FLOOD INSURANCE STUDY

VOLUME 1 OF 2

STARK COUNTY, OHIO
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
ALLIANCE, CITY OF	390508
BEACH CITY, VILLAGE OF	390509
BREWSTER, VILLAGE OF	390510
CANAL FULTON, CITY OF	390511
CANTON, CITY OF	390512
EAST CANTON, VILLAGE OF	390513
EAST SPARTA, VILLAGE OF	390655
* HARTVILLE, VILLAGE OF	390514
* HILLS AND DALES, VILLAGE OF	390515
LIMAVILLE, VILLAGE OF	390836
LOUISVILLE, CITY OF	390516
MASSILLON, CITY OF	390517
* MEYERS LAKE, VILLAGE OF	390519
MINERVA, VILLAGE OF	390518
NAVARRE, VILLAGE OF	390520
NORTH CANTON, CITY OF	390521
STARK COUNTY (UNINCORPORATED AREAS)	390780
WAYNESBURG, VILLAGE OF	390667
* WILMOT, VILLAGE OF	390522

* NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

PRELIMINARY

March 18, 2016

Revised:
To Be Determined

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
39151CV001C

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Initial Countywide FIS Effective Date: **September 29, 2011**

Revised Countywide FIS Date(s): **February 16, 2012**
To Be Determined

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(VOLUME 2)

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Published Separately –

FLOOD INSURANCE STUDY

STARK COUNTY, OHIO AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This FIS revises and supersedes the previous FIS reports (including the previous countywide FIS report) and/or Flood Insurance Rate Maps (FIRMs), for the geographic area of Stark County, Ohio, including the unincorporated areas of Stark County, the Cities of Alliance, Canal Fulton, Canton, Louisville, Massillon and North Canton, and the Villages of Beach City, Brewster, East Canton, East Sparta, Hartville, Hills and Dales, Limaville, Meyers Lake, Minerva, Navarre, Waynesburg and Wilmot (hereinafter referred to collectively as Stark County). Please note that in the Villages of Hartville, Hills and Dales, Meyers Lake, and Wilmot, no special flood hazard areas (SFHAs) have been identified.

There are three multi-county communities in Stark County. The City of Alliance is a multi-county community geographically located in Stark and Mahoning Counties. Please note that the City of Alliance is being mapped, in its entirety, within Stark County and the flood hazard information is being included in its entirety within this FIS report. The Village of Minerva is a multi-county community geographically located in Carroll, Columbiana, and Stark Counties. Please note that the Village of Minerva is being mapped, in its entirety, within Stark County and the flood hazard information is being included in its entirety within this FIS report. The Village of Magnolia is a multi-county community geographically located in Stark and Carroll Counties. Please note that the flood hazard information for the Village of Magnolia is not included in this FIS, but is included, in its entirety, within the FIS for Carroll County, Ohio.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for this revised countywide study have been produced in digital format. Flood hazard information was converted to meet FEMA DFIRM database Specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Stark County to update existing floodplain regulations as part of the regular phase of the NFIP, and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgements

The source of authority for this FIS is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

<u>**Pre-Countywide**</u>

City of Alliance. The hydrologic and hydraulic analyses for the January 5, 1982 FIS for the City of Alliance (Reference 1) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in January of 1981.

City of Canal Fulton. The hydrologic and hydraulic analyses for the January 5, 1982 FIS for the City of Canal Fulton (Reference 2) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in January of 1981.

City of Canton. The hydrologic and hydraulic analyses for the July 6, 1982 FIS for the City of Canton (Reference 3) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in June of 1981.

City of Louisville. The hydrologic and hydraulic analyses for East Branch Nimishillen Creek and Broad-Monter Creek for the July 16, 1984 FIS for the City of Louisville (Reference 4), were performed by Howard Needles Tammen & Bergendoff for the Federal Insurance Administration (FIA), under Contract No. H3980. That work was completed in April of 1977.

For the July 5, 2000 revision to the City of Louisville FIS (Reference 5), the hydrologic and hydraulic analyses for Broad-Monter Creek and North Chapel Creek were prepared by the U.S. Geological Survey (USGS) for FEMA, under Inter-Agency Agreement No. EMW-89-E-2977. This work was completed in February of 1993.

City of Massillon. The hydrologic and hydraulic analyses for the January 5, 1982 FIS for the City of Massillon (Reference 6) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in January of 1981.

Village of Minerva. The hydrologic and hydraulic analyses for the January 5, 1982 FIS for the Village of Minerva (Reference 7) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in January of 1981.

Village of Navarre. The hydrologic and hydraulic analyses for the January 5, 1982 FIS for the Village of Navarre (Reference 8) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in January of 1981.

City of North Canton. The hydrologic and hydraulic analyses for the May 3, 1982 FIS for the City of North Canton (Reference 9) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in January of 1981.

Stark County, Unincorporated Areas. The hydrologic and hydraulic analyses for the March 1, 1983 FIS for the Unincorporated Areas of Stark County, Ohio (Reference 10) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in June of 1981.

Village of Waynesburg. The hydrologic and hydraulic analyses for the January 5, 1982 FIS for the Village of Waynesburg (Reference 11) were performed by Malcolm Pirnie, Inc. for FEMA under Contract No. H-4799. This work was completed in December of 1980.

No pre-countywide FIS reports are known to exist for the Villages of Beach City, Brewster, East Canton, East Sparta, Hartville, Hills and Dales, Limaville, Meyers Lake, or Wilmot.

Initial Countywide (September 29, 2011)

Redelineation of previously effective flood hazard information for the initial countywide FIS dated September 29, 2011, and the accompanying FIRMs, as well as the conversion of the unincorporated and incorporated areas of Stark County into countywide format was performed by Stantec Consulting Services, Inc. (Stantec) (formerly Fuller Mossbarger Scott and May Engineers (FMSM)), for FEMA under Contract No. HSFE-05-D-026, Task Order No. HSFE05-05-J-0001. This work was completed on September 29, 2011.

For the 2011 countywide FIS, studies of thirteen streams completed by the USGS under contract EMC-2003-IA-0038 were incorporated (Reference 12). The scope of the study was determined by discussions between the USGS, Stark County officials, and FEMA. Studied streams included: Clays Ditch, East Branch Nimishillen Creek, Mahoning River, McDowell Ditch, Metzger Ditch, Middle Tributary, North Chapel Creek, Unnamed Tributary to East Branch Nimishillen Creek, West Branch Nimishillen Creek, West Branch Nimishillen Tributary 1, West Sippo Creek, Zimber Ditch Tributary 1, and Zimber Ditch Tributary 1A. This work was completed in March 2005.

Stantec also completed additional hydrologic and hydraulic analyses for the 2011 countywide FIS. A detailed restudy of Plum Creek was completed in February of 2006 (Reference 13), and an existing detailed hydraulic analysis performed by the USGS on West Branch Nimishillen Creek was modified by Stantec in September of 2009 (Reference 14) to incorporate a bridge that was replaced after the original USGS survey data was obtained in 2003. Stantec performed approximate studies on fifty separate stream reaches in January of 2006 (Reference 15) and four stream reaches in September of 2009 (Reference 14). This work was also completed for FEMA under Contract No. HSFE-05-D-026, Task Order No. HSFE05-05-J-0001. Streams studied by approximate methods are listed in **Table 2**.

Revised Countywide (February 16, 2012)

This FIS revision was initiated by a Physical Map Revision (PMR) request submitted to FEMA. It included incorporation of an August 18, 2009, Levee System Report for the Brewster Levee prepared by the USACE, Chicago District (Reference 65). As a result of this report, some interior ponding areas along the Brewster Levee were revised. The incorporation of this data into this FIS and the accompanying FIRMs was performed by the Strategic Alliance for Risk Reduction (STARR) for FEMA under Contract No. HSFEHQ-09-D-0370, Task Order No. 3. This work was completed in February 2012.

The digital base mapping information shown on the FIRMs was provided in digital format by the Stark County Auditor's Office and was acquired in February 2004. Further information about the base mapping is available by contacting the County. These files were compiled by photogrammetric methods and meet or exceed National Map Accuracy Standards. The projection used for the production of this FIRM is Ohio State Plane North (FIPSZONE 3401) referenced to the North American Datum of 1983 (NAD83), GRS1980 spheroid. Differences in the datum, spheroid, projection or state plane zones used in the production of FIRMs in adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

Revised Countywide (To Be Determined)

This FIS revision was initiated by a Physical Map Revision (PMR) request and included incorporation of enhanced hydrologic and hydraulic analyses performed on a portion of Sandy Creek by Strategic Alliance for Risk Reduction (STARR). Incorporation of these studies into this FIS and accompanying FIRMS was performed by STARR as part of FEMA Contract No. HSFEHQ-09-D-0370, Task Order No. HSFE05-11-J-0080. This work was completed in _________.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO's) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

Pre-Countywide

The dates of the initial and final CCO meetings held for prior FISs for the incorporated communities within Stark County are shown in **Table 1**.

Table 1. CCO Meeting Dates for Prior FISs

Community Name	Initial CCO Date	Final CCO Date
Alliance, City of	May 10, 1978	August 7, 1981
Canal Fulton, City of	May 9, 1978	August 6, 1981
Canton, City of	May 9, 1978	January 27, 1982
Louisville, City of	March, 1976	September 19, 1978
Massillon, City of	May 9, 1978	August 6, 1981
Minerva, Village of	May 10, 1978	August 7, 1981
Navarre, Village of	May 9, 1978	August 6, 1981
North Canton, City of	May 9, 1978	*
Stark County, Unincorporated	May 9, 1978	April 20, 1982
Waynesburg, Village of	May 10, 1978	August 6, 1981

* Data not available

Initial Countywide (September 29, 2011)

For the initial countywide FIS, an initial CCO meeting was held on August 18, 2003. The results of the study were reviewed at the final CCO meeting held on February 23, 2010, and attended by representatives from FEMA, the Ohio Department of Natural Resources (ODNR), Stantec, Stark County, the Cities of Alliance, Canal Fulton, Canton, Louisville, North Canton, and the Villages of East Canton, Meyers Lake and Navarre. All problems raised at that meeting were addressed in the study for the September 29, 2011 initial countywide FIS report.

Revised Countywide (February 16, 2012)

No final CCO meeting was held for the February 16, 2012 revised countywide FIS report.

Revised Countywide (To Be Determined)

For this revised FIS, the results of the study were reviewed at the final CCO meeting held on _________, and attended by representatives of _________. All problems raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Stark County, Ohio, including the incorporated communities listed in Section 1.1 and unincorporated areas.

All flooding sources studied by detailed methods are shown in **Table 5**. Flooding sources studied by approximate methods are listed in **Table 2**.

Pre-Countywide

For the original studies, the areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction. Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by FEMA and Stark County officials.

