	Strongsville, City of	Confluence with East Branch Rocky River Tributary 2	About 850 feet upstream of lake Medows Drive	04110001	1.85	N	A	2010
East Branch Rocky River Tributary 3	Strongsville, City of	Confluence with East Branch Rocky River	About 1,950 feet upstream of Huntington Meadows Drive	04110001	3.15	N	A	2010
East Branch Rocky River Tributary 4	Strongsville, City of	Confluence with East Branch Rocky River	About 680 feet upstream of I80 Interstate Highway	04110001	1.38	N	A	2010
East Branch Rocky River Tributary 5	Strongsville, City of	Confluence with East Branch Rocky River	Drake Road	04110001	2.70	N	A	2010
East Branch Rocky River Tributary 5.1	Strongsville, City of	Confluence with East Branch Rocky River Tributary 5	I 71 Interstate Highway	04110001	1.71	N	A	2010
East Branch Rocky River Tributary 6	Strongsville, City of	Confluence with East Branch Rocky River	Boston Road	04110001	4.11	N	A	2010
East Branch Rocky River Tributary 7	North Royalton, City of	Valley Parkway	About 3600 feet upstream	04110001	0.67	Y	AE	1978
Euclid Creek	Cleveland, City of	Confluence with Lake Erie	Euclid Avenue	04110003	2.03	Y	AE	1977
Euclid Creek	Euclid, City of; South Euclid, City of	Confluence with Euclid Creek Tributary 1	Mayfield Road	04110003	1.87	Y	AE	1980

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Euclid Creek Tributary 1.5	Highland Heights, City of	About 1150 feet downstream of Bishop Road	About 310 feet upstream of Highland Road	04110003	2.39	Y	AE	1989
Euclid Creek Tributary 1.5.1	Highland Heights, City of	Confluence with Tributary A	About 270 feet upstream of Highland Road	04110003	0.18	Y	AE	1989
Euclid Creek Tributary 1.6	Highland Heights, City of	About 2900 feet downstream of Highland Road	About 2190 feet upstream of Highland Road	04110003	0.95	Y	AE	1992
Euclid Creek Tributary 2	South Euclid, City of	Confluence with Euclid Creek	About 30 feet downstream of Professor Road	04110003	2.25	N	AE	1980
Fitch Lateral	North Olmsted, City of	Confluence with Roots Ditch	About 2750 feet upstream	04110001	0.51	Y	AE	Unknown
Hawthorne Creek	Bedford Heights, City of	Confluence with Tinkers Creek	About 915 feet upstream of Metro Court	04110002	0.39	Y	AE	1979
Hawthorne Creek	Bedford Heights, City of; Oakwood, Village of; Orange, Village of; Solon, City of; Warrensville Heights, City of	About 385 feet downstream of Miles Road, About 30 feet upstream of Metro Court	About 322 feet downstream of Country Lane, About 830 feet upstream of Aurora Road	04110002	4.14	N	A	2010

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Hawthorne Creek	Solon, City of	About 130 feet downstream of Aurora Road	About 385 feet downstream of Miles Road	04110002	1.85	Y	AE	Unknown
Hawthorne Creek	Warrensville Heights, City of	About 965 feet downstream of Country Lane	About 3500 feet upstream of Emery Road	04110002	1.03	Y	AE	1980
Kirk Lateral	Westlake, City of	Confluence with Cahoon Creek	About 80 feet upstream of Woodpath Trail	04110001	1.28	Y	AE	1978
Lake Erie	Bay Village, City of; Bratenahl, Village of; Cleveland, City of; Euclid, City of; Lakewood, City of; Rocky River, City of	Eastern Cuyahoga County Boundary	Western Cuyahoga County Boundary	04110001, 04110002, 04110003, 04120200	36.5	N	AE/AO/VE/X	2016
Mill Creek	Cleveland, City of	About 1 mile downstream of Warner Road	About 660 feet downstream of Broadway Avenue	04110002	1.67	Y	AE	1977
Mill Creek	Garfield Heights, City of	About 660 feet downstream of Broadway Avenue	McCracken Road	04110002	2.11	Y	AE	1986
Mill Creek	Maple Heights, City of	McCracken Road	About 730 feet upstream of Lee Road	04110002	1.36	Y	AE	1979
Mill Creek	Warrensville Heights, City of	About 720 feet downstream of Miles Road	About 430 feet upstream of Emery Road	04110002	0.62	Y	AE	1980

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Mill Creek	Warrensville Heights, City of	About 525 feet downstream of Longbrook Road	Warrensville Center Road	04110002	0.47	Y	AE	1980
Nine Mile Creek	Bratenahl, Village of	The mouth at Lake Erie to	Approximately 30 feet downstream of Lake Shore Boulevard	04110003	0.34	N	AE	2016
Pepper Creek	Pepper Pike, City of	About 2400 feet below the Shaker Boulevard bridge	1900 feet above the Lander Road bridge	04110003	1.91	Y	AE	1980
Pepper Creek Tributary 4.1.1	Mayfield Heights, City of; Pepper Pike, City of	About 1200 feet downstream of Cedar Road	About 775 feet upstream of Landerbrook Drive	04110003	0.71	N	A	2010
Plum Creek	Cuyahoga County, Unincorporated Areas; Olmsted Township	About 890 feet downstream of Usher Road	The Lorain County Boundary	04110001	0.93	Y	AE	1977
Plum Creek	Olmsted Falls, City of	Confluence at the West Branch Rocky River	About 890 feet downstream of Usher Road	04110001	2.92	Y	AE	2001
Pond Brook	Solon, City of	Pettibone Road	About 2,415 feet upstream of Rollingbrook Trail	04110002	1.93	N	A	2010
Porter Creek (Huntington Creek) / Gifford-Avon ditch	Bay Village, City of	Confluence with Lake Erie	County Boundary	04110001	2.69	Y	AE	1976

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Reservoir Creek	Parma Heights, City of	4300 feet downstream of Eureka Parkway	Pearl Road	04110002	0.58	Y	AE	1980
Rocky River	Lakewood, City of	Confluence with Lake Erie	About 3600 feet upstream of Park Drive	04110001	3.69	Y	AE	1976
Rocky River	Rocky River, City of	Confluence with Lake Erie	About 3600 feet upstream of Park Drive	04110001	3.69	Y	AE	1977
Roots Ditch	North Olmsted, City of	About 80 feet downstream of Canterbury Road	About 800 feet upstream of Stearns Road	04110001	2.30	Y	AE	Unknown
Rose Lateral	Westlake, City of	Confluence with Kirk Lateral	480 feet upstream of Canterbury	04110001	0.36	Y	AE	1978
Sagamore Creek	Cuyahoga Valley National Park; Walton Hills, Village of	About 3500 feet downstream of Dunham Road	Sagamore Road	04110002	1.27	Y	AE	1979
Shwartz Ditch	Westlake, City of	Lorain County Boundary	500 ft Downstream of Center Ridge Road	04110001	1.58	N	A	2010
Spencer Creek	Rocky River, City of	Confluence with Lake Erie	Center Ridge Road	04110001	1.94	Y	AE	1977
Sperry Creek	Westlake, City of	About 430 feet downstream of Interstate 90	About 70 feet upstream of Center Ridge Road	04110001	1.89	Y	AE	1978
Stone Water Creek	Highland Heights, City of	About 3400 feet downstream of Omega Parkway	About 1700 feet upstream of Omega Parkway	04110003	0.96	Y	AE	1989

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Stone Water Creek Tributary 1	Highland Heights, City of	About 150 feet away from Stirling Drive	About 300 feet upstream	04110003	0.06	Y	AE	1989
Tinkers Creek	Bedford Heights, City of; Bedford, City of	About 80 feet downstream of Union Street	About 2120 feet downstream of Richmond Road	04110002	2.33	Y	AE	1979
Tinkers Creek	Bedford, City of; Cuyahoga Valley National Park; Walton Hills, Village of	About 260 feet downstream of Dunham Road	About 480 feet upstream of Union Street	04110002	4.19	N	A	2010
Tinkers Creek	Cuyahoga Valley National Park; Walton Hills, Village of	About 2100 feet downstream of Dunham Road	About 135 feet upstream of Dunham Road	04110002	0.43	Y	AE	1979
Tinkers Creek	Glenwillow, Village of	Richmond Road	About 1 mile upstream of Pettibone Road	04110002	3.48	Y	AE	1979
Tinkers Creek	Valley View, Village of	About 560 feet downstream of Canal Road	About 2100 feet downstream of Dunham Road	04110002	1.81	Y	AE	1979
Tinkers Creek Tributary 1	Walton Hills, Village of	About 100 feet downstream of Egbert Road	1800 feet upstream of Walton Road	04110002	0.41	Y	AE	1979

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Tinkers Creek Tributary 2	Glenwillow, Village of; Orange, Village of; Solon, City of	About 730 feet downstream of Cannon Road, confluence with Tinkers Creek	About 40 feet upstream of Miles Road, about 2800 feet downstream of Carter Street	04110002	3.47	N	A	2010
Tinkers Creek Tributary 2	Solon, City of	About 3100 feet downstream of Carter Road	Cannon Road	04110002	2.99	Y	AE	1979
Tinkers Creek Tributary 2.1	Glenwillow, Village of; Solon, City of	Confluence with Tinkers Creek Tributary 2	About 810 feet upstream of Ada Drive	04110002	2.45	N	A	2010
Tinkers Creek Tributary 3	Glenwillow, Village of; Solon, City of	The Lorain County Boundary	About 635 feet upstream of Som Center Road	04110002	1.21	N	A	2010
West Branch Rocky River	Cuyahoga County, Unincorporated Areas; Olmsted Township	About 1,470 feet downstream of Lewis Road	About 1215 feet downstream of Water Street	04110001	2.57	Y	AE	1977
West Branch Rocky River	Olmsted Falls, City of	About 1215 feet downstream of Water Street	The Lorain County Boundary	04110001	2.79	Y	AE	2001
West Branch Rocky River Tributary 1	Olmstead Falls, City of; Strongsville, City of	Confluence with West Branch Rocky River, Marks Road	Sprague Road, about 1200 feet upstream of Westwood Drive	04110001	2.80	N	A	2010

Table 2: Flooding Sources Included in this FIS Report *(Continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
West Creek	Parma, City of	The Snow Road bridge	1900 feet upstream of Ridgewood Drive bridge	04110002	1.70	y	AE	1980
Wilhelmy Creek	Westlake, City of	740 feet downstream of Detroit Road	Bradley Road	04110001	0.94	Y	AE	1978
Wischmeyer Creek	Bay Village, City of	Confluence with Lake Erie	Approximately 3 feet upstream of Knickerbocker Road	04110001	0.89	Y	AE	1995
Wood Creek	Bedford, City of	690 feet downstream of Wood Creek	About 900 feet upstream of Thames Avenue	04110002	0.81	Y	AE	1979

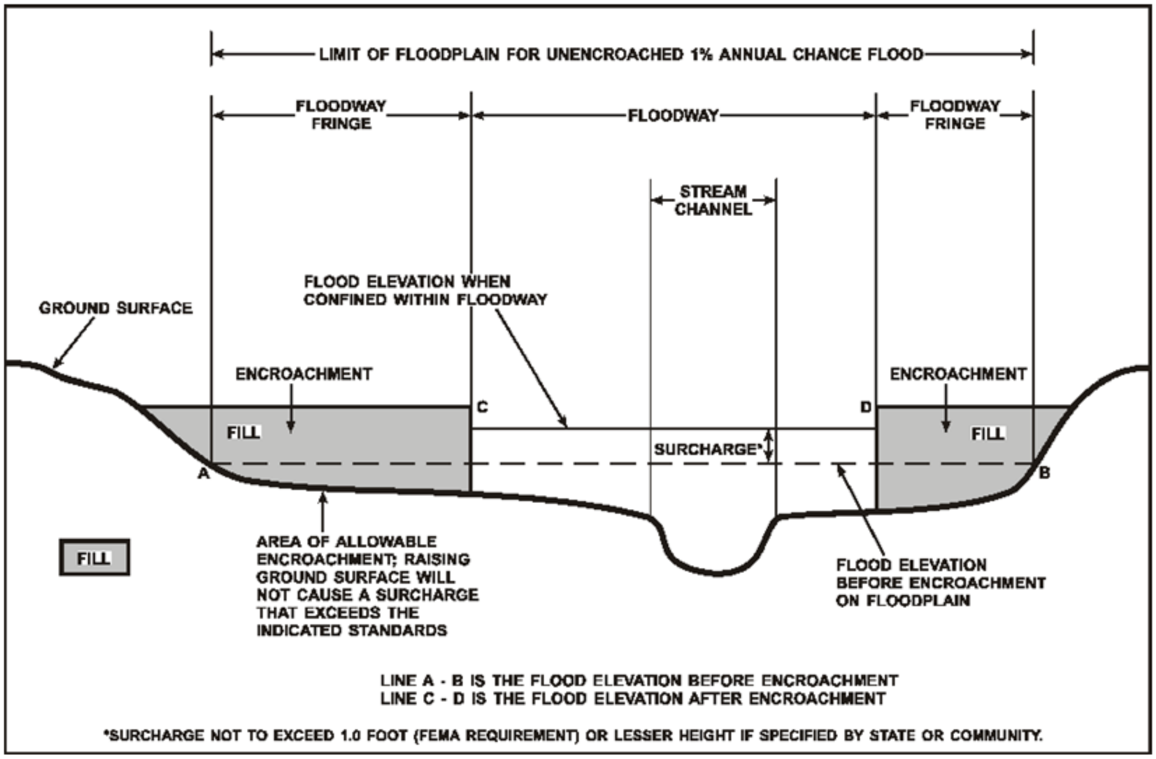
2.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard.