Previous to the initial countywide FIS report (September 29, 2011), effective FIS reports did not exist for the Villages of Beach City, Brewster, East Canton, East Sparta, Hartville, Hills and Dales, Limaville, Meyers Lake, or Wilmot.

Initial Countywide (September 29, 2011)

New or revised detailed studies performed as a part of the initial countywide FIS report are listed in Section 1.2. The limits of study for these reaches are included in **Table 5.**

For the initial countywide FIS report, streams previously mapped as Zone A were replaced by new approximate studies. The flooding sources studied by approximate methods are listed in **Table 2**.

Table 2. Streams Studied by Approximate Methods

Beech Creek	Mahoning River	Mahoning River Tributary No. 1
Berlin Creek	Middle Branch Nimishillen Creek	Tributary to Pearson Ditch
Chatham Ditch	Middle Fork Sugar Creek	Tributary 2 in City of Louisville
Congress Lake Outlet	Newman Creek	Tributary to Beech Creek
East Branch Nimishillen Creek	Nimishillen Creek	Tributary to Fox Run
East Sippo Creek	Nimisila Creek	Tributary to Little Beech Creek
Elm Run	Osnaburg Ditch	Tributary to Mahoning River
Fair Hope Ditch	Pearson Ditch	Tributary to Middle Branch Nimishillen Creek
Firestone Ditch	Pigeon Run	Tuscarawas River
Fox Run	Sandy Creek	Unnamed Creek C
Huckleberry Ditch	Sippo Creek	Unnamed Creek D
Hurford Run	Sugar Creek	Unnamed Stream in East Canton
Johney Ditch	Swartz Ditch	Unnamed Tributary
Koontz Ditch	Tributary 2 to East Branch Nimishillen Creek	West Branch Nimishillen Creek
Lake Cable Dam	Tributary A to Tuscarawas River	West Sippo Creek
Landing Lake	Tributary B to Tributary No 1 Mahoning River	Willowdale Lake
Little Beech Creek	Tributary B to Tuscarawas River	Overland Flow in Southern Waynesburg
Lucern Lake	Tributary C to Mahoning River	

All Letters of Map Revision (LOMRs) incorporated into the initial countywide FIS are summarized in **Table 3**. The Letter of Map Change (LOMC) actions for previously-issued LOMCs for Stark County are summarized in the Summary of Map Amendment (SOMA) included in the Technical Support Data Notebook (TSDN) associated with the FIS. Copies of the TSDN may be obtained from the Community Map Repository.

Table 3. Incorporated LOMRs

Flooding Source	LOMC Case No.	Flooding Source	Date Issued	LOMC Type
North Canton, City of	07-05-0382P	Chatham Ditch	4/12/2007	LOMR
North Canton, City of	IA-RA-RS(102A)	Chatham Ditch	1/7/1988	LOMR
Stark County, Unincorporated Areas	199100107FIA	Chatham Ditch	2/22/1988	102
Stark County, Unincorporated Areas	875029	Chatham Ditch	2/22/1988	LOMR

Revised Countywide (February 26, 2012)

For the February 16, 2012 revised countywide FIS, no new detailed or approximate studies were performed.

Revised Countywide (To Be Determined)

For this revised FIS, a new detailed hydraulic analysis was performed on Sandy Creek (Lower Reach) near Magnolia, adjacent to the previously studied reach in Waynesburg, as shown in **Table 4**. No new approximate studies were performed for this revised FIS.

Table 4. Limits of New or Revised Detailed Studies

Flooding Source	Limits of Detailed Study
Sandy Creek (Lower Reach)	From the Carroll/ Stark County boundary to the northeastern corporate limits of Magnolia

All flooding sources studied by detailed methods are shown in **Table 5.**

Table 5. Limits of Detailed Studies

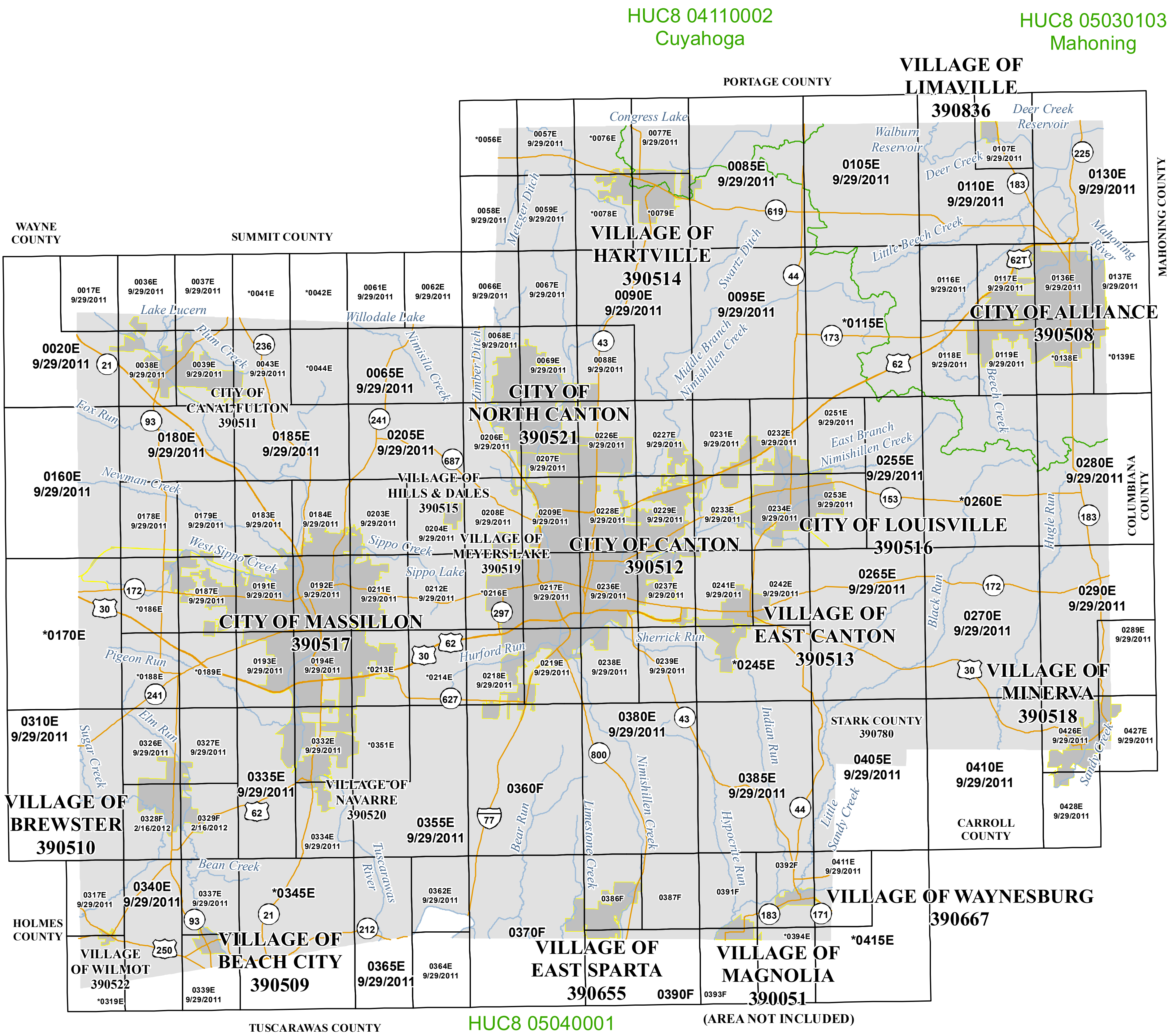
Flooding Source	Limits of Detailed Study
Beech Creek	From Vine Street to Beeson Street
Black Run	From about 1,100 feet downstream of Lincoln Street to about 400 feet upstream of Robertsville Avenue
Broad-Monter Creek	Entire length within the City of Louisville
Chatham Ditch	From about 1,200 feet downstream of 7th Street N.E. to the City of North Canton upstream corporate limits;
Clays Ditch	From the Confluence with Johney Ditch to approximately 225 feet upstream of Knight Street
East Branch Nimishillen	From the Confluence with Nimishillen Creek to 1.0

Table 5. Limits of Detailed Studies

Flooding Source	Limits of Detailed Study
Creek	mile upstream of Nickel Plate Avenue
East Branch Nimishillen Creek Diversion	From confluence with East Branch Nimishillen Creek to divergence with East Branch Nimishillen Creek
East Branch of Nimishillen Creek Unnamed Tributary	From the Confluence of the East Branch of Nimishillen Creek to Georgetown Street NE
East Sippo Creek	From the upstream end of the East Sippo Creek Culvert to 2,300 feet upstream at South Sippo Park
Fairhope Ditch	From the confluence with East Branch Nimishillen Creek to about 2,100 feet upstream of Broadview Avenue
Firestone Ditch	From the confluence with Middle Branch Nimishillen Creek to Applegrove Street
Hayden Ditch	From the confluence with Sherrick Run to about 2,000 feet upstream of State Route 43
Indian Run	The confluence with Sandy Creek to just upstream of Goodland Road
Johney Ditch	From the confluence with Sippo Creek to Perry Drive
Little Sandy Creek	From the confluence with Sandy Creek to Minerva Road;
Mahoning River	From the confluence with Mahoning River Tributary No. 1 to the Eastern Stark County Line
Mahoning River Tributary No. 1	From West Vine Street to Klinger Avenue
Mahoning River Tributary No. 1	From the confluence with the West Branch Nimishillen Creek to the confluence of Zimber Ditch
Metzger Ditch	From the Stark County line to 1,135 feet downstream of Cain Street
Middle Branch Nimishillen Creek	From the confluence with Nimishillen Creek to Diamond Street

Table 5. Limits of Detailed Studies

Flooding Source	Limits of Detailed Study
Middle Branch Nimishillen Creek Tributary No. 1	From the Confluence of the Middle Branch Nimishillen Creek to 3,600 feet upstream
Middle Tributary	From the confluence with North Chapel Creek to State Route 62
Nimishillen Creek	From 1,200 feet downstream of Cheyenne Street SE to the confluence with West Branch Nimishillen Creek
North Chapel Creek	From the confluence with East Branch Nimishillen Creek to State Route 62
Plum Creek	From the confluence with the Tuscarawas River to Akron Avenue NW
Reemsnyder Ditch	From the confluence with McDowell Ditch to Whipple Avenue
Sandy Creek (Upper Reach)	From the Southwestern corporate limits of Minerva to the Stark-Columbiana County line
Sandy Creek (Lower Reach)	From upstream of the Village of Magnolia to upstream of the Village of Waynesburg corporate limits
Sherrick Run	From the confluence with Nimishillen Creek to 1.600 feet upstream of the confluence with Hayden Ditch
Sippo Creek	From Hankins Road NE to the confluence of Johney Ditch
Tuscarawas River	From 700 feet downstream Blough Avenue to 1,500 feet upstream of Wooster Street NW, from 100 feet downstream of Highmill Avenue to 1,300 feet upstream of the confluence of Nimishillen Creek, and from Pontius Street to about 7,000 feet upstream
West Branch Nimishillen Creek	From the confluence with Nimishillen Creek to about 2,800 feet upstream of Interstate Highway 77, and from the confluence of McDowell Ditch to Hoover Avenue NW
West Branch Nimishillen Creek Tributary No. 1	From the confluence with the West Branch Nimishillen Creek to State Street NE
West Sippo Creek	From Deermount Avenue NW to State Route 93
Zimber Ditch	From the confluence with McDowell Ditch to Mount Pleasant Street NW;
Zimber Ditch Tributary 1	From the Confluence with Zimber Ditch to 1,200 feet upstream of Cleveland Avenue NW
Zimber Ditch Tributary 1A	From the confluence with Zimber Ditch Tributary 1 to Cleveland Avenue



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 [most recent FIRM panel date].