For purposes of the NFIP, a floodway is used as a tool to assist local communities in balancing floodplain development against increasing flood hazard. With this approach, the area of the 1-percent annual chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1-percent annual chance flood. The floodway fringe is the area between the floodway and the 1-percent annual chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water surface elevation of the 1-percent annual chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, Federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic



Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 24, "Floodway Data."

All floodways that were developed for this Flood Risk Project are shown on the FIRM using the symbology described in Figure 3. In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown on the FIRM. For information about the delineation of floodways on the FIRM, refer to Section 6.3.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (BFE) is the elevation of the 1-percent annual chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. BFEs are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM.

2.4 Non-Encroachment Zones

This section is not applicable to this Flood Risk Project.

2.5 Coastal Flood Hazard Areas

For most areas along rivers, streams, and small lakes, BFEs and floodplain boundaries are based on the amount of water expected to enter the area during a 1-percent annual chance flood and the geometry of the floodplain. Floods in these areas are typically caused by runoff from storm events. However, for areas on, or near, the Great Lakes, ocean coasts, large rivers, or other large bodies of water, the BFE and floodplain boundaries may be based on additional components that include storm surge and wave dynamics.

Coastal flooding sources that are included in this Flood Risk Project are shown in Table 2.

2.5.1 Water Elevations and the Effects of Waves

Specific terminology is used in coastal analyses to indicate which components have been included in evaluating flood hazards.

The stillwater elevation (SWEL or still water level) is the surface of the water resulting from astronomical tides, storm surge, and freshwater inputs, but excluding wave setup contribution or the effects of waves.

- *Astronomical tides* are periodic rises and falls in large bodies of water caused by the rotation of the earth and by the gravitational forces exerted by the earth, moon and sun. Tidal-induced fluctuations in the Great Lakes are small and their presence is masked by the normal fluctuations due to atmospheric forcing. The Great Lakes can be treated as if no tidal signal exists, and this contribution to water levels is neglected.

- *Storm surge, inclusive of wind setup and seiche-induced fluctuation,* is the additional water depth that occurs during large storm events. These events can bring air pressure changes and strong winds that force water up against the shore. The most common cause of a large seiche in the Great Lakes is the oscillating water level after a storm that moves over the lake, with the downwind portion of the lake subject to wind setup as water piles up against the coast and the upwind portion subject to a decrease in water levels. Seiche influence and resulting oscillation is particularly dominant in Lake Erie, due to the lake's narrow east-west orientation and shallow depths.

- *Freshwater inputs* include rainfall that falls directly on the body of water, runoff from surfaces and overland flow, and inputs from rivers.

The 1-percent annual chance stillwater elevation is the stillwater elevation that has been calculated for a storm surge from a 1-percent annual chance storm. The 1-percent annual chance storm surge can be determined from analyses of water level station records, statistical study of regional historical storms, or other modeling approaches. Stillwater elevations for storms of other frequencies can be developed using similar approaches.

The total stillwater elevation (also referred to as the mean water level) is the stillwater elevation plus wave setup contribution but excluding the effects of wave heights.

- *Wave setup* is the increase in stillwater elevation at the shoreline caused by the breaking of waves in shallow water. It occurs as breaking wave momentum is transferred to the water column.

Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1-percent annual chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since water level stations are often located in areas sheltered from wave action and do not capture wave height or wave setup information.

Coastal analyses may examine the effects of overland waves by analyzing storm-induced erosion, overland wave propagation, wave runup, and/or wave overtopping.

- *Storm-induced erosion* is the modification of existing topography by erosion caused by a specific storm event, as opposed to erosion that occurs over time and at a more constant rate.

- *Overland wave propagation* describes the combined effects of variation in ground elevation, vegetation, and physical features on wave characteristics as waves move onshore.

- *Wave runup* is the uprush of water from wave action on a shore barrier. It is a function of the roughness and geometry of the shoreline at the point where the total stillwater elevation intersects the land, see Figure 5a.

- *Wave overtopping* refers to the flooding that occurs when wave runup passes over the crest of a barrier, see Figure 5b.

Figure 5a: Wave Runup Transect Schematic

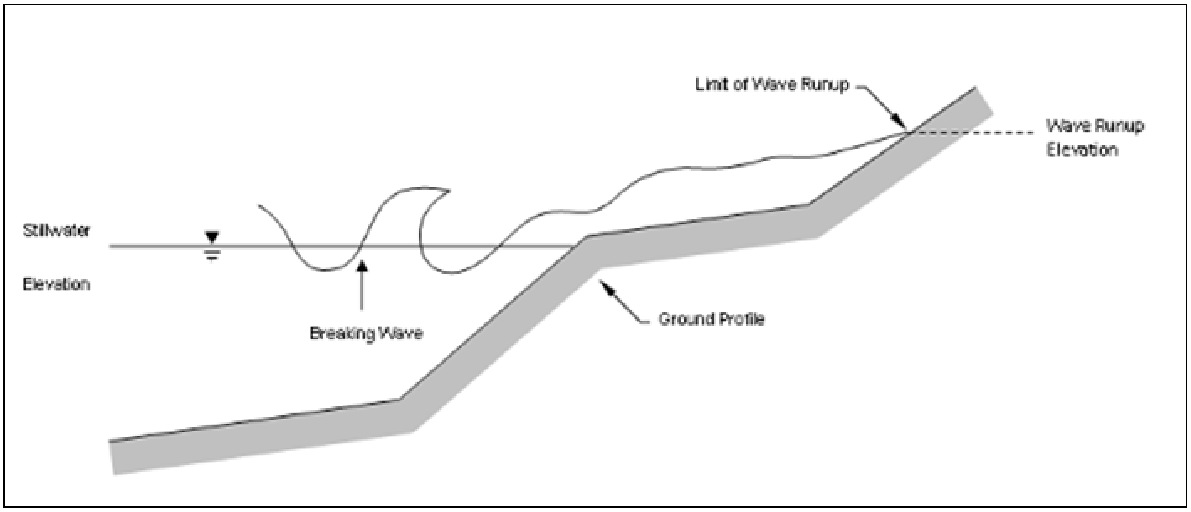
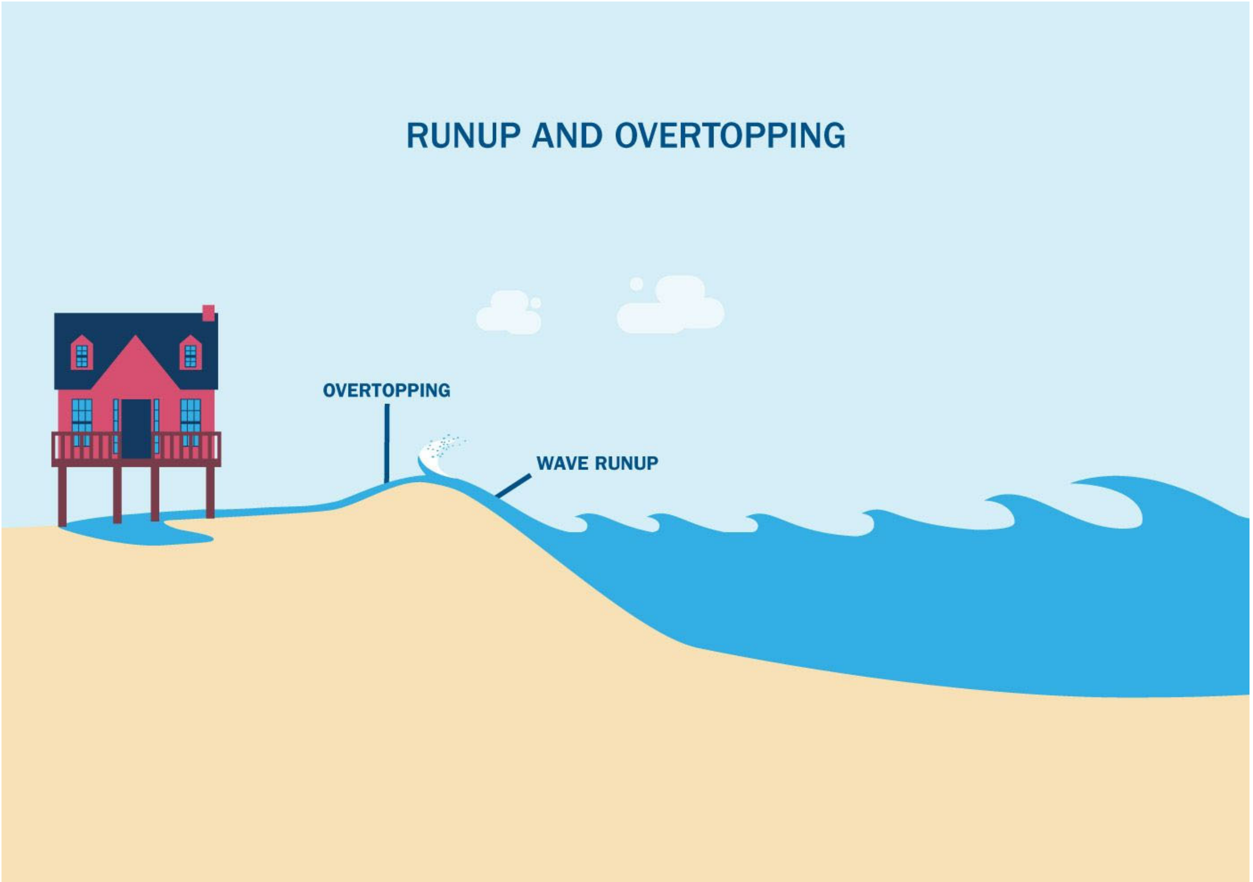


Figure 5b: Wave Overtopping Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

For coastal communities along the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and the Caribbean Sea, flood hazards must take into account how storm surges, waves, and extreme tides interact with factors such as topography and vegetation. Storm surge and waves must also be considered in assessing flood risk for certain communities on rivers or large inland bodies of water.

Beyond areas that are affected by waves and tides, coastal communities can also have riverine floodplains with designated floodways, as described in previous sections.

Floodplain Boundaries
In many coastal areas, storm surge is the principle component of flooding. The extent of the 1-percent annual chance floodplain in these areas is derived from the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1-percent annual chance storm. The methods that were used for calculation of total stillwater elevations for coastal areas are described in Section 5.3 of this FIS Report. Location of total stillwater elevations for coastal areas are shown in Figure 8, “1-Percent Annual Chance Total Stillwater Levels for Coastal Areas.”

In some areas, the 1-percent annual chance floodplain is determined based on the limit of wave runup or wave overtopping for the 1-percent annual chance storm surge. The methods that were used for calculation of wave hazards are described in Section 5.3 of this FIS Report.

Table 26 presents the types of coastal analyses that were used in mapping the 1-percent annual chance floodplain in coastal areas.

Coastal BFEs
Coastal BFEs are calculated as the total stillwater elevation for the 1-percent annual chance storm plus the additional flood hazard from overland wave effects (storm-induced erosion, overland wave propagation, wave runup and wave overtopping).

Where they apply, coastal BFEs are calculated along transects extending from offshore to the limit of coastal flooding onshore. Results of these analyses are accurate until local topography, vegetation, or development type and density within the community undergoes major changes.

Parameters that were included in calculating coastal BFEs for each transect included in this FIS Report are presented in Table 17, “Coastal Transect Parameters.” The locations of transects are shown in Figure 9, “Transect Location Map.” More detailed information about the methods used in coastal analyses and the results of intermediate steps in the coastal analyses are presented in Section 5.3 of this FIS Report. Additional information on specific mapping methods is provided in Section 6.4 of this FIS Report.

2.5.3 Coastal High Hazard Areas

Certain areas along the open coast and other areas may have higher risk of experiencing structural damage caused by wave action and/or high-velocity water during the 1-percent annual chance flood. These areas will be identified on the FIRM as Coastal High Hazard Areas.

- *Coastal High Hazard Area (CHHA)* is a SFHA extending from offshore to the inland limit of the primary frontal dune (PFD) or any other area subject to damages caused by wave action and/or high-velocity water during the 1-percent annual chance flood.

- *Primary Frontal Dune (PFD)* is a continuous or nearly continuous mound or ridge of sand with relatively steep slopes immediately landward and adjacent to the beach. The PFD is subject to erosion and overtopping from high tides and waves during major coastal storms.

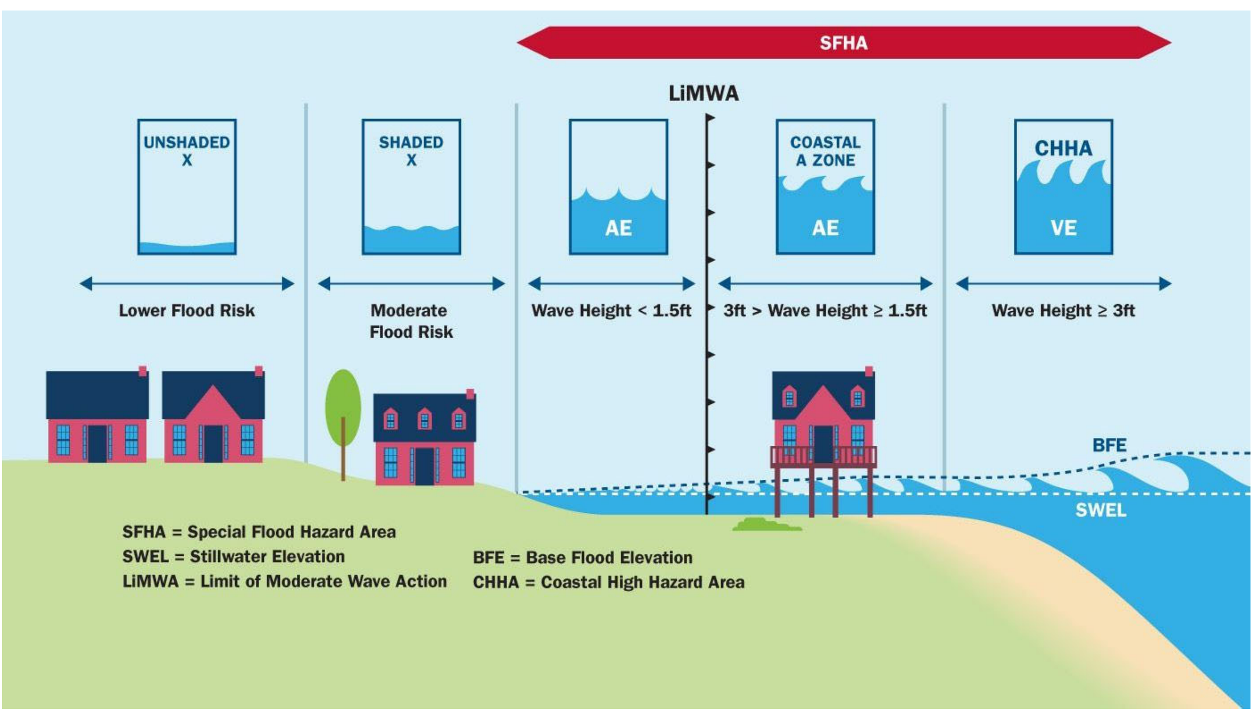
CHHAs are designated as “VE” zones (for “velocity wave zones”) and are subject to more stringent regulatory requirements and a different flood insurance rate structure. Zone VE is further subdivided into elevation zones and shown with BFEs on the FIRM.

The landward limit of the PFD occurs at a point where there is a distinct change from a relatively steep slope to a relatively mild slope; this point represents the landward extension of Zone VE. More detailed information about the identification and designation of Zone VE is presented in Section 6.4 of this FIS Report.

Areas that are not within the CHHA but are SFHAs may still be impacted by coastal flooding and damaging waves; these areas are shown as “AE” zones on the FIRM.

Figure 6, “Coastal Transect Schematic,” illustrates the relationship between the base flood elevation, the 1-percent annual chance stillwater elevation, and the ground profile as well as the location of the Zone VE and Zone AE areas in an area without a PFD subject to overland wave propagation. This figure also illustrates energy dissipation and regeneration of a wave as it moves inland.

Figure 6: Coastal Transect Schematic



Methods used in coastal analyses in this Flood Risk Project are presented in Section 5.3 and mapping methods are provided in Section 6.4 of this FIS Report.

Coastal floodplains are shown on the FIRM using the symbology described in Figure 3, “Map Legend for FIRM.” In many cases, the BFE on the FIRM is higher than the stillwater elevations shown in Table 17 due to the presence of wave effects. The higher elevation should be used for construction and/or floodplain management purposes.

2.5.4 Limit of Moderate Wave Action

Laboratory tests and field investigations have shown that wave heights as little as 1.5 feet can cause damage to and failure of typical Zone AE building construction. Wood-frame, light gage steel, or masonry walls on shallow footings or slabs are subject to damage when exposed to waves less than 3 feet in height. Other flood hazards associated with coastal waves (floating debris, high velocity flow, erosion, and scour) can also damage Zone AE construction.

Therefore, a LiMWA boundary may be shown on the FIRM as an informational layer to assist coastal communities in safe rebuilding practices. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The location of the LiMWA relative to Zone VE and Zone AE is shown in Figure 6.

The effects of wave hazards in Zone AE between Zone VE (or the shoreline where Zone VE is not identified) and the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot or greater breaking waves are projected to occur during the 1-percent annual chance flooding event. Communities are therefore encouraged to adopt and enforce more stringent floodplain management requirements than the minimum NFIP requirements in areas lakeward of the LiMWA. The NFIP Community Rating System provides credits for these actions.

Where wave runup elevations dominate over wave heights, there is no evidence to date of significant damage to residential structures by runup depths less than 3 feet. Examples of runup dominated areas include areas with steeply sloped beaches, bluffs, or flood protection structures that lie parallel to the shore. In these areas, the FIRM does not show a LiMWA . Similarly, in areas where the Zone VE designation is based on the presence of a primary frontal dune or wave overtopping, the LiMWA is not shown on the FIRM.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, “Map Legend for FIRM.” Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in Cuyahoga County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Bay Village, City of	A, AE, VE, X
Beachwood, City of	A, X
Bedford, City of	A, AE, X
Bedford Heights, City of	A, AE, X
Bentleyville, Village of	A, AE, X
Berea, City of	A, X
Bratenahl, Village of	A, AE, AO, VE, X
Brecksville, City of	A, AE, X
Broadview Heights, City of	A, X
Brook Park, City of	A, AE, X
Brooklyn, City of	A, AE, X
Brooklyn Heights, Village of	A, AE, X
Chagrin Falls, Village of	AE, X
Cleveland, City of	A, AE, AO, VE, X
Cleveland Heights, City of	A, AE, X
Cuyahoga County, Unincorporated Areas	A, AE, X
Cuyahoga Heights, Village of	A, AE, X
East Cleveland, City of	X
Euclid, City of	A, AE, VE, X
Fairview Park, City of	A, X
Garfield Heights, City of	A, AE, X
Gates Mills, Village of	A, AE, X
Glenwillow, Village of	A, AE, X
Highland Heights, City of	A, AE, X
Highland Hills, Village of	A, X
Hunting Valley, Village of	A, AE, X
Independence, City of	A, AE, X

Table 3: Flood Zone Designations by Community *(Continued)*

Community	Flood Zone(s)
Lakewood, City of	A, AE, VE, X
Linndale, Village of	AE, X
Lyndhurst, City of	A, AE, X
Maple Heights, City of	A, AE, X
Mayfield, Village of	A, AE, X
Mayfield Heights, City of	A, X
Middleburg Heights, City of	A, AE, X
Moreland Hills, Village of	A, AE, X
Newburgh Heights, Village of	A, X
North Olmsted, City of	A, AE, X
North Randall, Village of	A, X
North Royalton, City of	A, AE, X
Oakwood, Village of	A, AE, X
Olmsted Falls, City of	AE, X
Orange, Village of	A, X
Parma, City of	A, AE, X
Parma Heights, City of	A, AE, X
Pepper Pike, City of	A, AE, X
Richmond Heights, City of	A, X
Rocky River, City of	A, AE, VE, X
Seven Hills, City of	A, X
Shaker Heights, City of	A, AE, AH, X
Solon, City of	A, AE, X
South Euclid, City of	A, AE, X
Strongsville, City of	A, AE, X
University Heights, City of	X
Valley View, Village of	A, AE, X
Walton Hills, Village of	A, AE, X
Warrensville Heights, City of	A, AE, X
Westlake, City of	A, AE, X
Woodmere, Village of	X

3.2 Coastal Barrier Resources System

This section is not applicable to this Flood Risk Project.

Table 4: Coastal Barrier Resources System Information

[Not Applicable to this Flood Risk Project]

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 5 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Ashtabula-Chagrin	4110003	Chagrin River	Covers approximately 131 square miles of East Cuyahoga County	634
Black-Rocky	4110001	Rocky River	Drains approximately 138 square miles of west Cuyahoga County	898
Cuyahoga	4110002	Cuyahoga River	Drains central Cuyahoga County covering approximately 190 square miles. This is the largest basin in the county	811

4.2 Principal Flood Problems

Table 6 contains a description of the principal flood problems that have been noted for Cuyahoga County by flooding source.

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
Big Creek	Localized flooding occurs when runoff from heavy rain exceeds the combined sewers capacity causing flooding in low areas in streets. Floods generally occur in the area of the Cleveland Zoological Park. Major floods of record have occurred in 1948, 1959, 1964, 1972, and 1975. The 1975 storm was rated by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), Environmental Data Service as the 100-year storm. Calculations prepared for this study rate the 1972 storm as the 80-year storm, the 1959 and 1948 storms as between 20- and 30-years. The stage records for the 1964 storm are poor, and attempted rating of this storm produces a result that is not reliable. Conditions noted wich compound flood problems include restrictions generally by older bridges.
Chagrin River	Damaging floods can occur at any time of year but almost all instances of major floods have occurred in late winter or early spring due to a combination of rainfall and snowmelt. The highest flood of record at the Willoughby gage on the Chagrin River occurred in March 1948. The recorded water-surface elevation was 611.63 feet NGVD with an estimated peak discharge of 28,000 cubic feet per second (cfs). Other notable floods of record occurred in March 1913, January 1929, June 1931, January 1959 and May 1969. The discharges for these floods are 23,000 cfs (Discharge estimated by USACE), 22,000 cfs, 24,000 cfs, 22,000 cfs, and 23,300 cfs respectively. The flood in January 1959 is the most damaging flood of record. Ice james have been reported to be a major contributor to flood problems on the lower reaches of the Chagrin River.
Cuyahoga River	Although no information was available on the specific effects of floods in Cuyahoga Heights and Brooklyn Heights, damage to structures in the Cuyahoga River floodplain has occurred during floods in 1954, 1959, 1969, and 1976. The discharge associated with these events at the USGS Cuyahoga River gage at Independence, Ohio (No. 04208000) were 14,200 cubic feet per second (cfs), 24,800 cfs, 13,600 cfs, and 14,050 cfs, respectively. The estimated return periods for these floods are 10- year, 100-year, 9-year, and l0-year based on the flood discharge-frequency analysis developed for the City of Independence FIS. The greatest historical flood occured in March 1913 with an estimated stage of 12 feet at the Old Portage gage.
Doan Brook	Periodic flooding caused by overflow in Cleveland. Localized flooding occurs when runoff from heavy rain exceeds the combined sewers capacity causing flooding in low areas in streets.
Euclid Creek	Periodic flooding caused by overflow in Cleveland. Localized flooding occurs when runoff from heavy rain exceeds the combined sewers capacity causing flooding in low areas in streets.

Table 6: Principal Flood Problems *(Continued)*

Flooding Source	Description of Flood Problems
Kingsbury Run	Flooding occurs during high intensity storms due to hydraulic overloading of storm drains causing overland flow.
Kingsbury Run Tributary 2	Flooding occurs during high intensity storms due to hydraulic overloading of storm drains causing overland flow.
Lake Erie	The Lake Erie levels are affected by three categories of fluctuations: long-term, seasonal, and short period. Long-term fluctuations are caused principally by an increase or decrease of precipitation over the Great Lakes basin. Flooding can occur along the shoreline when consecutive annual rainfalls are higher that the mean annual precipitation. The time intervals between successive high water periods are of irregular length. In accordance with seasonal fluctuations, high lake levels occur in the spring when runoff increases because of snowmelt and low rates of evaporation from the lake and evapotranspiration from the land surface. Short period fluctuations of the lake levels can be caused by wind blowing over the lake. This wind drives surface water in great volumes towards the shore, thus raising the water level at one side of the lake while lowering the water at the other side. Cities affected by Lake Erie flooding are Bay Village, Village of Bratenahl, Cleveland, Euclid, Lakewood,
Mill Creek	Periodic flooding caused by overflow in Cleveland. Localized flooding occurs when runoff from heavy rain exceeds the combined sewers capacity causing flooding in low areas in streets. The Mill Creek flooded the City of Garfield heights in July 1969, June 1972 and August 1975. However, no detailed descriptions of these flood events are available. Flooding is caused by a number of factors including runoff, accumulations and ponding hilly terrain, an inadequately sized combined storm and sanitary sewer system in part of the city, an incomplete drainage system and restrictive obstructions such as walls and lengthy culverts.
Plum Creek	Local thunderstorms may cause flooding. Damaging floods can occur at any time of year but almost all instances of major floods have occurred in late winter or early spring. There are no stream gaging stations or official records of past floods on Plum Creek.