N

1 inch = 17,917 feet 1:215,000

0 5,000 10,000 20,000 30,000 40,000 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

HTTP://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

COUNTY LOCATOR

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

STARK COUNTY, OHIO and Incorporated Areas

PRELIMINARY
3/18/2016

PANELS PRINTED:
0017, 0020, 0036, 0037, 0038, 0039, 0043, 0057, 0058, 0059, 0061, 0062, 0065, 0066, 0067, 0068, 0069, 0077, 0085, 0088, 0090, 0095, 0105, 0107, 0110, 0116, 0117, 0118, 0119, 0130, 0136, 0137, 0160, 0178, 0179, 0180, 0183, 0184, 0185, 0187, 0191, 0192, 0193, 0194, 0203, 0204, 0205, 0206, 0207, 208, 0209, 0211, 0212, 0217, 0218, 0219, 0226, 0227, 0228, 0229, 0231, 0232, 0233, 0234, 0236, 0237, 0238, 0239, 0241, 0242, 0251, 0253, 0255, 0265, 0270, 0280, 0289, 0290, 0310, 0317, 0326, 0327, 0328, 0329, 0332, 0334, 0335, 0337, 0339, 0340, 0355, 0360, 0362, 0364, 0365, 0370, 0380, 0385, 0386, 0387, 0390, 0391, 0392, 0393, 0405, 0410, 0411, 0426, 0427, 0428

FEMA

MAP NUMBER
39151CIND0C

MAP REVISED

2.2 Community Description

Stark County is located in northeastern Ohio approximately 60 miles south of Cleveland. The county is bordered on the north by Portage and Summit Counties, on the east by Mahoning and Columbiana Counties, on the south by Carroll and Tuscarawas Counties, and on the west by Holmes and Wayne Counties. The City of Canton, the largest city in the county, is the county seat. The total land area contained within the county is 567 square miles. According to the U.S. Census Bureau, the population estimate for Stark County was 375,736 in 2014 (Reference 16).

Stark County was founded in 1801, as the 30th county in Ohio. Population and land use during the first few decades of its existence experienced very little change as agriculture remained by and far the predominant occupation. However, rapid changes occurred in the county with the advent of the railroad and the construction of the Ohio-Erie Canal, which traversed through Stark County. These two events in the mid-1800s signaled the beginning of industrial growth in Stark County which has continued to this day. This growth has caused the continual expansion of metropolitan areas in Stark County both in population and land area. As industrialization increased, Stark County gained fame as a large manufacturer of watches, agricultural implements, paving bricks and most recently, industries related to iron and steel have been dominant. However, much of the land in Stark County still remains farmland with dairying as the main farm enterprise (Reference 17).

Lake Erie has considerable influence on the area weather, tempering cold air masses during the late fall and winter, and contributing to heavy snowfall until the lake freezes over. Summers are moderately warm, but quite humid. Area temperatures range from an average monthly high of 71.7 degrees Fahrenheit (F.) in July to an average monthly low of 26.3 degrees F. in January. Average annual precipitation for the Akron-Canton area is 36.4 inches and is representative of all of Stark County (Reference 18).

Stark County's topography is a product of continental glaciations during recent geologic time. Over two-thirds of the county has either been covered by ice or buried by glacial outwash deposits. The drainage areas of the Mahoning River basin and the Tuscarawas River basin share Stark County's geographical location in the Allegheny portion of the Appalachian Plateau. The part of the plateau occupied by these two drainage basins is mainly composed of soils formed in glacial till or drift, and outwash material transported by glacial meltwaters of the Wisconsin Age (Reference 19). The topography of the county ranges from flat, rolling terrain in the glaciated northern region to somewhat more hilly, steeper land in the unglaciated southeast region. Elevations in Stark County vary from about 879 feet North American Vertical Datum of 1988 (NAVD88) along the banks of the Tuscarawas River south of Canal Fulton to approximately 1,359 feet east of East Canton.

Stark County lies within the Tuscarawas and Mahoning Rivers drainage basins. The Tuscarawas River basin, whose main watercourses in Stark County are the Tuscarawas River, Sandy Creek and Nimishillen Creek, is a subdrainage basin contained in the much larger Muskingum River basin. The Tuscarawas River, Sandy Creek and Nimishillen Creek each drain approximately 266, 106 and 195 square miles of land in Stark County, respectively. The northeastern corner of the county is located in the Mahoning River drainage basin. This basin drains approximately 63 square miles of Stark County and contains the three largest lakes in the county – Berlin Lake, Walborn Reservoir and Deer Creek Reservoir. Beech Creek and the Mahoning River are the main watercourses in the basin. Land use within the floodplain in Stark County ranges from sparsely to heavily developed and is characterized by residential, commercial and industrial development. The heavily developed flood plain areas in Stark County are located in the Cities of Canton, North Canton, Massillon and Alliance and surrounding areas (References 20 and 21).

The City of Alliance is a multi-county community located in northeastern Stark County and southwestern Mahoning County. It is located approximately 15 miles northeast of Canton. Alliance is bordered on the north, west and south by the unincorporated areas of Stark County and on the east by Mahoning County. According to U.S. Census Bureau figures, the population estimate for the City of Alliance was 22,078 in 2014 (Reference 16).

The Village of Beach City is located in southwestern Stark County and is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Beach City was 1,013 in 2014 (Reference 16).

The Village of Brewster is located in western Stark County and is surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Brewster was 2,170 in 2014 (Reference 16).

The City of Canal Fulton is located along the Tuscarawas River in northwestern Stark County, approximately 7 miles northwest of the City of Massillon. The City is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the City of Canal Fulton was 5,493 in 2014 (Reference 16).

The City of Canton is located in central Stark County and is the county seat of Stark County. The City of Canton is bordered by the City of North Canton on the north and the unincorporated areas of Stark County on all other sides. According to U.S. Census Bureau figures, the population estimate for the City of Canton was 72,297 in 2014 (Reference 16).

The Village of East Canton is located in central Stark County. The Village is bordered on the south by the City of Canton and on all other sides by the unincorporated areas of Stark County. According to U.S.

Census Bureau figures, the population estimate for the Village of East Canton was 1,600 in 2014 (Reference 16).

The Village of East Sparta is located in southern Stark County and is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of East Sparta was 808 in 2014 (Reference 16).

The Village of Hartville is located in northern Stark County and is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Hartville was 2,962 in 2014 (Reference 16).

The Village of Hills and Dales is located in central Stark County and is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Hills and Dales was 221 in 2014 (Reference 16).

The Village of Limaville is located in northeastern Stark County and is bordered on the north by Portage County and on all other sides by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Limaville was 151 in 2014 (Reference 16).

The City of Louisville is located in east-central Stark County, approximately 6 miles northeast of the City of Canton. The City of Louisville is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the City of Louisville was 9,147 in 2014 (Reference 16).

The City of Massillon is located in western Stark County, approximately 7 miles west of the City of Canton. The City of Massillon is bordered on the south by the Village of Navarre and on all other sides by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the City of Massillon was 32,149 in 2014 (Reference 16).

The Village of Meyers Lake is located in central Stark County and is bordered on the west by the City of Canton and the unincorporated areas of Stark County. On all other sides, the Village is bordered by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Meyers Lake was 572 in 2014 (Reference 16).

The Village of Minerva is a multi-county community located in southeastern Stark County, north-central Carroll County, and southwestern Columbiana County. The Village of Minerva is approximately 15 miles southeast of the City of Canton. The Village is bordered on the north and west by the unincorporated areas of Stark County, on the east by Columbiana & Carroll Counties, and on the south by Carroll County. According to U.S. Census Bureau figures, the population estimate for the Village of Minerva was 3,698 in 2014 (Reference 16).

The Village of Navarre is located in southwestern Stark County approximately 5 miles south of the City of Massillon. The Village is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Navarre was 1,931 in 2014 (Reference 16).

The City of North Canton is located in north-central Stark County. It is bordered on the south by the City of Canton and on all other sides by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the City of North Canton was 17,490 in 2014 (Reference 16).

The Village of Waynesburg is located in southern Stark County approximately 10 miles southeast of the City of Canton. The Village is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Waynesburg was 924 in 2014 (Reference 16).

The Village of Wilmot is located in southwestern Stark County and is completely surrounded by the unincorporated areas of Stark County. According to U.S. Census Bureau figures, the population estimate for the Village of Wilmot was 304 in 2014 (Reference 16).

2.3 Principal Flood Problems

Flooding throughout Stark County results from the overflow of streams caused by heavy rainfall or by a combination of rainfall and snowmelt. Severe thunderstorms frequently cause local flash flooding. General flooding occurs most frequently during the winter or early spring months, but it can occur at any time during the year. Although most of the major floods have occurred during the winter or early spring, summer storms have also caused considerable damage.

Major floods have occurred within the Tuscarawas River and Mahoning River drainage basins during all seasons of the year. Most of the past floods have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in high runoff rates. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows. Large floods, however, may occur at any time, particularly on smaller streams.

Flooding has frequently occurred within these two drainage basins with the largest known flood occurring in March 1913. Due to the fact that extensive records of floods and river stages were not made at that time, the peak discharge values associated with this historic flood are not known. The date and discharge value of the largest recorded floods at various gaging stations in Stark County are listed in **Table 6**.

Table 6. Historical Flood Crests

Location	Date	Gage Number	Peak Discharge (cfs)
Mahoning River at Alliance	1/21/59	03086500	9,740
Beech Creek at Bolton (discontinued 1954)	6/24/50	03087000	2,210
Tuscarawas River at Massillon	7/5/69	03117000	10,700
Sandy Creek at Waynesburg	1/22/59	03117500	15,000
Middle Branch Nimishillen Creek at Canton	1/22/59	03118000	2,470
Nimishillen Creek at North Industry	1/21/59	03118500	8,600

Nearly all of these recorded peak flood discharges exceed the calculated 1-percent annual chance flood discharge values at each station. The major recorded floods in Stark County have occurred in August 1935, January 1959 and July 1969. A more recent flood occurred in September 1979 as a result of heavy rainfall generated from the aftermath of Hurricane Frederic (References 22, 23 and 24).

Active USGS gages are located within Stark County to record peak stream flows. All flows and gage heights represent actual flows occurring at the gage. **Table 7** provides information on current and past USGS gages on Stark County Streams.

Table 7. USGS Gages within Stark County

Name	Number	Located	Period of Record
Beech Creek	3087000	near Bolton, Ohio	1944 - 1951
Beech Creek	3087500	near Lexington, Ohio	1941 - 1943
Deer Creek	3088000	at Limaville, Ohio	1942 - 1951
Mahoning River	3086500	at Alliance, Ohio	1941 - present
Middle Branch	3118000	at Canton, Ohio	1942 - present
Nimishillen	3118500	at North Industry, Ohio	1922 - present
Sandy Creek	3117500	at Waynesburg, Ohio	1939 - present
Sugar Creek	3123000	above Beach City Dam at Beach City,	1945 - 1975
Tuscarawas	3116500	at Crystal Springs, Ohio	1922 - 1929
Tuscarawas	3117000	at Massillon, Ohio	1938 - present

Presently, the average annual economic flood damages in Stark County are relatively small; however, damages could increase dramatically if development is permitted in floodprone areas.

City of Alliance. The principal cause of flooding along the Mahoning River and its tributaries within Alliance is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes the inundation of areas adjacent to these structures.

The City of Alliance could also be affected by the impoundment of floodwaters within Berlin Lake. The dam making this reservoir is located on the Mahoning River approximately 11 miles northeast of Alliance in Portage County. This lake is operated as a unit of a coordinated reservoir system for flood control in the Mahoning, Beaver, and Ohio River Valleys and for low-water regulation for the highly industrialized Mahoning River Valley. Currently, the flood control aspect of Berlin Lake is the responsibility of the USACE.

Berlin Lake has a flood storage capacity of 33,600 acre-feet in the winter and 56,600 acre-feet in the summer and covers an area of 5,500 acres when filled to the spillway crest. It was designed to store 2.5 to 4.3 inches of runoff from the 249 square miles draining into it. With the existing flood controls at Berlin Lake, it has been estimated that a 1-percent-annuual-chance flood will result in a water-surface pool elevation equaling approximately 1034.1 feet. The reservoir's floodwater would extend along the Mahoning River resulting in a total inundation of the flood plain in northern Alliance below a ground elevation of 1034.1 feet. The 0.2-percent-annual-chance flood storage elevation in Berlin Lake has been calculated to equal 1036.3 feet, mean sea level (References 29 and 30).

City of Canal Fulton. Most of the major floods along the Tuscarawas River and its tributaries have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows (Reference 22 and 23).

Flooding has frequently occurred within this drainage basin with the largest known flood occurring gin March 1913. The discharge associated with this flood, in the vicinity of USGS Gage No. 03117000 just south of Massillon on the Tuscarawas River, was estimated by the USGS to be 23,500 cfs. The largest flood recorded on the Tuscarawas River at this gage station was on July 5, 1969, when a discharge of 10,700 cfs was recorded. The return period for this flood exceeded the magnitude of the 0.2-percent- annual-chance flood estimated to be 10,600 cfs. A more recent flood occurred on September 15, 1979, as a result of heavy rainfall generated from the aftermath of Hurricane Frederic. A discharge of 9,070 cfs, which was estimated to be about a 0.4- percent-annual-chance flood, was recorded at the Massillon gaging station. Other major floods occurred on January 22, 1959, and March 5, 1940 (References 22, 23, and 24).

The principal cause of flooding along the Tuscarawas River and its tributaries within Canal Fulton is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes the inundation of areas adjacent to these streams.

City of Canton. Major floods have occurred within the Nimishillen Creek drainage basin during all seasons of the year. Most of the past floods have been produced by winter and spring rains falling on the ground which is already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are a lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows. Large floods, however, may occur at any time, particularly on smaller streams.

Flooding has frequently occurred within this drainage basin with the largest known flood occurring in March 1913. Due to the fact that extensive records of floods and river stages were not made at that time, the discharge value associated with this historic flood was not determined in the Canton area. The largest flood of recent years, as recorded on Nimishillen Creek at USGS Gage No. 03118500, located about two miles downstream of Canton at North Industry, was on January 21, 1959, and had a discharge of 8,600 cfs and estimated recurrence interval of slightly less than 500 years. Other major floods occurred in September 1979, August 1935, and February 1929 (References 22, 23, and 24).

In Canton, the principal cause of flooding along Nimishillen Creek and its tributaries is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes the inundation of areas adjacent to these streams.

City of Louisville. In Louisville, major flooding problems along East Branch Nimishillen Creek have been produced by winter and spring rains falling on soil already saturated, snow covered, or frozen. Although these storms are of lesser intensity than summer and fall rains they are of longer duration and have greater peak flows (Reference 31).

The largest known flood occurred in 1913. Because extensive records were not kept at the time of the 1913 flood, the extent of flooding and subsequent damages that occurred are not known. Local residents along East Branch Nimishillen Creek reported flooding that would be roughly equivalent to the largest recorded flood on Middle Branch, which occurred in January 1959 and was recorded at USGS Gage No. 1180 on Middle Branch in Canton with a discharge of 2,470 cfs. Other damaging floods occurred on March 4, 1940, August 7, 1935, and February 26, 1929 (Reference 31).

The major problem area for flooding along Broad-Monter Creek in Louisville is by South Street and East Broad Street.

City of Massillon. Practically all of the major floods along the Tuscarawas River and its tributaries have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows (Reference 22 and 23).

Flooding has frequently occurred within this drainage basin with the largest known flood occurring in March 1913. The discharge associated with this flood, in the vicinity of USGS Gage No. 03117000 just south of Massillon on the Tuscarawas River, was estimated by the USGS to be 23,500 cfs. The largest flood recorded on the Tuscarawas River at this gaging station was on July 5, 1969, when a discharge of 10,700 cfs was recorded. The return period for this flood exceeded the magnitude of the 0.2-percent- annual-chance flood estimated to be 10,600 cfs. A more recent flood occurred on September 15, 1979, as a result of heavy rainfall generated from the aftermath of Hurricane Frederic. A discharge of 9,070 cfs, which was estimated to be about a 0.4- percent-annual-chance flood, was recorded at the Massillon gaging station. Other major floods occurred on January 22, 1959, and March 5, 1940 (References 22, 23, and 24).

The principal cause of flooding along the Tuscarawas River and its tributaries within Massillon is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes the inundation of areas adjacent to these streams.

Village of Minerva. Practically all of the major floods along Sandy Creek have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have a greater peak flows (References 22 and 23).

Flooding has frequently occurred within this drainage basin with the largest known flood occurring in March 1913. Because extensive records of flood discharges were not kept at that time, the peak discharge associated with this flood is not known. The largest flood recorded on Sandy Creek at USGS Gage No. 03117500 in Waynesburg, approximately nine miles downstream of Minerva, was on January 22, 1959, when a discharge of 15,000 cfs was recorded. The return period for this flood exceeded the magnitude of the 0.2- percent-annual-chance flood estimated to be 14,300 cfs at the gaging station. More recent floods occurred in March 1963 and March 1964 (References 22, 23, and 24).

The principal cause of flooding along Sandy Creek within Minerva is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes the inundation of areas adjacent to Sandy Creek.

Village of Navarre. Practically all of the major floods along the Tuscarawas River and its tributaries have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows (Reference 22 and 23).

Flooding has frequently occurred within this drainage basin with the largest known flood occurring in March 1913. The discharge associated with this flood, in the vicinity of USGS Gage No. 03117000 just south of Massillon on the Tuscarawas River, was estimated by the USGS to be 23,500 cfs. The largest flood recorded on the Tuscarawas River at this gaging station was on July 5, 1969, when a discharge of 10,700 cfs was recorded. The return period for this flood exceeded the magnitude of the 0.2-percent- annual-chance flood estimated to be 10,600 cfs. A more recent flood occurred on September 15, 1979, as a result of heavy rainfall generated from the aftermath of Hurricane Frederic. A discharge of 9,070 cfs, which was estimated to be about a 0.4- percent-annual-chance flood, was recorded at the Massillon gaging station. Other major floods occurred on January 22, 1959, and March 5, 1940 (References 22, 23, and 24).

The principal cause of flooding along the Tuscarawas River within Navarre is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes inundation of areas adjacent to the Tuscarawas River.

Navarre could be affected by the impoundment of floodwaters within Dover Reservoir. The dam making this reservoir is located on the Tuscarawas River, 3.5 miles northeast of Dover, Ohio on State Route 800. The reservoir has a small conservation pool with a surface area of 350 acres at an elevation of 873 feet. In addition to the normal pool capacity of 1,000 acre-feet, Dover Reservoir has a flood storage capacity of 202,000 acre- feet covering an area of 10,100 acres when filled to the spillway crest elevation of 915 feet. It was designed to store 5.0 inches of runoff from the 1,397 square miles draining into the reservoir (Reference 32).

This flood control reservoir is one of 14 reservoirs which were planned and constructed under the cooperative effort of the Muskingum Watershed Conservancy District and the USACE. Currently, the flood control aspect of these 14 reservoirs is the responsibility of the USACE as a portion of the Ohio-Mississippi Flood Control Program. This system of reservoirs was designed to impound the runoff resulting from a total five-day rainfall approximately 36 percent greater than the average total rainfall for the five days of the 1913 storm (Reference 33).

With the existing flood controls at Dover Reservoir, it has been estimated that a 1- percent-annual-chance flood will result in a water-surface pool elevation equaling approximately 910 feet. The reservoir’s floodwater would extend north along the Tuscarawas River resulting in a total inundation of the floodplain below a ground elevation of 910 feet. The maximum flood which can be controlled without the water surface elevation exceeding the spillway crest elevation of 915.4 feet has been estimated to equal the 0.4-percent-annual-chance flood (Reference 34).

City of North Canton. Major floods have occurred within the West Branch Nimishillen Creek drainage basin during all seasons of the year. Most of the past floods have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows. Large floods, however, may occur at any time, particularly on smaller streams.

Flooding has frequently occurred within this drainage basin with the largest known flood occurring in March 1913. Due to the fact that extensive records of floods and river stages were not made at that time, the discharge value associated with this historic flood was not determined in the North Canton area. The largest flood of recent years, as recorded on Nimishillen Creek at USGS Gage No. 03118500, located about nine miles downstream of North Canton at North Industry, was on January 21, 1959, and had a discharge of 8,600 cfs. Other major floods occurred in September 1979, August 1935, and February 1929 (References 22, 23, and 24).