Table 6: Principal Flood Problems *(Continued)*

Flooding Source	Description of Flood Problems
Rocky River	Damaging floods usually occur in late winter or early spring and are associated with spring rain and accompanying snowmelt. However, significant floods have been recorded related to intense summer storms in the drainage basin. Due to the nature of the terrain, the river flooding is confined to the relatively narrow limits of the valley. The highest recorded flood stage at the Berea gage occurred in March 1913. A water-surface elevation of 670.1 feet North American Vertical Datum of 1988 (NAVD) was recorded. The discharge is unknown. Flooding is an annual occurrence with major floods occurring in 1928, 1929 and 1935. The most severe flood of record occurred in January of 1959 and was rated as the worst storm in 50 years. This flood had a recorded discharge of 21,400 cfs at the stream gage near Berea located approximately 7.5 miles upstream of Lakewood. This flood is estimated to have a return period of 200 years. Flooding in the Rocky River Valley is occasionally compounded by ice jams created during the annual spring breakup. However, prompt action by the community in cooperation with the U.S. Coast Guard, the USACE and other government agencies has kept flooding behind ice jams to a minimum.
Roots Ditch	Spring floods with a short period of recurrence (less than 10 years) in the City of North Olmsted. Flooding usually occurs in the City of North Olmsted during summer storms of relatively high intensity due to undersized culverts.
Tinkers Creek	Damage to structures in Tinkers Creek floodplain located in the City of Middleburg Heights has occurred during floods in 1968, 1969 and 1976. The discharges associated with these events at the USGS Tinkers Creek gage at Bedford, Ohio (No. 04207200), were 3,560 cfs; floods of these magnitudes are five years, greater than 100 years, and 12 years. The length of record for the gage is from 1963 to present.
Wolf Creek	The Wolf Creek flooded the City of Garfield a series of times. However, no detailed descriptions of these flood events are available. Flooding is caused by a number of factors including runoff, accumulations and ponding hilly terrain, an inadequately sized combined storm and sanitary sewer system in part of the city, an incomplete drainage system and restrictive obstructions such as walls and lengthy culverts.

Table 7 contains information about historic flood elevations in the communities within Cuyahoga County.

Table 7: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Big Creek	City of Cleveland	Unknown	1948	25	NOAA
Big Creek	City of Cleveland	Unknown	1959	25	NOAA

Table 7: Historic Flooding Elevations *(Continued)*

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Big Creek	City of Cleveland	Unknown	1964	Unknown	NOAA
Big Creek	City of Cleveland	Unknown	1972	80	NOAA
Big Creek	City of Cleveland	Unknown	1975	100	NOAA
Chagrin River	Unknown	610.93	1948	Unknown	USACE 2/1971
Chagrin River	Unknown	Unknown	1913	Unknown	Unknown
Chagrin River	Unknown	Unknown	1929	Unknown	Unknown
Chagrin River	Unknown	Unknown	1931	Unknown	Unknown
Chagrin River	Unknown	Unknown	1959	Unknown	Unknown
Chagrin River	Unknown	Unknown	1969	Unknown	Unknown
Cuyahoga River	USGS Gage No. 04208000	Unknown	1954	10	FEMA 8/1980, FEMA 2/1981
Cuyahoga River	USGS Gage No. 04208000	Unknown	1959	100	FEMA 8/1980, USGS 7/2004
Cuyahoga River	USGS Gage No. 04208000	Unknown	1969	9	FEMA 8/1980, USACE 6/2000
Cuyahoga River	USGS Gage No. 04208000	Unknown	1976	10	FEMA 8/1980, B71 1992
Mill Creek	Unknown	Unknown	1969	Unknown	Unknown
Mill Creek	Unknown	Unknown	1972	Unknown	Unknown
Mill Creek	Unknown	Unknown	1975	Unknown	Unknown
Rocky River	USGS Gage No. 04201500	670.1	1913	500	USACE 7/1968
Rocky River	USGS Gage No. 04201500	Unknown	1924	Unknown	USACE 2/1971
Rocky River	USGS Gage No. 04201500	Unknown	1927	10	USACE 7/1968
Rocky River	USGS Gage No. 04201500	Unknown	1928	Unknown	City of Lakewood
Rocky River	USGS Gage No. 04201500	Unknown	1929	10	USGS Gage No. 04201500
Rocky River	USGS Gage No. 04201500	Unknown	1933	8	USACE 7/1968

Table 7: Historic Flooding Elevations *(Continued)*

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Rocky River	USGS Gage No. 04201500	Unknown	1935	Unknown	USGS Gage No. 04201500
Rocky River	USGS Gage No. 04201500	Unknown	1947	8	USACE 7/1968
Rocky River	USGS Gage No. 04201500	Unknown	1952	8	USACE 7/1968
Rocky River	USGS Gage No. 04201500	Unknown	1959	200	USACE 2/1971
Rocky River	USGS Gage No. 04201500	Unknown	2004	Unknown	USGS Gage No. 04201500
Tinkers Creek	USGS Gage No. 04207200	Unknown	1968	5	ODNR 5/1977
Tinkers Creek	USGS Gage No. 04207200	Unknown	1969	100	USACE 7/1968
Tinkers Creek	USGS Gage No. 04207200	Unknown	1976	12	USWB 1955

4.3 Non-Levee Flood Protection Measures

Table 8 contains information about non-levee flood protection measures within Cuyahoga County such as dams, revetments, seawalls, and or dikes. Levees are addressed in Section 4.4 of this FIS Report.

Table 8: Non-Levee Flood Protection Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Chagrin River	Millpond Dam	Dam	310 ft upstream of Cleveland Street	Not constructed for flood control but provides flood protection by dampening peak dishcarges.
Chagrin River	N/A	Grade Elevation	Chagrin Falls Waste Water Treatment Plant discharge	The grade at the Wastewater Treatment Plant was elevated to prevent flooding of the treatment facilities.
Chippewa Creek	N/A	Cleaning and Maintenance	Along channel in the City of Bracksville	Periodic removal of debris and refuse from stream and embankments.

Table 8: Non-Levee Flood Protection Measures *(Continued)*

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Cuyahoga River	N/A	Flooding Warning	Cuyahoga River Drainage Basin in the City of Cleveland	Emergency flood warning system operated by NOAA.
Cuyahoga River	N/A	Dredge	Mouth of river	USACE maintains a dredge program for navigation approximately 5.5 miles upstream from the mouth.
Euclid Creek Tributary 1.5	N/A	Detention Basin	Confluence of Eculid Creek Tributaries 1.5 and 1.5.1	Planned to be constructed as part of the Highland Greens subdivision, which may provide flood protection when construction is completed.
Hawthorne Creek	N/A	Cleaning and Maintenance	Along channel and embankments in City of Solon.	Periodic cleaning and channel maintenance.
Lake Erie	N/A	Sea Walls	Coast along City of Bay Village	Sea walls to protect against erosion and retard the advance of wave action.
Lake Erie	N/A	Berm	Coast along City of Bay Village	Rubble mound banks constructed to protect against erosion and retard the advance of wave action.
Lake Erie	N/A	Breakwall	Offshore in Lake Erie from the mouth of the Cuyahoga River at Cleveland.	Serves as a flood protection measure by inhibiting the advance of waves from storms on the open lake. The breakwall is sufficiently high to provide complete protection from the 100-year storm, and, if properly maintained, should provide the harbor with adequate protection from the 500-year storm.
Mill Creek	N/A	Retention Basin-Reservoir	Upstream of Lee Road in the City of Warrensville	The retention basin-reservoir has an uncontrolled outlet and ungated spillway that reduces downstream flooding by temporarily storing flood waters.

Table 8: Non-Levee Flood Protection Measures *(Continued)*

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Mill Creek	N/A	Cleaning and Maintenance	Along channel and embankments in the City of Maple Heights	Periodic cleaning and channel maintenance.
Multiple Streams	N/A	Regulations	Village of Bratenahl, Village of Brooklyn Heights, Village of Cuyahoga Heights, City of Euclid, City of Highland Heights, City of Middleburg Heights, City of Parma, City of Parma Heights, City of Pepper Pike, City of Shaker Heights, City of South Euclid, and City of Warrensville Heights	Land use regulations adopted from the Code of Federal Regulations (CFR) which control building within areas that have a high risk of flooding.
Tinkers Creek	N/A	Cleaning and Maintenance	Along channel and embankments in the Village of Glenwillow.	Periodic cleaning and maintenance of the channel. Additional maintenance is conducted on culverts and roadside ditches when needed.
Tinkers Creek Tributary 2	N/A	Cleaning and Maintenance	Along channel and embankments in the Village of Glenwillow and the City of Solon.	Periodic cleaning and maintenance of the channel. Additional maintenance is conducted on culverts and roadside ditches when needed.
Wischmeyer Creek	N/A	Cleaning and Maintenance	Along the channel in the City of Bay Village	Channel maintenance perfomred by the County Engineer and the community.
Wischmeyer Creek	N/A	Culvert	West Glen Park Drive, Wolf Road, Normandy Road, Midland Road and Osborn Road	New culvert replaced a smaller bridge or culvert to increase carrying capacity. The upstream and downstream locations of each culvert were widened.
Wischmeyer Creek	N/A	Channelization	Between Lake Road and West Glen Park Drive, and between Osborn Road and East Oviatt Road.	Channel widening and reconstruction, and lining with gabions.

4.4 Levees

This section is not applicable to this Flood Risk Project.

Table 9: Levees

[Not Applicable to this Flood Risk Project]

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded at least once on the average during any 10-, 25-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2-percent annual chance, respectively, of being equaled or exceeded during any year.

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 27, "Incorporated Letters of Map Change", which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, "FIRM Revisions."

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 13. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 10. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 11. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 17). Stream gage information is provided in Table 12.

Table 10: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Anthony Lane Tributary to Big Creek	Downstream study limit	**	*	*	*	*	*
Aurora Branch	6950' upstream of mouth	55.4	3,663	*	5,375	6,200	8,156
Aurora Branch Tributary 2	At mouth	1.48	283	*	437	511	684
Aurora Branch Tributary 3	At mouth	2.39	384	*	587	683	911
Baker Creek	Cross Section A	4.19	680	*	1,060	1,250	1,720
Baker Creek	Cross Section H	2.22	430	*	670	780	1,070
Baker Creek	Cross Section P	1.93	380	*	590	680	930
Baker Creek	Cross Section S	1.77	360	*	560	660	900
Baker Creek Tributary 1	Cross Section B	1.8	350	*	650	650	900
Baker Creek Tributary 1	Cross Section E	1.63	330	*	600	600	830
Baldwin Creek	Downstream study limit (Lucerne Drive)	7.02	1,470	*	2,000	2,380	3,040
Baldwin Creek	Below Tributary 4	6.23	1,340	*	1,850	2,200	2,860
Baldwin Creek	Above Tributary 4	5.96	1,300	*	1,800	2,150	2,810
Baldwin Creek	At West 130th Street Bridge	5.69	1,250	*	1,740	2,080	2,730
Baldwin Creek	At Sprague Road	2.62	590	*	940	1,110	1,530
Bear Creek	Just downstream of Columbus Street	4.14	687	*	1,023	1,183	1,560

* Not calculated for this Flood Risk Project. **No data available.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Bear Creek	Just downstream of Libby Road	4.14	526	*	828	975	1,329
Big Creek	Mouth at Cuyahoga River	39	5,751	*	8,356	9,472	12,078
Big Creek	Confluence with Big Creek Tributary	34	5,251	*	7,676	8,721	11,147
Big Creek	About 1900' upstream of Stumph Road	5.82	1,300	*	1,850	2,180	2,850
Big Creek	At the southern Corporate Limits	3.44	775	*	1,160	1,365	1,860
Blodgett Creek	Marks Road	3.04	520	*	800	940	1,290
Blodgett Creek	Prime Road	2.7	470	*	730	850	1,160
Blodgett Creek	Courtland Drive	2.07	380	*	600	700	970
Cahoon Creek / Dover Ditch	At Lake Erie	8.1	1,214	*	1,804	2,057	2,647
Cahoon Creek / Dover Ditch	At southern Corporate Limits	7.81	1,164	*	1,730	1,947	2,539
Cahoon Creek / Dover Ditch	Cross Section A	6.98	869	*	1,322	1,537	2,721
Cahoon Creek / Dover Ditch	Just downstream of State Route 2	5.38	494	*	720	817	1,225
Cahoon Creek / Dover Ditch	Beginning of Dover Ditch	3.44	424	*	635	729	1,197
Cahoon Creek / Dover Ditch	Upstream of Ehle Lateral	3.1	401	*	601	692	1,148
Cahoon Creek / Dover Ditch	Upstream of Hollywood Drive	2.57	342	*	512	589	972

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Chagrin River	At USGS Gage in Willoughby	246	*	*	*	32,000	*
Chagrin River	Village of Gates Mills northern Corporate Limits	179	14,138	*	22,839	27,312	39,561
Chagrin River	Village of Gates Mills southern Corporate Limits	159	13,685	*	22,173	26,537	38,487
Chagrin River	Village of Hunting Valley upstream Corporate Limits	139	12,681	*	20,616	24,696	35,870
Chagrin River	City of Bentleyville downstream Corporate Limits	123	8,390	*	13,000	15,300	21,700
Chagrin River	At confluence with Aurora Branch	62	4,240	*	6,570	7,740	10,900
Chagrin River	City of Chagrin Falls western Corporate Limits	52.5	3,044	*	4,386	5,012	6,496
Chagrin River Tributary 1	S.O.M. Center Road to Interstate 271[1]	**	284	*	442	516	681
Chagrin River Tributary 2 [2]	Upstream of Cross Section A	**	360	*	470	512	640
Chagrin River Tributary 2 [2]	Upstream of Cross Section D	**	350	*	460	495	615
Chagrin River Tributary 2 [2]	Upstream of Cross Section G	**	290	*	380	410	505
Chagrin River Tributary 2.1	Upstream of Cross Section A	**	650	*	885	1,000	1,250
Chagrin River Tributary 2.1	Upstream of Cross Section B	**	635	*	860	970	1,220
Chagrin River Tributary 2.1	Upstream of Cross Section G	**	610	*	840	940	1,190

* Not calculated for this Flood Risk Project. **No data available.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Chagrin River Tributary 2.1	Upstream of Cross Section H	**	330	*	450	510	640
Chippewa Creek	Chippewa Creek	14.53	1,946	*	3,042	3,591	4,919
Countrymans Creek	Mouth at Big Creek	11.5	1,721	*	2,557	2,917	3,743
Countrymans Creek	Corporate Limit	2	772	*	1,153	1,319	1,699
Cuyahoga River	Mouth at Lake Erie	808	17,250	*	24,250	27,600	34,400
Cuyahoga River	Corporate Limit	710	14,400	*	19,650	21,800	27,350
Cuyahoga River	At confluence with Big Creek	786	16,505	*	22,764	25,625	33,500
Cuyahoga River	At confluence with Mill Creek	730	14,902	*	20,408	22,930	28,100
Cuyahoga River	At independent gage	707	14,300	*	19,500	21,900	27,800
Cuyahoga River Tributary 1	Upstream of Brecksville Road	2.11	584	*	917	1,085	1,476
Doan Brook	Upstream of enclosed system	7.3	1,500	*	2,200	2,500	3,300
Doan Brook	Downstream study limit in City of Shaker Heights	5.1	1,220	*	1,860	2,210	2,950
Doan Brook	Downstream lower Shaker Lake	4.7	1,160	*	1,770	2,100	2,810
Doan Brook	Upstream lower Shaker Lake	4.7	1,875	*	2,600	3,000	3,800
Doan Brook	Downstream Tributary 1	4	1,685	*	2,290	2,695	3,370
Doan Brook	Upstream Tributary 1	2.4	1,365	*	1,865	2,195	2,775
Doan Brook	Upstream study limit in City of Shaker Heights	0.5	415	*	575	675	860

* Not calculated for this Flood Risk Project. **No data available.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
East Branch Rocky River	At Bennett Road	44.3	3,700	*	5,600	6,500	8,900
East Branch Rocky River	At Edgerton Road	1.79	380	*	600	690	930
East Branch Rocky River Tributary 7	At mouth	2.84	590	*	930	1,260	1,520
Euclid Creek	Mouth at Lake Erie	23	3,183	*	4,662	5,298	6,777
Euclid Creek	At City of Euclid downstream Corporate Limits	22	3,150	*	4,620	5,250	6,710
Euclid Creek	At City of South Euclid downstream study limit	5.98	1,675	*	2,335	2,745	3,520
Euclid Creek	At City of South Euclid upstream study limit	4.03	1,050	*	1,500	1,765	2,320
Euclid Creek Tributary 1.5	Just upstream of confluence of Stone Water Creek Tributary 1	2.1	*	*	*	1,300	*
Euclid Creek Tributary 1.5	At confluence of Tributary E	1.6	*	*	*	980	*
Euclid Creek Tributary 1.5	At confluence of Euclid Creek Tributary 1.5.1	1	*	*	*	600	*
Euclid Creek Tributary 1.5.1	At mouth	0.5	*	*	*	310	*
Euclid Creek Tributary 1.6	At Interstate Route 271	0.14	*	*	*	380	*
Euclid Creek Tributary 1.6	Upstream of Leverett Road	0.35	*	*	*	293	*
Euclid Creek Tributary 1.6	At Highland Road	0.2	*	*	*	200	*
Euclid Creek Tributary 2	Confluence with Euclid Creek	2.36	1,065	*	1,470	1,735	2,205

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Euclid Creek Tributary 2	Upstream study limit	1.85	855	*	1,175	1,385	1,755
Fitch Lateral	At confluence with Roots Ditch	2	*	*	*	1,140	*
Fitch Lateral	Just upstream of confluence of Westerly Lateral	1.43	*	*	*	910	*
Hawthorne Creek	At confluence with Tinker Creek	7.01	1,047	*	1,636	1,919	2,610
Hawthorne Creek	500' upstream of Cannon Road	4.64	764	*	1,195	1,404	1,911
Kirk Lateral	At mouth	1.96	332	*	511	594	1,047
Kirk Lateral	Downstream of Strawberry Lane	1.31	252	*	392	457	817
Mill Creek	At City of Cleveland corporate Limit	16	2,411	*	3,551	4,043	5,183
Mill Creek	Broadway Avenue	15	2,358	*	3,477	3,959	5,078
Mill Creek	At City of Garfield Heights downstream corporate boundary (near state hospital)	12.7	2,270	*	3,150	3,820	5,200
Mill Creek	Just downstream of confluence of Wolf Creek	10.66	1,960	*	2,720	3,370	4,500
Mill Creek	Just downstream of confluence of tributary near Interstate 480	8.26	1,780	*	2,560	3,000	4,100

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Mill Creek	At City of Garfield Heights upstream corporate boundary	6.67	1,250	*	1,670	2,150	2,650
Mill Creek	Downstream of McCracken Road Bridge	5.65	982	*	1,424	1,622	2,082
Mill Creek	At Marvin Road (extended)	3.48	995	*	1,395	1,650	2,130
Mill Creek	Just upstream of Emery Road	3.13	930	*	1,305	1,540	1,985
Mill Creek	About 500' downstream of Longbrook Road	2.93	845	*	1,185	1,400	1,810
Mill Creek	At Warrensville Center Road	2.38	645	*	925	1,085	1,425
Nine Mile Creek	At mouth	7.8	*	*	*	3,500	*
Pepper Creek	Just downstream of confluence of Tributary 2	6.43	1,230	*	1,760	2,070	2,750
Pepper Creek	Just upstream of confluence of Tributary 2	6.17	1,200	*	1,700	2,000	2,700
Pepper Creek	Just downstream of confluence of Tributary 3	5.89	1,150	*	1,675	1,970	2,460
Pepper Creek	Just upstream of confluence of Tributary 3	5.2	1,060	*	1,545	1,810	2,410
Pepper Creek	Just downstream of confluence of Tributary 4	5.17	1,055	*	1,540	1,800	2,400
Pepper Creek	Just upstream of confluence of Tributary 4	4.76	1,010	*	1,450	1,715	2,290

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Pepper Creek	Just downstream of confluence of Tributary 5	4.55	980	*	1,410	1,660	2,245
Pepper Creek	Just upstream of confluence of Tributary 5	1.85	530	*	790	930	1,270
Pepper Creek	Approx. 1900' upstream at Lander Road	1.49	465	*	690	815	1,115
Plum Creek	At mouth	17	1,860	*	3,210	3,980	5,850
Plum Creek	1,700 feet downstream of Railroad	16.4	1,840	*	3,170	3,930	5,780
Plum Creek	300 feet downstream of Nichols Road	13.2	1,600	*	2,770	3,440	5,050
Plum Creek	3,400 feet downstream of Royalton Road	9.2	1,320	*	2,330	2,870	4,210
Porter Creek (Huntington Creek) / Gifford Avon Ditch	At Lake Erie	8.34	1,188	*	1,764	2,012	2,588
Porter Creek (Huntington Creek) / Gifford Avon Ditch	At southern Corporate Limit	5.3	853	*	1,274	1,455	1,875
Porter Creek (Huntington Creek) / Gifford Avon Ditch	Cross Section Q	4.29	531	*	798	921	1,573
Plum Creek	At Mouth	17	1,860	*	3,210	3,980	5,850
Plum Creek	1,700 feet downstream of the Conrail Railroad	16.4	1,840	*	3,170	3,930	5,780

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Plum Creek	300 feet downstream of Nichols Road	13.2	1,600	*	2,770	3,440	5,050
Plum Creek	3,400 feet upstream of Royalton Road	9.2	1,320	*	2,330	2,870	4,210
Reservoir Creek	At confluence with Big Creek at Pearl Road	0.79	465	*	640	755	950
Reservoir Creek	At Pearl Road	0.63	380	*	520	610	770
Rocky River	At mouth	293	16,734	*	23,742	26,775	33,678
Roots Ditch	Canterbury Road	3.92	443	*	658	752	1,188
Roots Ditch	Revere Road	2.99	371	*	553	634	1,015
Roots Ditch	80' upstream of Revere Road	0.81	137	*	207	237	380
Roots Ditch	Decker Road	0.43	80	*	120	136	212
Roots Ditch	Park Ridge Drive	0.14	34	*	51	59	91
Rose Lateral	At mouth	1.96	332	*	511	594	1,047
Rose Lateral	Cross Section A	0.57	133	*	208	242	433
Sagamore Creek	Downstream of bike trails	5.29	836	*	1,302	1,530	2,079
Spencer Creek	At mouth	4.3	1,990	*	2,275	2,360	2,610
Spencer Creek	Norfolk and Western Railroad	4.24	1,750	*	1,990	2,060	2,235
Spencer Creek	Interstate 90	3.41	1,500	*	1,610	1,640	1,730

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
Spencer Creek	Detroit Road	3.35	1,490	*	1,585	1,630	1,690
Spencer Creek	Cross Section AS	2.92	1,490	*	1,555	1,590	1,640
Spencer Creek	Cross Section AW	2.5	1,100	*	1,175	1,200	1,250
Sperry Creek	Station 2770	3.73	577	*	856	997	1,801
Sperry Creek	Station 8942	2.33	379	*	582	677	1,196
Stonewater Creek	At confluence of Stonewater Creek Tributary 1	0.13	*	*	*	145	*
Stonewater Creek Tributary 1	Upstream of Middle Detention Basin	0.58	*	*	*	441	*
Tinkers Creek	Upstream of the Mouth	96	4,400	*	6,100	6,750	8,150
Tinkers Creek	Just downstream of Union Street	83.9	4,100	*	5,550	6,200	7,750
Tinkers Creek	At Richmond Road	61.5	3,485	*	4,750	5,460	6,600
Tinkers Creek Tributary 1	Downstream of Egbert Road Bridge	0.36	130	*	212	252	349
Tinkers Creek Tributary 2	At Cannon Road	4.61	664	*	1,021	1,189	1,596
West Branch Rocky River	At City of North Olmstead eastern Corporate Limit	267	12,260	*	14,948	17,164	22,906
West Branch Rocky River	Downstream of Plum Creek	190	9,470	*	14,445	16,750	21,800
West Branch Rocky River	Upstream of Plum Creek	161	8,550	*	12,830	14,780	19,000

* Not calculated for this Flood Risk Project.

Table 10: Summary of Discharges *(Continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10-Percent Annual Chance	4-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance Existing	0.2-Percent Annual Chance
West Creek	At Snow Road	4.77	1,870	*	2,560	3,010	3,850
West Creek	At Ridgewood Drive Bridge	3.85	1,600	*	2,200	2,600	3,300
West Creek	About 1800' upstream from Ridgewood Drive	3.66	1,520	*	2,100	2,500	3,080
Wilhelmy Creek	At City of Westlake downstream Corporate Limits	2.11	286	*	426	489	819
Wilhelmy Creek	Just downstream of Cross Section 1	1.3	195	*	292	335	549
Wischmeyer Creek	At Lake Erie	1.33	366	*	555	637	826
Wischmeyer Creek	At southern Corporate Limit	0.94	279	*	426	489	635
Wood Creek	Just downstream of Conrail	1.63	556	*	790	899	1,136

* Not calculated for this Flood Risk Project.

**No data available.

[1] These flows have been reduced by 100 cfs to reflect diversion out of the watershed along the highway ditch downstream of Interstate 271.

[2] All 2-, 1-, 0.2-percent annual chance flows have been reduced by 20, 45, and 75 cfs, respectively, to reflect diversion out of the watershed along the highway ditch upstream of Interstate 271.