The principal cause of flooding along West Branch Nimishillen Creek and its tributaries within North Canton is heavy rainfall which creates runoff beyond the capacity of the natural drainage system. This causes the inundation of areas adjacent to these streams.

Village of Waynesburg. Practically all flooding along Sandy Creek have been produced by winter and spring rains falling on ground already saturated, snow covered, or frozen, thus resulting in a high runoff rate. Although these storms are of lesser intensity than the summer and fall rains, they are of longer duration and have greater peak flows (References 22 and 23).

Flooding has frequently occurred within this drainage basin with the largest known flood occurring in March 1913. Because extensive records of flood discharges were not kept at that time, the peak discharge associated with this flood is not known. The largest flood recorded on Sandy Creek was at USGS Gage No. 03117500 in Waynesburg on January 22, 1959, when a discharge of 15,000 cfs was recorded. The return period for this flood approximately equaled the magnitude of the 0.2-percent-annual-chance flood. Peak discharges of 6,460 cfs and 8,130 cfs, respectively, were recorded at the Waynesburg gage on March 6, 1963, and March 10, 1964 (References 22, 23, and 24).

More recent flooding events occurred between May 17 and May 23, on June 9, and between June 11 and June 17, 2004. Several severe thunderstorms passed over Ohio, causing flooding and widespread damage throughout much of central and eastern Ohio. Parts of Stark County received nearly 8 inches or rainfall during the 7 day period from June 11 to June 17. Peak streamflow on Sandy Creek at USGS Gage No. 03117500 was 3,560 cfs on May 22, 2004, which was estimated to be between a 50- and 20-percent- annual-chance flood event. At the same gage, peak streamflow was 5,110 cfs on June 15, 2004, which was estimated to be between a 20- and 10-percent-annual-chance flood event (Reference 13).

At the end of August 2004, a series of severe thunderstorms and the remnants of Hurricanes Frances and Ivan caused severe flooding in eastern Ohio, resulting in 21 counties being declared Federal disaster areas. Unusually wet conditions prior to the storms contributed to the severity of the flooding. Peak streamflow on Sandy Creek at USGS Gage No. 03117500 was 7,970 cfs on September 10, 2004, which was estimated to be between a 4- and 2-percent- annual-chance flood event (Reference 14).

A large winter storm between December 22 and 23, 2004 left approximately 12 to 18 inches of snow over much of central and north-central Ohio. Following this storm were unseasonably warm temperatures and widespread rain showers during January 2005, resulting in flooding throughout Ohio. Peak streamflow on Sandy Creek at USGS Gage No. 03117500 was 5,700 cfs on January 7, 2005, which was estimated to be between a 20- and 10-percent-annual-chance flood event (Reference 15)

Heavy rain in the amount of 3-4 inches in a 24-hour period over February 27 and 28, 2011, along with rapid snowmelt over saturated ground, led to severe flooding in northern Ohio. Peak streamflow on Sandy Creek at USGS Gage No. 03117500 was 5,640 cfs on February 28, 2011 (Reference 16).

The principal cause of flooding along Sandy Creek within Waynesburg is heavy rainfall which creates a runoff beyond the capacity of the natural drainage system. This causes inundation of areas adjacent to Sandy Creek.

Waynesburg could be affected by the impoundment of floodwaters within Bolivar Reservoir, downstream of Waynesburg. The dam making this reservoir is located on Sandy Creek just upstream of the Tuscarawas River and one mile east of Bolivar, Ohio. The reservoir has a flood storage capacity of 149,600 acre feet covering an area of 6,500 acres when filled to the spillway crest elevation of 961 feet. It was designed to store 5.6 inches of runoff from the 502 square miles draining into the reservoir (Reference 32).

This flood control reservoir is one of 14 reservoirs which were planned and constructed under the cooperative effort of the Muskingum Watershed Conservancy District and the USACE. Currently, the flood control aspect of these 14 reservoirs is the responsibility of the USACE as a portion of the Ohio-Mississippi Flood Control Program. This system of reservoirs was designed to impound the runoff resulting from a total five-day rainfall, approximately 36 percent greater than the average total rainfall for the five days of the 1913 storm (Reference 33).

With the existing flood controls at Bolivar Reservoir, it has been estimated that a 1- percent-annual-chance flood will result in a water surface pool elevation equaling approximately 954 feet. The reservoir's floodwater would extend east along Sandy Creek resulting in a total inundation of the floodplain below a ground elevation of 954 feet. The maximum flood which can be controlled without the water surface elevation exceeding the spillway crest elevation of 961.4 feet has been estimated to equal the 0.4- percent-annual-chance flood (Reference 34).

No information was found relating to flooding problems within the Villages of Beach City, Brewster, East Canton, East Sparta, Hartville, Hills and Dales, Limaville, Meyers Lake, or Wilmot.

2.4 Flood Protection Measures

City of Alliance. There are no existing or proposed flood protection structures on the flooding sources within the City of Alliance. Nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. These are in the form of land use regulations which control building within the USACE Flowage Easements. These easements encompass the land area adjacent to the Mahoning River with elevations less than 1033.4 feet.

Village of Brewster. A levee is present is the Village of Brewster along portions of Elm Run and Sugar Creek.

City of Canal Fulton. No existing or proposed flood protection structures exist on flooding sources within the City of Canal Fulton. Nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. These are in the form of land use regulations which control building within the Flood Plain District in Canal Fulton. The Zoning Ordinance Regulations of the Village stipulate that no structure or building shall be used in this Flood Plain District except for agricultural purposes, recreational activities or wildlife refuge. The district encompasses all land bordering the Tuscarawas River possessing an elevation below 951.4 feet NAVD88 (Reference 35).

City of Canton. No existing or proposed flood protection structures are on the flooding sources within the City of Canton. Nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. These are in the form of flood plain zoning ordinances which restrict the use of the Flood Plain District to various recreational uses, wildlife refuges, agricultural and parking (Reference 36). In additional, a flood warning system was established at the Akron-Canton airport in order to assist Canton and surrounding communities in predicting the magnitude of potential flooding.

City of Louisville. No flood protection measures are known to exist at this time along East Branch Nimishillen Creek, Broad-Monter Creek, or North Chapel Creek within the City of Louisville.

City of Massillon. A local protection project in Massillon was completed by the USACE on the Tuscarawas River in October 1951. The project was comprised of 2.4 miles of channel widening and deepening, 0.8 mile of new channel, relocation of six miles of railroad lines, new railroad and highway bridges, three miles of earth levees and concrete walls and pump stations. There are gated openings on railroad lines and highways to permit traffic during non-flood periods (Reference 37).

Also, the City of Massillon has adopted a floodplain ordinance in its Zoning Ordinance Regulations. This ordinance restricts building in floodplain designated areas unless satisfactory provisions are provided to guard against loss of property or human life due to flooding conditions (Reference 38). In addition, the City Subdivision Regulations require that land which is subject to periodic flooding shall be improved as to make the area completely safe for residential occupancy.

Village of Minerva. There are no existing or proposed flood protection structures on the flooding sources within the Village of Minerva. However, nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. In 1978, the Village passed a floodplain ordinance which required the lowest flood of newly constructed or substantially improved structures to be elevated to or above the 1-percent- annual-chance flood elevation (Reference 39).

Village of Navarre. There are no existing or proposed flood protection structures on the flooding sources within the Village of Navarre. Nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. These are in the form of land use regulations which control building within the USACE Flowage Easements. These easements encompass the land area adjacent to the Tuscarawas River with elevations less than 915.4 feet. Additionally, the Village of Navarre has adopted a Flood Plain Ordinance in its Zone Ordinance Regulations. This ordinance requires the lowest flood of new construction or substantial improvement of any residential structure to be elevated to or above the base flood elevation (Reference 40).

City of North Canton. The flooding sources within the City of North Canton have no existing or proposed flood protection structures. However, nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. In 1978, the City passed a floodplain ordinance which required the lowest flood of newly constructed or substantially improved structures to be elevated to or above the 1-percent- annual-chance flood elevation (Reference 41).

Stark County, Unincorporated Areas. Bolivar Dam, located on Sandy Creek along the boundary of Tuscarawas County and Stark County, is an earth-fill “dry dam” used for flood control that was initially constructed in 1938 by the U.S. Army Corps of Engineers (USACE). During historical flood events in 2005 and 2008, seepage was observed beneath the dam. Beginning in January 2015, construction began on a concrete seepage barrier with work anticipated to continue for four years. The project is cost-shared between USACE and the Muskingum Watershed Conservancy District (MWCD) (References 67 and 68).

The Village of Magnolia (included in the Carroll County, Ohio FIS) along Sandy Creek is located approximately 6.5 miles upstream (east) of Bolivar Dam. The Magnolia Levee is a 4,877-foot long component of the

Bolivar Dam flood damage reduction project, and is also owned by USACE. Magnolia Levee experienced significant problems during periods of high water and was in danger of failing during one of these events due to seepage. To address this problem, a filter blanket composed of sand was constructed on the land side of the levee to disperse seepage. The filter blanket was constructed 4 to 5 feet thick and extended approximately 120 feet from the toe of the levee. This project was completed in August 2005 (Reference 69).

Due to the 2005 and 2008 seepage observed at Bolivar Dam, a construction project to inspect and re-line existing pipes penetrating the levee was completed in 2011-2012, and additional improvements are planned for Magnolia Levee as a part of the Bolivar Dam rehabilitation that is currently ongoing (Reference 70).

The Magnolia Levee is fully accredited for the base (1-percent-annual-chance) flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Since the levee is fully accredited, it was included in the new detailed hydraulic analysis of Sandy Creek (Lower Reach).

Nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. In 1980, the County passed a floodplain ordinance which required the lowest floor of newly constructed or substantially improved structures to be elevated to at least one-and-one-half feet above the 1-percent-annual-chance flood elevation (Reference 42).

Stark County could also be affected by the impoundment of floodwaters within four flood control reservoirs operated by the USACE – Beach City Reservoir, Berlin Lake, Bolivar Reservoir and Dover Reservoir. Beach City, Bolivar and Dover Reservoirs, all located south of Stark County, are three of 14 reservoirs which are planned and constructed under the cooperative effort of the Muskingum Watershed Conservancy District and the USACE. Currently, the flood control aspect of these 14 reservoirs is the responsibility of the USACE as part of the Ohio-Mississippi Flood Control Program. This system of reservoirs was designed to impound the runoff resulting from a total 5-day rainfall approximately 36 percent greater than the average total rainfall for the 5 days of the 1913 storm. Berlin Lake, located in northeastern Stark County, is operated as a unit of a coordinated reservoir system for flood control in the Mahoning, Beaver and Ohio River Valleys and for low-water regulation for the highly industrialized Mahoning River Valley. **Table 8** lists each of these four reservoirs (References 29, 30, 32, 33, 34, 43 and 66).