Figure 7: Frequency Discharge-Drainage Area Curves

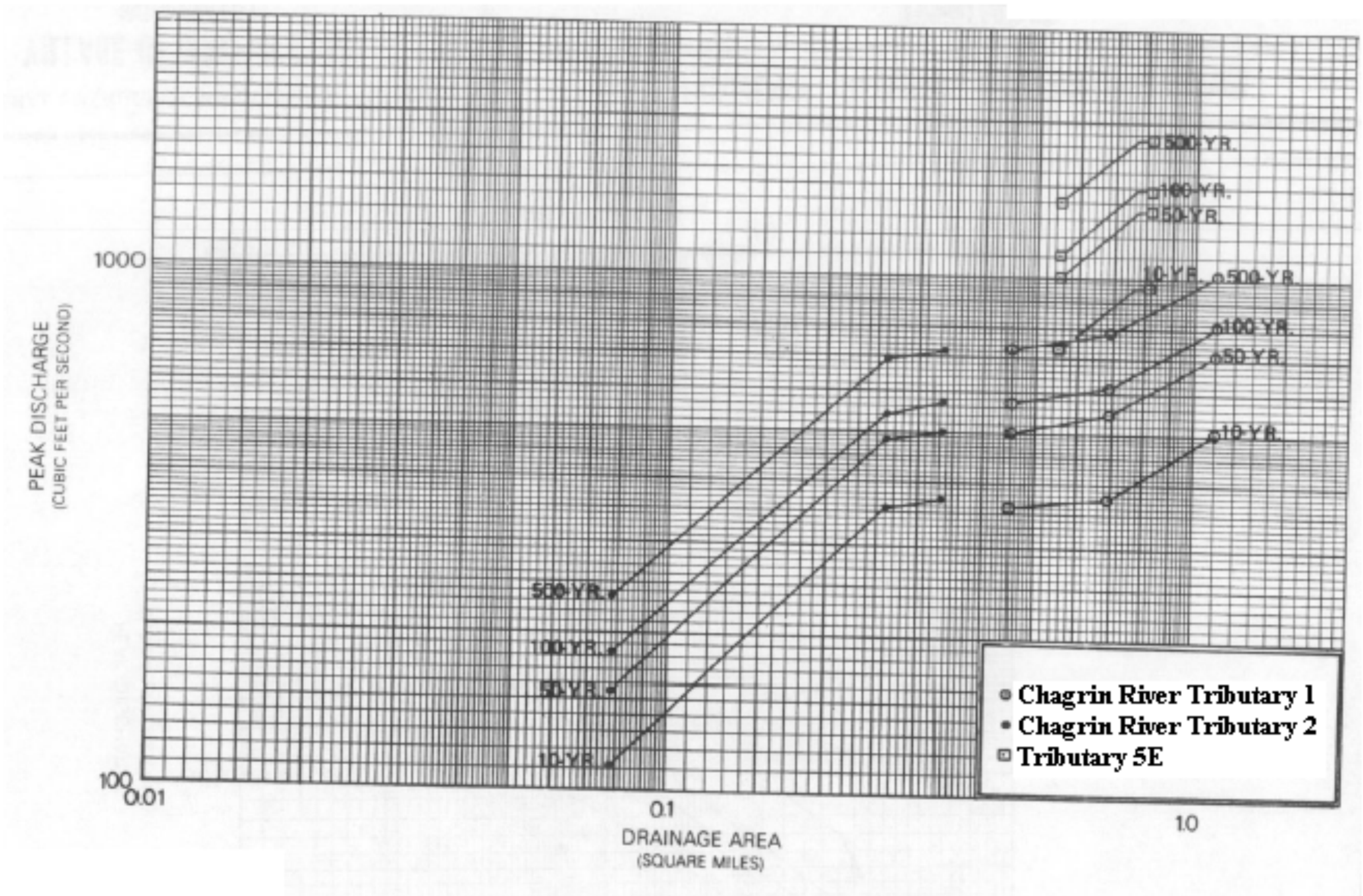


Figure 7: Frequency Discharge-Drainage Area Curves *(Continued)*

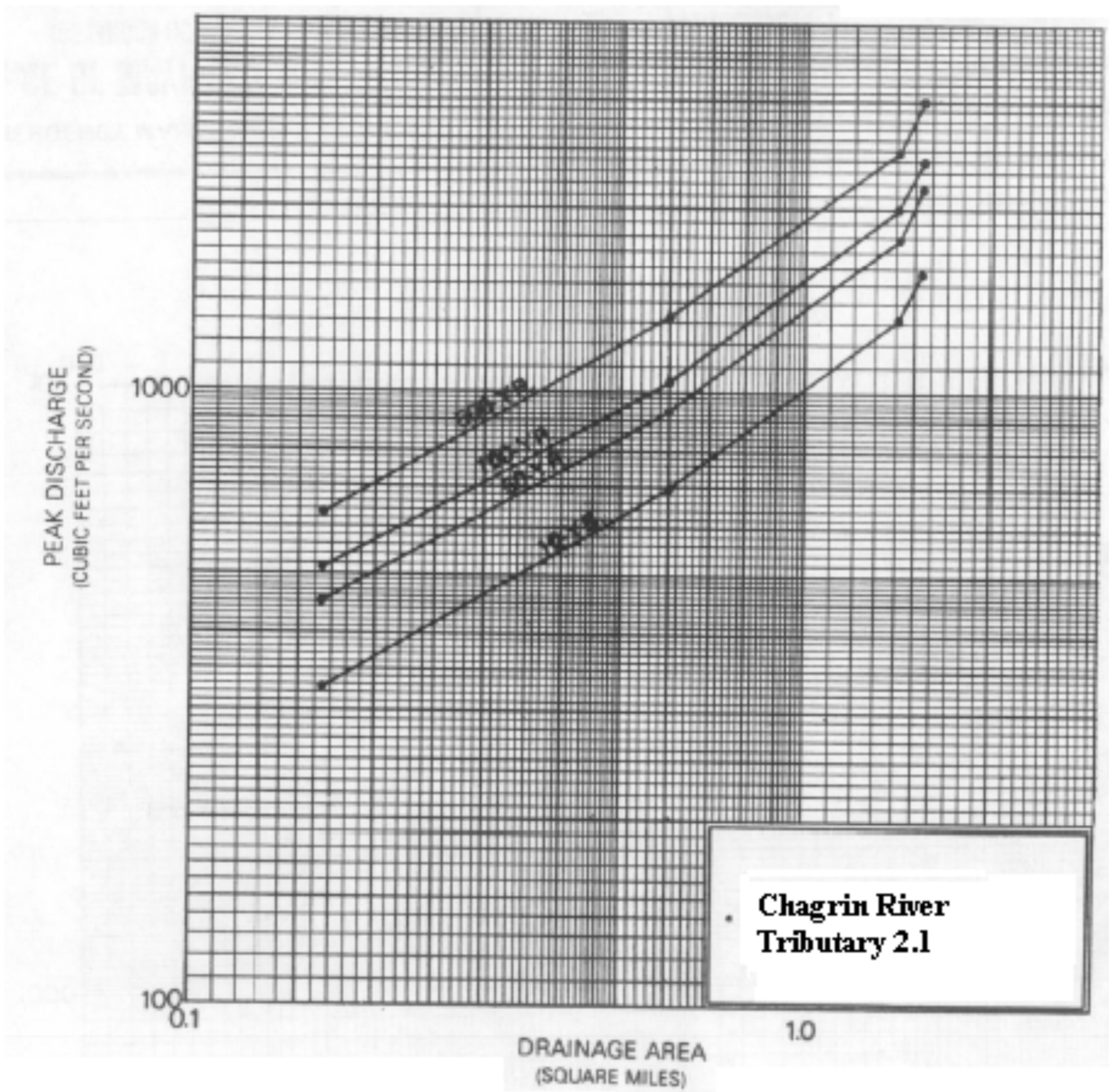


Table 11: Summary of Non-Coastal Stillwater Elevations

[Not Applicable to this Flood Risk Project]

Table 12: Stream Gage Information used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
Big Creek	4208502	USGS	Big Creek at Cleveland OH	35.3	7/10/1973	6/15/1986
Chagrin River	4209000	USGS	Chagrin River at Willoughby OH	246	3/23/1913	1/5/2007
Cuyahoga River	4206000	USGS	Cuyahoga River at Old Portage OH	404	3/31/1922	8/20/2007
Cuyahoga River	4208000	USGS	Cuyahoga River at Independence OH	707	4/15/1922	1/6/2007
Rocky River	4201500	USGS	Rocky River near Berea OH	267	1/11/1924	1/6/2007
Tinkers Creek	4207200	USGS	Tinkers Creek at Bedford OH	83.9	3/12/1963	1/5/2007

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed in Table 24, “Floodway Data.”

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 13. Roughness coefficients are provided in Table 14. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 13: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Anthony Lane Tributary to Big Creek	Confluence with Big Creek	150 feet upstream of Anthony Lane	Unknown	HEC-2	04/1980	AE w/ Floodway	
Aurora Branch	Confluence with Chagrin River	3300 feet upstream of confluence with Aurora Branch Tributary 3	Log-Pearson Type III	HEC-2	03/2000	AE w/ Floodway	
Aurora Branch Tributary 1	Confluence with Aurora Branch	About 675 feet upstream of Cannon Road	Unknown	HEC-RAS	12/2010	A	
Aurora Branch Tributary 2	Confluence with Aurora Branch	About 700 feet upstream of Pheasant Court	Regression Equations	HEC-2	02/1979	AE w/ Floodway	
Aurora Branch Tributary 3	Confluence with Aurora Branch	About 1500 feet upstream	Regression Equations	HEC-2	02/1979	AE w/ Floodway	
Baker Creek	About 4500 feet downstream of confluence with Baker Creek Tributary 1	1480 feet upstream of Royalton Road	Regression Equations	HEC-2	06/1977	AE w/ Floodway	
Baker Creek Tributary 1	Confluence with Baker Creek	About 1750 feet upstream of Royalton Road	Regression Equations	HEC-2	06/1977	AE w/ Floodway	
Baker Creek Tributary 2	Confluence with Baker Creek	About 40 feet upstream of Pearl Road	Unknown	HEC-RAS	12/2010	A	
Baldwin Creek	Lucerne Drive	130th Street	Regression Equations	HEC-2	02/1980	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Baldwin Creek	Sprague Road	3550 feet upstream of Abbey Road	Regression Equations	E-431 or J-635	09/1978	AE w/ Floodway	
Baldwin Creek	1700 ft down stream of Lynn Drive	York Road	Unknown	HEC-RAS	12/2010	A	
Baldwin Creek	130th Street	Sprague Road	Regression Equations	HEC-2	03/1980	AE w/ Floodway	
Baldwin Creek Tributary 2	Confluence with Baker Creek	About 35 feet upstream of Pearl Road	Unknown	HEC-RAS	12/2010	A	
Baldwin Creek Tributary 7	Confluence with Baldwin Creek	York Road	Unknown	HEC-RAS	12/2010	A	
Bear Creek	Confluence with Tinkers Creek	About 1940 upstream of Interstate Highway 480	Regression Equations	HEC-2	02/1979	AE w/ Floodway	
Big Creek	About 600 feet downstream of Jennings Road	About 1600 feet upstream of Ridge Road	Regression Equations	HEC-2	04/1977	AE w/ Floodway	
Big Creek	About 1700 feet downstream Pearl Road	1800 feet upstream of Independence Boulevard	Regression Equations	HEC-2	04/1980	AE w/ Floodway	
Blodgett Creek	Marks Road	Courtland Drive	Regression Equations	HEC-2	06/1977	AE w/ Floodway	
Cahoon Creek / Dover Ditch	Confluence with Lake Erie	About 550 feet upstream of Oviatt Road	Regression Analysis	HEC-2	11/1976	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Cahoon Creek / Dover Ditch	About 650 feet upstream of Oviatt Road	About 1700 feet upstream of Cleveland Metro Park	Regression Analysis	HEC-2	02/1978	AE w/ Floodway	
Chagrin River	About 707 feet downstream of Miles Road	About 4745 feet downstream of Miles Road	Gage Analysis	HEC-2	03/2000	AE w/ Floodway	
Chagrin River	About 3030 feet upstream of Woodland Road	About 1922 feet downstream of Chagrin Boulevard	Log-Pearson Type III	HEC-2	Unknown	AE	
Chagrin River	About 4745 feet downstream of Miles Road	About 1 miles upstream of Cleveland Street	Gage Analysis	HEC-RAS (Jan. 2001)	03/2002	AE w/ Floodway	
Chagrin River	About 60 feet downstream of Rogers Road	1700 feet upstream of Woodland Road	Log-Pearson Type III	HEC-2	12/1976	AE w/ Floodway	
Chagrin River Tributary 1	Interstate 271	Som Center Road	Regression Equations	HEC-2	Unknown	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Chagrin River Tributary 2	About 1100 feet downstream of Som Center Road	About 1750 feet upstream of Som Center Road	Regression Equations	HEC-2	Unknown	AE w/ Floodway	It should be noted that adjustments were made to account for diversion of flow from one tributary into another. Diverted flows were not added to the natural flow in the tributary, however, since each flood occurrence was considered to be a separate event on each watershed. That is, flood flows for each stream were examined independently of each other. If, for example, a diversion occurred from Beechers Brook to Chagrin River Tributary 2 (formerly known as Tributary 4), the flows in Beechers Brook were reduced below the diversion point by the amount diverted. Estimated flood flows for Chagrin River Tributary 2, however, do not include the amount diverted from Beechers Brook. Thus, the probability of flood occurring simultaneously on the two streams was not examined.
Chagrin River Tributary 2.1	Worton Park Drive	Ridgebury Boulevard	Regression Equations	HEC-2	Unknown	AE w/ Floodway	
Chippewa Creek	About 200 feet downstream of Old Royalton Road	About 4500 feet upstream of Chippewa Road	Regression Equations	HEC-2	04/1979	AE w/ Floodway	
Countrymans Creek	From Interstate 71	Brookpark Road	Unknown	HEC-2	04/1977	AE w/ Floodway	
Cuyahoga River	Denison Avenue	Pleasant Valley Road	HEC-FFA	HEC-2	05/1998	AE w/ Floodway	
Cuyahoga River	Confluence with Lake Erie	Denison Avenue	Log-Pearson Type III	HEC-2	04/1977	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Cuyahoga River	About 890 feet downstream of Granger Road	Pleasant Valley Road	Log-Pearson Type III	HEC-2	07/1979	AE w/ Floodway	The Ohio Canal, located to the east of and approximately parallel to the Cuyahoga River, was not considered in the modeling of Valley view's water courses for this study. The Ohio Canal would add a negligible increase in drainage values if considered because it is almost stagnant with no drainage basin. Therefore, the Ohio Canal was treated as a physical feature rather than a hydraulic feature in this report.
Cuyahoga River Tributary 1	Brecksville Road	The northbound lane of Interstate Route 77	Unknown	HEC-2	07/1979	AE w/ Floodway	
Cuyahoga River Tributary 1	Confluence with Cuyahoga River, about 265 feet downstream of northbound I-77 Interstate Highway	About 190 feet upstream of Brecksville Road, about 2000 feet upstream of Hillside Road	Unknown	HEC-RAS	12/2010	A	
Doan Brook	About 1550 feet downstream of Martin Luther King Drive	About 850 feet upstream of Martin Luther King Drive	Regression Equations	HEC-2	04/1977	AE w/ Floodway	
Doan Brook	About 2300 feet downstream of Fairhill Road	About 4350 feet upstream of Torrington Road	Regression Equations	HEC-2	03/1980	AE w/ Floodway	
East Branch Rocky River	About 3,850 feet downstream of Valley Parkway	About 2,400 feet upstream of Royal View Lane	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River	Bennett Road	Boston Road	Regression Equations	E-431 or J-635	09/1978	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
East Branch Rocky River	70 feet downstream of Edgerton Road	360 feet upstream of Royalton Road	Regression Equations	E-431 or J-635	09/1978	AE w/ Floodway	
East Branch Rocky River Tributary 1	Confluence with East Branch Rocky River	About 2,340 feet upstream of Progress Drive	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 2	About 480 feet upstream of Pearl Road	About 2,250 feet upstream of Forest View Drive	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 2.1	Confluence with East Branch Rocky River Tributary 2	About 850 feet upstream of lake Medows Drive	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 3	Confluence with East Branch Rocky River	About 1,950 feet upstream of Huntington Meadows Drive	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 4	Confluence with East Branch Rocky River	About 680 feet upstream of I80 Interstate Highway	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 5	Confluence with East Branch Rocky River	Drake Road	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 5.1	Confluence with East Branch Rocky River Tributary 5	I 71 Interstate Highway	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 6	Confluence with East Branch Rocky River	Boston Road	Unknown	HEC-RAS	12/2010	A	
East Branch Rocky River Tributary 7	Valley Parkway	About 3600 feet upstream	Regression Equations	E-431 or J-635	09/1978	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Euclid Creek	Confluence with Lake Erie	Euclid Avenue	Regression Equations	HEC-2	04/1977	AE w/ Floodway	
Euclid Creek	Confluence with Euclid Creek Tributary 1	Mayfield Road	Regression Equations	HEC-2	04/1980	AE w/ Floodway	
Euclid Creek Tributary 1.5	About 1150 feet downstream of Bishop Road	About 310 feet upstream of Highland Road	TR 55	HEC-2	04/1989	AE w/ Floodway	
Euclid Creek Tributary 1.5.1	Confluence with Tributary A	About 270 feet upstream of Highland Road	TR 55	HEC-2	04/1989	AE w/ Floodway	
Euclid Creek Tributary 1.6	About 2900 feet downstream of Highland Road	About 2190 feet upstream of Highland Road	Unknown	HEC-2	11/1992	AE w/ Floodway	
Euclid Creek Tributary 2	Confluence with Euclid Creek	About 30 feet downstream of Professor Road	Regression Equations	HEC-2	04/1980	AE	
Fitch Lateral	Confluence with Roots Ditch	About 2750 feet upstream	USACE HEC-1 and HEC-DSS	HEC-2	Unknown	AE w/ Floodway	
Hawthorne Creek	Confluence with Tinkers Creek	About 915 feet upstream of Metro Court	Regression Analysis	HEC-2	02/1979	AE w/ Floodway	
Hawthorne Creek	About 385 feet downstream of Miles Road, About 30 feet upstream of Metro Court	About 322 feet downstream of Country Lane, About 830 feet upstream of Aurora Road	Unknown	HEC-RAS	12/2010	A	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Hawthorne Creek	About 130 feet downstream of Aurora Road	About 385 feet downstream of Miles Road	Regression Analysis	HEC-2	Unknown	AE w/ Floodway	
Hawthorne Creek	About 965 feet downstream of Country Lane	About 3500 feet upstream of Emery Road	Regression Analysis	HEC-2	03/1980	AE w/ Floodway	
Kirk Lateral	Confluence with Cahoon Creek	About 80 feet upstream of Woodpath Trail	Regression Analysis	HEC-2	02/1978	AE w/ Floodway	
Nine Mile Creek	The mouth at Lake Erie to	Approximately 30 feet downstream of Lake Shore Boulevard	Unknown	Unknown	2016	AE	LOMR 15-05-6419P
Mill Creek	About 1 mile downstream of Warner Road	About 660 feet downstream of Broadway Avenue	Regression Equations	HEC-2	04/1977	AE w/ Floodway	
Mill Creek	About 660 feet downstream of Broadway Avenue	McCracken Road	Regression Equations	HEC-2	04/1986	AE w/ Floodway	The retention basin-reservoir on Mill Creek, upstream of Lee Road, will attenuate flood hydrographs, thus reducing the peaks downstream. The discharge-frequency curves for locations along Mill Creek were adjusted to reflect the storage effects of the reservoir. The discharge-frequency curves were modified by analyzing the results of routing flood hydrographs through the reservoir.
Mill Creek	McCracken Road	About 730 feet upstream of Lee Road	Regression Equations	HEC-2	04/1979	AE w/ Floodway	
Mill Creek	About 720 feet downstream of Miles Road	About 430 feet upstream of Emery Road	Regression Equations	HEC-2	03/1980	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Mill Creek	About 525 feet downstream of Longbrook Road	Warrensville Center Road	Regression Equations	HEC-2	03/1980	AE w/ Floodway	
Pepper Creek	About 2400 feet below the Shaker Boulevard bridge	1900 feet above the Lander Road bridge	Regression Analysis	HEC-2	04/1980	AE w/ Floodway	
Pepper Creek Tributary 4.1.1	About 1200 feet downstream of Cedar Road	About 775 feet upstream of Landerbrook Drive	Unknown	HEC-RAS	12/2010	A	
Plum Creek	About 890 feet downstream of Usher Road	The Lorain County Boundary	Regression Analysis	HEC-2	04/1977	AE w/ Floodway	
Plum Creek	Confluence at the West Branch Rocky River	About 890 feet downstream of Usher Road	HEC-HMS	HEC-RAS (Jan. 2001)	02/2001	AE w/ Floodway	
Pond Brook	Pettibone Road	About 2,415 feet upstream of Rollingbrook Trail	Unknown	HEC-RAS	12/2010	A	
Porter Creek (Huntington Creek) / Gifford-Avon Ditch	Confluence with Lake Erie	County Boundary	Regression Analysis, Bulletin 43	HEC-2	11/1976	AE w/ Floodway	
Reservoir Creek	4300 feet downstream of Eureka Parkway	Pearl Road	Regression Analysis	HEC-2	04/1980	AE w/ Floodway	
RIDE Studied Streams	Multiple	Multiple	SWMM 4.4	SWMM 4.4	12/2010	A	
Rocky River	Confluence with Lake Erie	About 3600 feet upstream of Park Drive	Log-Pearson Type III	HEC-2	11/1976	AE w/ Floodway	Hydraulic analyses for this study, however, are based only on the effects of unobstructed flow

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Rocky River	Confluence with Lake Erie	About 3600 feet upstream of Park Drive	Log-Pearson Type III	HEC-2	05/1977	AE w/ Floodway	
Roots Ditch	About 80 feet downstream of Canterbury Road	About 800 feet upstream of Stearns Road	USACE HEC-1 and HEC-DSS	HEC-2	Unknown	AE w/ Floodway	
Rose Lateral	Confluence with Kirk Lateral	480 feet upstream of Canterbury	Regression Analysis	HEC-2	02/1978	AE w/ Floodway	
Sagamore Creek	About 3500 feet downstream of Dunham Road	Sagamore Road	Regression Analysis	HEC-2	05/1979	AE w/ Floodway	
Shwartz Ditch	Lorain County Boundary	500 ft Downstream of Center Ridge Road	Unknown	HEC-RAS	12/2010	A	Analysis includes structures (bridges and culverts).
Spencer Creek	Confluence with Lake Erie	Center Ridge Road	Tributary Hydrographs and Channel Routing	HEC-2	05/1977	AE w/ Floodway	
Sperry Creek	About 430 feet downstream of Interstate 90	About 70 feet upstream of Center Ridge Road	Regression Analysis	HEC-2	02/1978	AE w/ Floodway	
Stone Water Creek	About 3400 feet downstream of Omega Parkway	About 1700 feet upstream of Omega Parkway	Unknown	HEC-2	04/1989	AE w/ Floodway	
Stone Water Creek Tributary 1	About 150 feet away from Stirling Drive	About 300 feet upstream	TR 55	HEC-2	04/1989	AE w/ Floodway	
Tinkers Creek	About 80 feet downstream of Union Street	About 2120 feet downstream of Richmond Road	Log-Pearson Type III	HEC-2	02/1979	AE w/ Floodway	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Tinkers Creek	About 260 feet downstream of Dunham Road	About 480 feet upstream of Union Street	Unknown	HEC-RAS	12/2010	A	
Tinkers Creek	About 2100 feet downstream of Dunham Road	About 135 feet upstream of Dunham Road	Unknown	HEC-2	05/1979	AE w/ Floodway	
Tinkers Creek	Richmond Road	About 1 mile upstream of Pettibone Road	Unkown	HEC-2	06/1979	AE w/ Floodway	
Tinkers Creek	About 560 feet downstream of Canal Road	About 2100 feet downstream of Dunham Road	Uknown	HEC-2	07/1979	AE w/ Floodway	
Tinkers Creek Tributary 1	About 100 feet downstream of Egbert Road	1800 feet upstream of Walton Road	Regression Analysis	HEC-2	05/1979	AE w/ Floodway	
Tinkers Creek Tributary 2	About 730 feet downstream of Cannon Road, confluence with Tinkers Creek	About 40 feet upstream of Miles Road, about 2800 feet downstream of Carter Street	Unknown	HEC-RAS	12/2010	A	
Tinkers Creek Tributary 2	About 3100 feet downstream of Carter Road	Cannon Road	Regression Analysis	HEC-2	03/1979	AE w/ Floodway	
Tinkers Creek Tributary 2.1	Confluence with Tinkers Creek Tributary 2	About 810 feet upstream of Ada Drive	Unknown	HEC-RAS	12/2010	A	
Tinkers Creek Tributary 3	The Lorain County Boundary	About 635 feet upstream of Som Center Road	Unknown	HEC-RAS	12/2010	A	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(Continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
West Branch Rocky River	About 1,470 feet downstream of Lewis Road	About 1215 feet downstream of Water Street	Regression Analysis	HEC-2	04/1977	AE w/ Floodway	
West Branch Rocky River	About 1215 feet downstream of Water Street	The Lorain County Boundary	HEC-FFA	HEC-2	02/2001	AE w/ Floodway	
West Branch Rocky River Tributary 1	Confluence with West Branch Rocky River, Marks Road	Sprague Road, about 1200 feet upstream of Westwood Drive	Unknown	HEC-RAS	12/2010	A	
West Creek	The Snow Road bridge	1900 feet upstream of Ridgewood Drive bridge	Regression Analysis	HEC-2	03/1980	AE w/ Floodway	
Wilhelmy Creek	740 feet downstream of Detroit Road	Bradley Road	Regression Analysis	HEC-2	02/1978	AE w/ Floodway	
Wischmeyer Creek	Confluence with Lake Erie	Approximately 3 feet upstream of Knickerbocker Road	Regression Analysis, Bulletin 43	HEC-2	08/1995	AE w/ Floodway	
Wood Creek	690 feet downstream of Wood Creek	About 900 feet upstream of Thames Avenue	Regression Equations	HEC-2	02/1979	AE w/ Floodway	

Table 14: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Anthony Lane Tributary to Big Creek	*	*
Aurora Branch	0.03-0.045	0.05-0.055
Aurora Branch Tributary 2	0.03	0.05
Aurora Branch Tributary 3	0.03	0.05
Baker Creek	0.015-0.05	0.055-0.1
Baker Creek Tributary 1	0.015-0.05	0.055-0.1
Baldwin Creek	0.025-0.055	0.03-0.11
Bear Creek	0.03	0.05
Big Creek	0.025-0.045	0.020-0.12
Blodgett Creek	0.015-0.05	0.055-0.1
Cahoon Creek	0.04-0.05	0.021-0.10
Chagrin River	0.03-0.086	0.034-0.15
Chagrin River Tributary 1	*	*
Chagrin River Tributary 2	*	*
Chagrin River Tributary 2.1	*	*
Chippewa Creek	0.028	0.05
Countrymans Creek	0.03	0.03
Cuyahoga River Tributary 1	*	*
Cuyahoga River	0.035-0.056	0.040-0.150
Doan Brook	0.03-0.045	0.04-0.12
Dover Ditch	0.015-0.021	0.021-0.045
East Branch Rocky River	0.03-0.04	0.04-0.110
East Branch Rocky River Tributary 7	0.05-0.06	0.060-0.110
Euclid Creek	0.015-0.11	0.020-0.14
Euclid Creek Tributary 1.5	0.020-0.040	0.050-0.090
Euclid Creek Tributary 1.5.1	0.020-0.040	0.07
Euclid Creek Tributary 1.6	0.013-0.040	0.013-0.070
Euclid Creek Tributary 2	0.04	0.10-0.12
Fitch Lateral	0.012-0.035	0.035-0.070
Gillford-Avon Ditch	0.015-0.021	0.021-0.045
Hawthorne Creek	0.013-0.04	0.05-0.12