Table 8. Flood Control Reservoirs Affecting Stark County

Reservoir	Influent Stream	Drainage Area (square miles)	Storage Capacity (acre-feet)	1-Percent-Annual-Chance Flood Elevation (ft. NAVD)
Beach City Reservoir	Sugar Creek	300	70,000	Exceeds spillway crest*
Berlin Lake	Mahoning River	249	91,200	1,034.1
Bolivar Reservoir	Sandy Creek	502	149,600	951.8
Dover Reservoir	Tuscarawas	1,397	202,000	910.4

* Spillway Crest Elevation: 975.9 feet – Frequency of filling: 57 years.

Village of Waynesburg. There no existing or proposed flood protection structures on the flooding sources within the Village of Waynesburg. Nonstructural measures of flood protection have been used to aid in the prevention of future flood damage. These are in the form of land use regulations which control building within the USACE Flowage Easements. These easements encompass the land area adjacent to Sandy Creek with elevations less than 961.4 feet.

No information was available regarding flood protection measures within the Villages of Beach City, East Canton, East Sparta, Hartville, Hills and Dales, Limaville, Meyers Lake, or Wilmot.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail 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 which are expected to be equaled or exceeded once on the average during any 10-, 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-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent 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 which equals or exceeds the 100-year (1-percent-annual-chance) flood in any 50-year period is approximately 40 percent (4 in 10), and, 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.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

This revised countywide FIS report includes information from previously published FIS reports where streams were studied in detail. It also includes information for streams studied by approximate and detailed methods and information from USGS studies which were incorporated as part of the September 2011 initial countywide FIS.

Peak discharges for the 10-, 2-, 1- and 0.2-percent-annual-chance floods of each flooding source studied in detail are shown in **Table 9**.

<u>Pre-Countywide Analyses</u>

Detailed Studies

For the original study, discharge-frequency relationships for ungaged streams in the study area were developed using the method outlined in Bulletin No. 45, Floods in Ohio, Magnitude and Frequency (Reference 24). The procedures described in Bulletin No. 45 involve the use of regression equations, which incorporate the appropriate hydrologic and basin characteristics to calculate peak flood discharges for the 10-, 50- and 100-year frequency events. The regression equations applicable to the detailed study reaches located within the Tuscarawas River basin are based on a regional analysis using multiple regression techniques and data obtained from 14 gaging stations upstream from Stillwater Creek. The regression equations covering the northeastern portion of the county within the Mahoning River basin are based on a similar analysis using data obtained from 40 gaging stations upstream from Little Beaver Creek.

Discharge-frequency relationships for gaged sites were determined by the USGS and are reported in Bulletin No. 45. They include the 10-percent, 2-percent and 1-percent- annual-chance events obtained from a log-Pearson Type III distribution of annual peak flows with adjustments for regional skew factors and outliers. Flows on gaged streams at ungaged sites with drainage areas 5 to 100 percent larger or 5 to 50 percent smaller than the drainage area at the gage site were adjusted by the method described in Bulletin No. 45. Stream gaging stations used in the hydrologic analyses are listed in **Table 7**.

Discharge-frequency relationships for Mahoning River Tributary No. 1 within Alliance were developed using the method outlined in Bulletin No. 45, Floods in Ohio, Magnitude and Frequency (Reference 24). The procedures described in Bulletin No. 45 involve the use of regression equations to calculate peak flood discharges for the 10-percent, 2-percent and 1-percent-annual-chance events. The regression equations for this area are based on a regional analysis using multiple regression techniques and data obtained from 40 gaging stations located within the Mahoning River Basin upstream from Little Beaver Creek. They incorporate the parameters of drainage area, channel slope and storage area which had been found to be significant. The 0.2-percent-annual-chance peak flood discharges were estimated using a log-probability distribution based on the 50-percent, 10-percent, 2-percent and 1-percent-annual-chance discharges.

In areas of high density development, an adjustment factor was applied to the discharge values obtained from the regression equations to account for the effects of urbanization. The adjustment was based on a USGS urban hydrology report which evaluated the effects of storm sewered areas, impervious areas and rainfall quantity and intensity (Reference 44).

Peak discharges for the 10-percent, 2-percent, 1-percent and 0.2-percent-annual-chance floods of each flooding source studied in detail in the community are shown in **Table 9**.

Discharge-frequency relationships for Plum Creek within Canal Fulton were developed using the method outlined in Bulletin No. 45, Floods in Ohio, Magnitude and Frequency (Reference 24). The procedures described in Bulletin No. 45 involve the use of regression equations to calculate peak flood discharges for the 10-percent, 2-percent and 1-percent-annual-chance events. The regression equations for this area are based on a regional analysis using multiple regression techniques and data obtained from 14 gaging stations located within the Tuscarawas River Basin upstream from Stillwater Creek. They incorporate the parameters of drainage area and channel slope, which had been found to be significant. The 0.2 percent annual chance peak flood discharges were estimated using a log-probability distribution based on the 50-percent, 10-percent, 2- percent and 1-percent-annual-chance flood discharges.

Discharge-frequency relationships for West Branch Nimishillen Creek (original study), Sherrick Run, Fairhope Ditch and Middle Branch Nimishillen Creek Tributary No. 1 were developed using the method outlined in Bulletin No. 45, Floods in Ohio, Magnitude and Frequency (Reference 24). The procedures described in Bulletin No. 45 involve the use of regression equations which incorporate the parameters of drainage area and channel slope to calculate peak flood discharges for the 10-percent, 2-percent and 1- percent-annual-chance events. The regression equations for this area are based on a regional analysis using multiple regression techniques and data obtained from 14 gaging stations located within the Tuscarawas River basin upstream from Stillwater Creek.

Discharge-frequency relationships for gaged sites on Nimishillen Creek at North Industry (gage No. 03118500, 54 years of record) and on Middle Branch Nimishillen Creek at Canton (gage No. 03118000, 34 years of record) were determined by the USGS and are reported in Bulletin No. 45. They include the 10-percent, 2-percent and 1-percent- annual-chance events obtained from a log-Pearson Type III distribution of annual peak flows with adjustments for regional skew factors and outliers (Reference 45). Flows on gaged streams at ungaged sites with drainage areas five to

100 percent larger or five to 50 percent smaller than the drainage area at the gage site were adjusted by the method described in Bulletin No. 45.

The peak discharges for the 10-percent, 2-percent and 1-percent annual chance events for the original study of East Branch Nimishillen Creek were obtained from the SCS report entitled, Flood Hazard Analyses Report, East Branch Nimishillen Creek, Stark County, Ohio (Reference 31). The 0.2-percent annual chance flood discharges were estimated using a log-normal distribution based on the 2- and 1 percent annual chance flood discharges.

Estimates of the 1-percent annual chance peak discharges for Broad-Monter Creek were computed by using the regression equations presented in the USGS report entitled, Techniques for Estimating Flood-Peak Discharges of Rural Unregulated Streams in Ohio (Reference 46). The data required for the use of the regression equations are drainage area, main channel slope, and storage area. Data for these basin characteristics were obtained from topographic maps (Reference 47). For Broad-Monter Creek, adjustments were made to the rural peak discharge estimates to reflect the effects of urbanization by use of techniques described in the USGS report entitled, Flood Characteristics of Urban Watersheds in the United States (Reference 48).

Discharge-frequency relationships for East Sippo Creek within Massillon were developed using the method outlined in Bulletin No. 45, Floods in Ohio, Magnitude and Frequency (Reference 24).

The Bulletin No. 45 method also provides for adjusting the discharge values on the section of Sandy Creek downstream from Still Fork Creek based on the discharge- frequency data associated with the USGS gaging station in Waynesburg.

Discharge-frequency relationships for the Tuscarawas River within Navarre were developed from data recorded at the USGS gaging station (No. 03117000, 40 years of record) at Massillon. The discharge-frequency data developed for this gage includes the 10-percent, 2-percent and 1-percent annual chance events obtained from a log-Pearson Type III (Reference 45) distribution of annual peak flows with adjustments for regional skew factors and outliers.

The drainage area of the Tuscarawas River upstream of Navarre is within five per cent of the drainage area upstream of the Massillon gaging station. Therefore, the discharge- frequency relationships developed for the gaging station were also used for that section of the Tuscarawas River within Navarre.

Discharge-frequency relationships for Chatham, and Zimber Ditches within North Canton were developed using the method outlined in Bulletin No. 45, Floods in Ohio Magnitude and Frequency (Reference 24). The procedures described in Bulletin No. 45 involve the use of regression equations to calculate peak flood discharges for the 10-percent, 2-percent and 1-percent annual chance events. The regression equations for this area are based on a regional analysis using multiple regression techniques and data obtained from 14 gaging stations located within the Tuscarawas River Basin upstream from Stillwater Creek. They incorporate the parameters of drainage area and channel slope, which had been found to be significant. The 0.2-percent annual chance flood discharges were estimated using a log-probability distribution based on the 50-percent, 10-percent, 2- percent and 1-percent annual chance flood discharges.

Discharge-frequency relationships for Sandy Creek within Waynesburg were developed from data recorded at the USGS gaging station at Waynesburg (gage No. 03117500 with 37 years of record). The discharge-frequency data for this gage was developed by the USGS (Reference 24) and includes the 10-percent, 2-percent and 1-percent annual chance events obtained from a log-Pearson Type III distribution of annual peak flows with adjustments for regional skew factors and outliers.

For ungaged sites along Sandy Creek within Waynesburg, the peak discharges for the 10- percent, 2-percent and 1-percent annual chance events were computed using the regression equations (Reference 24) with adjustments based on the gaged site information.

The Bulletin No. 45 method did not produce valid peak flood discharges for Middle Branch Nimishillen Creek and for that portion of the Tuscarawas River from the gaging station at Massillon to Canal Fulton. An alternative approach was selected to adjust the computed peak flows at the gaged site to ungaged sites on these streams, which employed-the generally used empirical equation for area-discharge relationships expressed in the equation:

$Q = jAm$ Eqn. 1

For the purpose of this study, (j) was made equal to the computed discharge at the gage and (A) equaled the ratio of the drainage area at the point of interest to the drainage area at the gage. The values for the exponent (m), or the slope of the area-discharge line, equaled the exponent (x) used in the regression equations provided in Bulletin No. 45. Using this general formula, the peak flood discharges for the 10-percent, 2-percent and 1- percent annual chance events were computed.

In areas of high density development, an adjustment factor was applied to the discharge values obtained from the regression equations to account for the effects of urbanization. The adjustment was based on a USGS urban hydrology report which evaluated the effects of storm-sewered areas, impervious areas and rainfall quantity and intensity (Reference 48).

A decrease in discharges on Firestone Ditch results from the impoundment of floodwaters behind the Norfolk and Western Railroad. A decrease in discharge occurs on the East Branch Nimishillen Creek near Trump Avenue due to the diversion of flow around Trump Avenue. Peak discharges for the 10-percent, 2-percent 1-percent and 0.2-percent annual chance events floods of each flooding source studied in detail in the community are shown in **Table 9**.

For the unincorporated areas of Stark County, the hydrologic discharge analysis was developed through the use of the ODNR's Bulletin No. 45, Floods in Ohio, Magnitude and Frequency (Reference 24). This bulletin contains equations developed to predict discharges from nonregulated streams. The independent variables of these equations represent watershed characteristics that significantly affect watershed peak discharges for storms of selected recurrence intervals using regression exponents for significant hydrologic and basin characteristics. These discharges were developed by regional analysis using multiple regression techniques and data from stream gages in areas of similar hydrologic characteristics in two stages. First, discharge-frequency relationships were determined for individual gaged watersheds throughout the state following the method of the U.S. Water Resources Council Bulletin No. 17A (Reference 45). Second, watershed characteristics are related to the known discharges of these gaged basins through multiple regression analysis. Since these discharges have been observed to occur at certain frequencies, the regression analysis also takes into consideration the size of storm (i.e., storm frequency). The equations thus developed are used to predict peak discharges for selected storm frequencies on ungaged watersheds by the use of the basin characteristics such as channel slope, drainage area and average annual precipitation. The 0.2-percent-annual-chance frequency discharge was obtained by extrapolating on log-probability paper from the other frequency values.

<u>Initial Countywide Analyses (September 29, 2011)</u>

Detailed Studies

In March 2005, updated and/or new discharges were computed for 13 streams by the USGS (Reference 12). New hydrology was computed for Clays Ditch, East Branch Nimishillen Creek, Mahoning River, McDowell Ditch, Metzger Ditch, Middle Tributary, North Chapel Creek, Unnamed Tributary, West Branch Nimishillen Creek, West Branch Nimishillen Tributary 1, West Sippo Creek, Zimber Ditch Tributary 1, and Zimber Tributary 1A within Stark County. For East and West Branch Nimishillen Creeks, not the entire reach was restudied. Estimates of the 1-percent and 0.2-percent-annual-chance peak discharge, reported in cfs, were determined for various locations along each stream. Historical streamflow data were available for Mahoning River. A current streamflow gaging station, Mahoning River at Alliance, Ohio (03086500), has 60 years of record.

No historical streamflow-gaging data were available for any of the other 12 streams considered in this study. The estimates of 1-percent-annual-chance discharges for all streams were initially computed by use of a regression equation presented in the USGS's Water-Resources Investigations Report 03-4164 (Koltun, 2003) (Reference 49). The data required for the use of this equation are drainage area in square miles (mi2), main channel slope in feet per mile (ft/mi), and percentage of the drainage area as open water and wetlands. The basin-characteristics data were obtained directly from digital spatial data sets by means of a GIS. Techniques described in Koltun, 2003 were used to incorporate the available gage data into the peak-flood discharge estimates for Mahoning River. In order to reflect the urban conditions that exist for areas within McDowell Ditch basin, the rural peak-flood discharge estimates were adjusted using methods described in USGS Water Supply Paper 2207, Flood Characteristics of Urban Watersheds in the United States (Sauer and others, 1983) (Reference 48). Input variables for the Sauer and others, (1983) regression equations are drainage area, rural peak-flood discharge estimate, and a basin development factor.

In February 2006, Stantec developed a detailed hydrologic model for the Plum Creek watershed to determine peak discharges for the 10-, 2- and 1-percent-annual-chance flood events. The model was created using the HEC-HMS software package (v.2.2.2) developed by the USACE.

The methods of analysis and results of this 2006 study were reported in “Plum Creek Detailed Hydrology and Hydraulics Report: Countywide DFIRM Production and Development of Updated Flood Data for Stark County, Ohio” which was prepared by Stantec on February 22, 2006 (Reference 13).

In March 2006, Stantec performed hydrologic analyses to establish peak discharge- frequency relationships for seven stream reaches, which include portions of East Branch Nimishillen Creek, McDowell Ditch, McDowell Ditch Overflow 1, McDowell Ditch Overflow 2, North Chapel Creek, West Branch Nimishillen Creek, and West Branch Nimishillen Creek Overflow. USGS data provided for the 1.0-percent annual chance flood for each stream reach was used to determine the discharge rates for 0.2-percent annual chance flood events.

Peak discharge estimates were calculated using regression equations and the USGS leverage study data which was provided. In order to reflect the urban conditions that exist within the McDowell Ditch basin, the rural peak-flood discharge estimates were adjusted using methods described in USGS Water Supply Paper 2207 (Reference 48). The peak flows for the remainder of the streams were calculated with regression equations that were developed for rural watersheds (USGS WRIR 03-4164) (Reference 49).

The methods of analysis and results of this 2006 study were reported in “Leverage Study Hydrology and Hydraulics Report: Countywide DFIRM Production and Development of Updated Flood Data for Stark County, Ohio” which was prepared by Stantec on March 6, 2006 (Reference 50).

In September 2009, Stantec modified an existing detailed USGS leverage study for West Branch Nimishillen Creek to incorporate a bridge that was replaced after the original USGS survey data was obtained in 2003. The peak discharge values used in the original USGS model were not modified.

Peak discharges for the 10-, 2-, 1- and 0.2 percent-annual-chance floods of each flooding source that were previously studied in detail in Stark County are shown in **Table 9**. A summary of stillwater elevations is shown in **Table 10** (Reference 66).

Approximate Studies

In January 2006, Stantec performed approximate hydrologic analyses on 50 separate stream reaches within Stark County. For these analyses, peak discharges for the 1- percent annual chance (100-year) storm event were determined at various locations throughout each of the new and existing approximate study reaches in Stark County. Hydrologic calculations were performed using regression equations presented in the USGS WRIR 03-4164.

In instances where a significant dam was located on an approximate study reach, level pool routing computations were performed. In several instances, dams located along streams in Stark County control the downstream flow so that the regression equations could not be used. In these cases, information about the dam was obtained from ODNR, Division of Water and a level pool routing was performed using the HEC-1 computer program. Information was obtained for Lucern Lake Dam, Lake Cable Dam, Landing Lake Dam and Willowdale Lake Dam.

The methods of analysis and results of this study were reported in "Approximate Hydrologic and Hydraulics Report: Countywide DFIRM Production and Development of Updated Flood Data for Stark County, Ohio" which was prepared by Stantec on January 23, 2006.

In August 2009, Stantec performed hydrologic analyses on portions of Elm Run, Middle Fork Sugar Creek, Sugar Creek, and the Tuscarawas River in Stark County, Ohio, in order to properly identify and map the area protected by Provisionally Accredited Levees (PALs) in Stark County. Peak discharges for the 1-percent-annual-chance flood event were determined at various locations on the four streams. Flow change locations were set at the downstream limits, approximate 50% changes in discharge, and downstream of flow-regulating structures along a study reach. The 1-percent-annual-chance peak discharge values were determined using regression equations or best available data from existing gages or detailed FIS reports.

Hydrologic calculations were performed using regression equations presented in SIR 2006-5312 (Reference 51). The regression equations were developed using generalized least-squares (GLS) regression analyses on data from 305 gaging stations. The equations were developed to estimate flood discharges on unregulated streams based on the total-contributing drainage area, channel slope determined from the 10-85 method, percentage of drainage area as open water and wetlands, and hydrologic regional factors. Peak discharges were adjusted when needed to account for the influence of existing stream gages on the approximate study reach. Additional information about the model development is contained in WRIR 03-4164 (Reference 49). The methods of analysis and results were reported in a hydrologic report prepared by Stantec and dated August 21, 2009 (Reference 52).

Streams studied by approximate methods are listed in **Table 2**.

Revised Countywide Analyses (February 16, 2012)

An updated interior drainage analysis for areas along the Brewster Levee performed by the USACE for an August 18, 2009, Levee System Report was incorporated into the February 16, 2012 revised countywide FIS (Reference 65).

Revised Countywide Analyses (To Be Determined)

For this revised countywide FIS, a new detailed study was performed on a portion of Sandy Creek (Lower Reach) from the Tuscarawas / Carroll County boundary to the northeastern corporate limits of Magnolia. The 1-percent-plus discharge at the 3,000 feet downstream of State Route 183 flow location was calculated using a Bulletin 17B analysis with a specified 99% confidence interval at USGS Gage No. 03117500, Sandy Creek at Waynesburg, OH.

Peak discharges for the 10-, 2-, 1-, 1-percent-plus, and 0.2-percent-annual-chance recurrence floods at all other flow locations along the newly studied portion of Sandy Creek were then calculated using the drainage area ratio method.

The 4-percent-annual-chance recurrence discharges for all flow locations were calculated from logarithmic regression of the 10-, 2-, 1-, and 0.2-percent-annual-chance recurrence floods.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in **Table 9**.

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
Beech Creek							
Gaging station at Bolton, Ohio	17.4	1,930	*	2,700	3,030	*	3,850
At Vine Street	16.8	1,860	*	2,600	2,940	*	3,750
At Beeson Street	15.6	1,740	*	2,450	2,790	*	3,500
Black Run							
At State Route 30	12.9	944	*	1,470	1,720	*	2,380
Just US of Parks Avenue	12.0	884	*	1,380	1,620	*	2,250
Chatham Ditch							
Just US of confluence with West Branch Nimishillen Creek	1.4	204	*	343	413	*	600
At Laurel Greene Drive	0.8	304[1]	*	485[1]	571[1]	*	*
Clays Ditch							
At mouth	1.23	*	*	*	236	*	*
Above unnamed tributary	0.89	*	*	*	191	*	*
East Branch Nimishillen Creek							
Upstream of confluence with Nimishillen Creek	97.9	2,970	*	4,330	4,950	*	6,550
Downstream of Middle Branch Nimishillen Creek	93.2	2,890	*	4,230	4,840	*	6,400
Upstream of confluence of Middle Branch Nimishillen Creek	46.5	2,200	*	3,290	3,780	*	5,050
At Trump Avenue	43.1	2,110	*	2,950	3,290	*	4,020
About 0.8 mile US of Trump Avenue	37.8	1,920	*	2,880	3,320	*	4,450