Table 14: Roughness Coefficients *(Continued)*

Flooding Source	Channel "n"	Overbank "n"
Kirk Lateral	0.015-0.021	0.021-0.045
Mill Creek	0.030-0.06	0.04-0.12
Pepper Creek	0.035-0.04	0.05-0.14
Plum Creek	0.030 -0.035	0.025 – 0.040
Porter (Huntington) Creek	0.03-0.06	0.05-0.07
Reservoir Creek	0.035-0.045	0.04-0.12
Rocky River	0.03-0.04	0.03-0.12
Roots Ditch	0.014-0.04	0.017-1.0
Rose Lateral	0.015-0.021	0.021-0.045
Sagamore Creek	*	*
Spencer Creek	0.015-0.055	0.05-0.1
Sperry Creek	0.015-0.021	0.021-0.045
Stone Water Creek	0.040-0.080	0.040-0.080
Stone Water Creek Tributary 1	0.015-0.045	0.045-0.100
Tinkers Creek	0.03	0.05-0.08
Tinkers Creek Tributary 1	0.03	0.04 – 0.05
Tinkers Creek Tributary 2	0.03	0.05
West Branch Rocky River	0.025 – 0.030	0.040 – 0.080
West Creek	0.035-0.05	0.04-0.11
Wilhelmy Creek	0.015-0.021	0.021-0.045
Wischmeyer Creek	0.02-0.04	0.5
Wood Creek	0.03	0.05

* No data available

5.3 Coastal Analyses

For the areas of Cuyahoga County that are impacted by coastal flooding processes, coastal flood hazard analyses were performed to provide estimates of coastal BFEs. Coastal BFEs reflect the increase in water levels during a flood event due to storm surge as well as overland wave effects.

The following subsections provide summaries of how each coastal process was considered for this FIS Report. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation. Table 15 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.

Table 15: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Lake Erie	Entire shoreline of Cuyahoga County	Entire shoreline of Cuyahoga County	Erosion	CSHORE	1/1/2016
Lake Erie	Entire shoreline of lake in Cuyahoga County	Entire shoreline of lake in Cuyahoga County	Overland Wave Propagation	Wave Height Analysis for Flood Insurance Studies (WHAFIS)	1/1/2016
Lake Erie	Entire shoreline of lake in Cuyahoga County	Entire shoreline of lake in Cuyahoga County	Statistical Analyses	Peak Over Threshold/Generalized Pareto Distribution Joint Probability Method (JPM)	1/1/2016
Lake Erie	Entire shoreline of lake in Cuyahoga County	Entire shoreline of lake in Cuyahoga County	Storm Surge	Advanced Circulation Model (ADCIRC)	1/1/2016
Lake Erie	Entire shoreline of lake in Cuyahoga County	Entire shoreline of lake in Cuyahoga County	Wave Generation	Simulating Waves Nearshore (SWAN)	1/1/2016
Lake Erie	Entire shoreline of lake in Cuyahoga County	Entire shoreline of lake in Cuyahoga County	Wave Runup	CSHORE/ Shore Protection Manual (SPM)	1/1/2016
Lake Erie	Entire shoreline of lake in Cuyahoga County	Entire shoreline of lake in Cuyahoga County	Wave Setup	Simulating Waves Nearshore Models (SWAN)	1/1/2016

5.3.1 Total Stillwater Elevations

The total stillwater elevations (stillwater including storm surge plus wave setup) for the 1-percent annual chance flood were determined for areas subject to coastal flooding. The models and methods that were used to determine storm surge and wave setup are listed in Table 15. The stillwater elevation that was used for each transect in coastal analyses is shown in Table 17, “Coastal Transect Parameters.” Figure 8 shows the total stillwater elevations for the 1-percent annual chance flood that was determined for this coastal analysis.

Stillwater elevations for Cuyahoga County were determined from the lake-wide storm surge study conducted for Lake Erie by FEMA and Risk Assessment, Mapping, and Planning Partners (FEMA, 2012). The study was performed using the coupled SWAN + ADCIRC hydrodynamic and wave model on a mesh of 389,750 nodes validated using tides and 6 historical storms. The model was then used to simulate 155 selected historic storms based on historic peak water levels and peak wave heights. The modeled data were used to create a history of water elevation and wave height records from which the 10-, 2-, 1-, and 0.2-percent annual chance of exceedance elevations were created at each node.

Figure 8: 1-Percent Annual Chance Total Stillwater Elevations for Coastal Areas

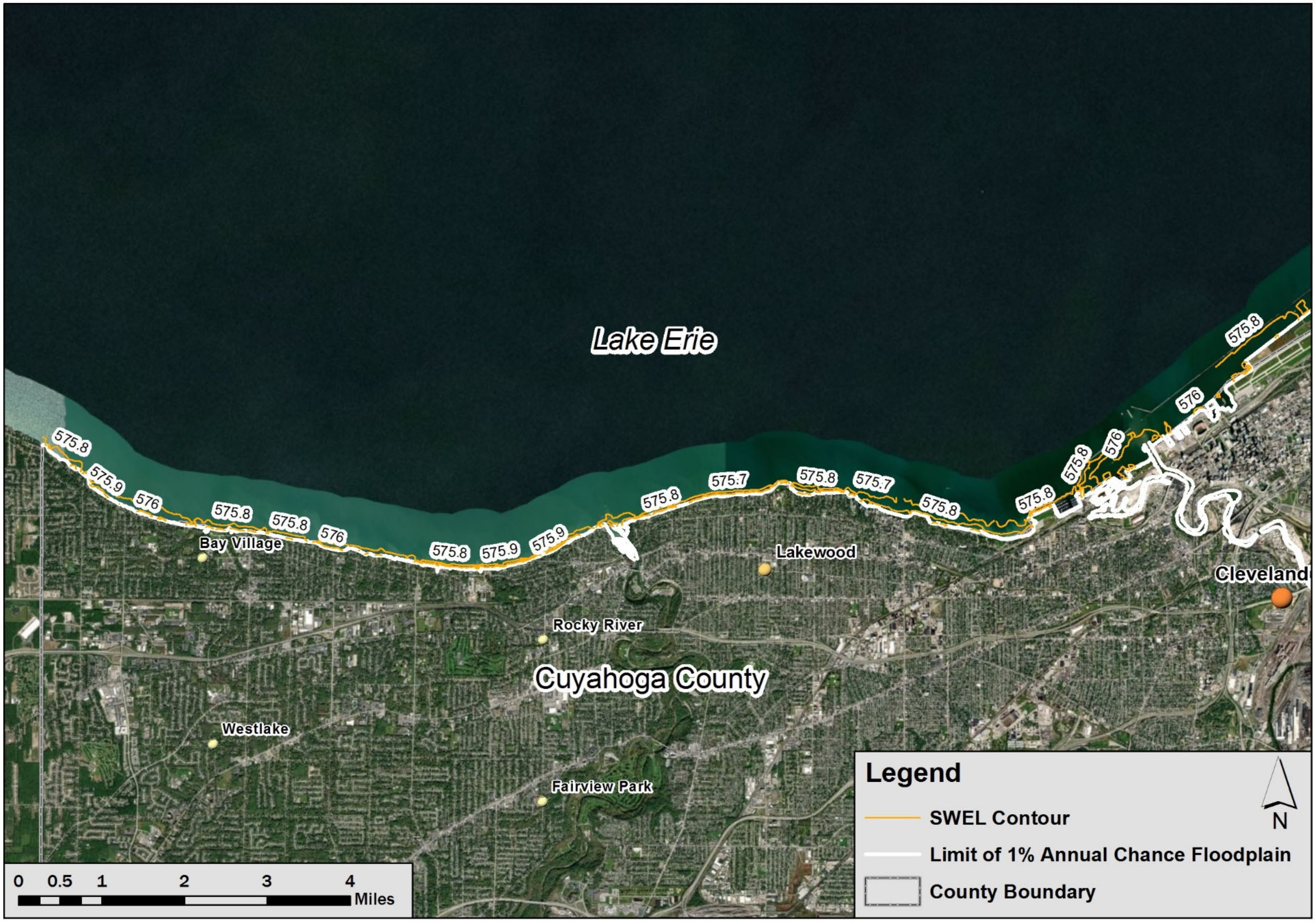


Figure 8: 1-Percent Annual Chance Total Stillwater Elevations for Coastal Areas *(Continued)*

Storm Surge Statistics

Storm surge is modeled based on characteristics of actual storms responsible for significant coastal flooding. The characteristics of these storms are typically determined by statistical study of the regional historical record of storms or by statistical study of water level stations.

When historic records are used to calculate storm surge, characteristics such as the strength, size, track, etc., of storms are identified by site. Storm data was used in conjunction with numerical hydrodynamic models to determine the corresponding storm surge levels. An extreme value analysis was performed on the storm surge modeling results to determine a stillwater elevation for the 1-percent annual chance event.

In an oceanic environment water level stations can be used instead of historic records of storms when the available station record for the area represents both the astronomical tide component and the storm surge component. Great Lakes studies rely on water level stations to identify the highest water level storm events from the historic record. The selected storms are then used to simulate storm surge and wave heights across the study area. Table 16 provides the water level station name, managing agency, station type, station identifier, start date, end date, and statistical methodology applied to each station to determine the stillwater elevations.

Table 16: Water Level Station Analysis Specifics

Station Name	Managing Agency of Station	Station Type	Start Date	End Date	Statistical Methodology
Erie, PA (9063038)	NOAA	Water Level	1959	2011	POT/GEV
Sturgeon Point, NY (9063028)	NOAA	Water Level	1989	2011	POT/GEV
Buffalo, NY (9063020)	NOAA	Water Level	1860	2011	POT/GEV
Fairport, OH (9063053)	NOAA	Water Level	1935	2011	POT/GEV
Cleveland, OH (9063063)	NOAA	Water Level	1860	2011	POT/GEV
Marblehead, OH (9063079)	NOAA	Water Level	1959	2011	POT/GEV
Toledo, OH (9063085)	NOAA	Water Level	1904	2011	POT/GEV
Fermi Power Plant, MI (9063090)	NOAA	Water Level	1963	2011	POT/GEV
Gibraltar, MI (9044020)	NOAA	Water Level	1989	2011	POT/GEV
Wyandotte, MI (9044030)	NOAA	Water Level	1930	2011	POT/GEV
Amherstburg, ON (11995)	Fisheries and Oceans, Canada	Water Level	1961	2011	POT/GEV
Bar Point, ON (12005)	Fisheries and Oceans, Canada	Water Level	1966	2011	POT/GEV

Table 16: Water Level Station Analysis Specifics *(Continued)*

Station Name	Managing Agency of Station	Station Type	Start Date	End Date	Statistical Methodology
Kingsville, ON (12065)	Fisheries and Oceans, Canada	Water Level	1962	2011	POT/GEV
Erieau, ON (12250)	Fisheries and Oceans, Canada	Water Level	1962	2011	POT/GEV
Port Stanley, ON (12400)	Fisheries and Oceans, Canada	Water Level	1927	2011	POT/GEV
Port Dover, ON (12710)	Fisheries and Oceans, Canada	Water Level	1962	2011	POT/GEV
Port Colborne, ON (12865)	Fisheries and Oceans, Canada	Water Level	1962	2011	POT/GEV
Peace Bridge Below, ON (12954)	Fisheries and Oceans, Canada	Water Level	1999	2011	POT/GEV

For each return period, the stillwater elevation at each node was used to create a raster surface using ArcInfo geoprocessing tools. The storm surge modeling was performed with elevation data referenced to the long term mean lake level as the zero elevation. At the time of this study, the mean lake level for Lake Erie was 571.6 feet NAVD88 or 571.4 feet IGLD 85. The node or point data was converted to the vertical datum of NAVD88 (from mean lake level) and extrapolated using a nearest neighbor method up narrow streams and other isolated low-lying features not captured by the ADCIRC mesh. Some anomalous elevations were found near the floodplain boundaries; these nodes were removed from the dataset. The remaining points were converted to a triangulated irregular network (TIN) and then converted to a raster for the coastal overland modeling and floodplain boundary generation. Each raster has a 25-foot grid cell size and is projected in NAD 1983 State Plane Ohio State Plane North Zone (FIPS Zone 3401).

Wave Setup Analysis

Wave setup was computed during the storm surge modeling through the methods and models listed in Table 15 and included in the frequency analysis for the determination of the total stillwater elevations

5.3.2 Waves

Starting wave heights and wave periods for Cuyahoga County were determined from the lake-wide storm surge study conducted for Lake Erie by FEMA and Risk Assessment, Mapping, and Planning Partners (FEMA, 2012) as described in Section 5.3.1. The modeled data were used to create a history of wave height and wave period records which was used as input to the transect analysis.