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
At the southwest Louisville Corporation Limit	32.6	*	*	*	2,980	*	3,660
Upstream of Unnamed Tributary to East Branch Nimishillen Creek	21.9	*	*	*	2,340	*	2,880
Upstream of Broad-Monter Creek	19.3	*	*	*	2,200	*	2,720
Upstream of North Chapel Creek	15.0	*	*	*	1,860	*	2,300
Upstream of Tributary 2	9.4	*	*	*	1,350	*	1,680
East Branch Nimishillen Creek Diversion			*			*	
At Trump Avenue	N/A	N/A	*	200	330	*	830
East Sippo Creek							
Upstream of culvert inlet	17.8	1,100	*	1,700	1,980	*	2,650
Fairhope Ditch							
US of confluence with East Branch Nimishillen Creek	3.6	459	*	743	881	*	1,270
At State Route 153	3.2	411	*	669	795	*	1,130
At Lesh Street	2.6	392	*	642	762	*	1,080
At State Route 62	1.9	356	*	586	697	*	1,000
About 2,000 feet US of State Route 62	1.6	320	*	531	632	*	900
About 2,000 feet US of Broadview Avenue	1.1	263	*	440	526	*	750
Firestone Ditch							
US of confluence with Middle Branch Nimishillen Creek	2.6	389	*	636	755	*	1,080

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
At Norfolk and Western Railway	2.3	384	*	629	747	*	1,050
At Applegrove Street	1.8	360	*	593	704	*	990
Hayden Ditch							
Just US of confluence with Sherrick Run	2.5	437	*	714	845	*	1,190
Indian Run							
Just US of confluence with Sandy Creek	8.4	741	*	1,170	1,370	*	1,840
Johney Ditch							
US of confluence with Sippo Creek	8.5	660	*	1,040	1,230	*	1,710
At Perry Drive	7.0	590	*	940	1,110	*	1,570
Little Sandy Creek							
US of confluence with Sandy Creek	37.5	2,040	*	3,060	3,520	*	4,700
Mahoning River							
At mouth	89.20	*	*	*	8,380	*	*
Mahoning River Tributary No. 1							
At Vine Street	2.24	627	*	928	1,070	*	1,440
800 feet upstream of Buckeye Avenue	1.07	266	*	426	500	*	700
McDowell Ditch							
At mouth	19.3	*	*	*	2,360	*	2,850
Above Unnamed Tributary	14.8	*	*	*	1,830	*	2,220

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
McDowell Ditch Overflow 1							
At confluence with McDowell Ditch	N/A	*	*	*	380	*	635
Above confluence with McDowell Ditch Overflow 2	N/A	*	*	*	50	*	55
McDowell Ditch Overflow 2							
Above confluence with McDowell Ditch Overflow 1	N/A	*	*	*	330	*	580
Metzger Ditch							
At Cain Road	3.45	*	*	*	307	*	*
Above Heckman Street	2.49	*	*	*	242	*	*
Above unnamed tributary	1.04	*	*	*	188	*	*
Middle Branch Nimishillen Creek							
US of confluence with Nimishillen Creek	46.6	1,340	*	1,920	2,180	*	2,800
At Martindale Road (USGS Gage No. 3118000)	43.1	1,280	*	1,840	2,090	*	2,660
At Norfolk and western Railway	39.4	1,210	*	1,750	1,990	*	2,540
About 3,400 feet US of 55th Street	35.9	1,150	*	1,660	1,890	*	2,410
About 4,000 feet US of 55th Street	32.2	1,080	*	1,560	1,780	*	2,300
About 5,000 feet US of 55th Street	30.7	1,050	*	1,520	1,730	*	2,260

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
About 3,000 feet US of Easton Street	28.4	999	*	1,460	1,660	*	2,130
At Diamond Street	26.4	957	*	1,400	1,600	*	2,090
Metzger Ditch							
At Cain Road	3.45	*	*	*	307	*	*
Above Heckman Street	2.49	*	*	*	242	*	*
Above unnamed tributary	1.04	*	*	*	188	*	*
Middle Branch Nimishillen Creek Tributary No. 1							
US of confluence with Middle Branch Nimishillen Creek	3.6	452	*	733	868	*	1,220
Middle Tributary							
At mouth	0.69	*	*	*	213	*	*
Nimishillen Creek							
At Gaging Station in North Industry, Ohio (03118500)	175.0	5,210	*	7,320	8,260	*	10,500
North Chapel Creek							
At mouth	4.08	*	*	*	754	*	940
Above unnamed tributary	3.20	*	*	*	614	*	770
Above Middle Tributary	2.35	*	*	*	505	*	630
Plum Creek							
Downstream of Erie Avenue/High Street	4.12	134	*	248	361	*	509
1900 feet upstream of Leaver Avenue	3.82	208	*	426	505	*	767

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
3000 feet downstream of State Route 93	3.53	378	*	759	1,008	*	1,563
2300 feet downstream of State Route 93	3.53	380	*	800	1,022	*	1,572
1700 feet downstream of State Route 93	3.22	379	*	769	971	*	1,486
Just upstream of State Route 93	2.93	378	*	737	930	*	1,479
Confluence with Unnamed Tributary	2.08	290	*	552	698	*	1,114
400 feet upstream of confluence with Unnamed Tributary	1.13	167	*	312	392	*	622
2600 feet upstream of State Route 236	0.65	107	*	195	243	*	378
Just upstream of State Route 236	0.33	55	*	99	124	*	191
Reemsnyder Ditch							
upstream of confluence with McDowell Ditch	1.5	207	*	347	419	*	620
At Whipple Avenue	1.0	187	*	316	381	*	565
Sandy Creek (Lower Reach)							
At Bolivar Dam	502.0	10,940	13,900	16,050	18,560	23,950	24,920
About 1,000 feet DS of Alliance Rd NW (State Route 183)	279.0	6,840	8,690	10,030	11,600	14,970	15,570
About 3,000 feet DS of State Route 183	264.0	6,540	*	9,600	11,100	*	14,900

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
At State Route 183 (USGS Gage No. 03117500)	253.0	6,290	*	9,260	10,700	*	14,300
About 1,000 feet US of State Route 183	216.0	5,760	*	8,430	9,680	*	12,800
Sherrick Run							
US of confluence with Nimishillen Creek	10.4	824	*	1,300	1,520	*	2,100
At Belden Avenue	8.2	812	*	1,280	1,500	*	2,060
At Waynesburg Drive	6.9	716	*	1,130	1,330	*	1,890
US of confluence with Hayden Ditch	4.1	530	*	854	1,010	*	1,440
Sippo Creek							
At Hankins Street	16.5	1,300	*	1,950	2,250	*	3,050
At Jackson Avenue	14.8	1,220	*	1,840	2,130	*	2,900
At Brook Avenue	13.5	1,120	*	1,690	1,960	*	2,650
Tuscarawas River							
At Gaging Station in Massillon, Ohio (No. 03117000)	518.0	6,180	*	8,040	8,820	*	10,600
At Highmill Avenue	435.0	5,440	*	7,120	7,830	*	9,480
US of confluence with Mudbrook Creek	426.0	5,360	*	7,020	7,720	*	9,350
DS of confluence with Plum Creek	403.0	5,140	*	6,750	7,430	*	9,020
Just US from confluence of Plum Creek	*	*	*	*	*	*	*

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
At Pontius Street	9.0	574	*	912	1080	*	1510
At Mogadore Avenue	8.4	559	*	888	1050	*	1500
About 2,060 feet US of Magadore Avenue	8.0	545	*	869	1030	*	1480
At Cain Road	3.45	*	*	*	307	*	*
West Branch Nimishillen Creek							
Upstream of confluence with Nimishillen Creek	46.5	2,650	*	3,840	4,400	*	5,610
At Railroad	45.4	2,450	*	3,580	4,100	*	5,320
Above confluence with McDowell Ditch	18.93	*	*	*	1,480	*	1,790
Above confluence with unnamed tributary	18.62	*	*	*	1,470	*	1,770
Above confluence with unnamed tributary	17.24	*	*	*	1,370	*	1,660
Above Easthill Street	17.06	*	*	*	1,310	*	1,590
Below Schneider Street	15.68	*	*	*	1,260	*	1,520
Above confluence with unnamed tributary	12.54	*	*	*	1,050	*	1,270
Above confluence with West Branch Nimishillen Tributary 1	7.18	*	*	*	802	*	980
Upstream of Mt. Pleasant Street	4.88	*	*	*	602	*	740
About 2500 feet upstream of State Street NW	2.35	*	*	*	339	*	420

Table 9. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs)					
		10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-annual-chance plus	0.2-percent-annual-chance
Above confluence with unnamed tributary	1.60	*	*	*	254	*	310
West Sippo Creek							
At Deermont Avenue	7.42	*	*	*	1,180	*	*
Above unnamed tributary	6.94	*	*	*	1,160	*	*
Above unnamed tributary	3.01	*	*	*	700	*	*
Above unnamed tributary	2.33	*	*	*	605	*	*
Zimber Ditch							
At Chessie System	12.1	955	*	1,430	1,680	*	2,280
At Glenwood Street	11.7	894	*	1,360	1,580	*	2,150
At Whipple Avenue	9.8	681	*	1,060	1,250	*	1,730
At Portage Street	7.6	606	*	944	1,110	*	1,550
At Strausser Street	7.0	488	*	782	927	*	1,330
At Shuffel Drive	6.2	446	*	717	852	*	1,220
At Mount Pleasant Street	5.4	336	*	545	653	*	940
Zimber Ditch Tributary 1							
At mouth	2.10	*	*	*	328	*	*
Above Zimber Ditch Tributary 1A	1.35	*	*	*	223	*	*
Above unnamed tributary	0.92	*	*	*	202	*	*
Zimber Ditch Tributary 1A							
At mouth	0.61	*	*	*	142	*	*

* Data not available

[1] Storm sewers and street runoff from the development between referenced locations along Chatham Ditch cause the discharges to be significantly higher at the upstream reference location.

Table 10. Summary of Stillwater Elevations

Flooding Source and Location	Elevation (Feet NAVD)					
	10-percent-annual-chance	4-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	1-percent-plus-annual-chance	0.2-percent-annual-chance
Berlin Lake	*	*	*	1034.1	*	*
Bolivar Reservoir	939.8	943.4	946.3	951.8	961.5	964.4
Dover Reservoir	*	*	*	910.4	*	*

* Data not available

3.2 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. Users should be aware that flood elevations shown on the FIRM represent rounded, whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data Table in the FIS report. 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 study 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.

This section includes information from previously published FIS reports where streams were studied by detailed methods and by approximate methods. It also includes information from USGS studies incorporated as part of the 2011 initial countywide FIS.

Detail-studied streams that were not re-studied as part of the 2011 initial countywide map update may include a “profile baseline” on the maps. This “profile baseline” provides a link to the flood profiles included in the FIS report. The detail-studied stream centerline may have been digitized or redelineated as part of the initial countywide revision. The “profile baselines” for these streams were based on the best available data at the time of their study and are depicted as they were on the previous FIRMs. In some cases where improved topographic data was used to redelineate floodplain boundaries, the “profile baseline” may deviate significantly from the channel centerline or may be outside the SFHA.

The hydraulic analyses for this study were based only on the effects of unobstructed flow. The flood elevations shown on the profiles and in the Summary of Stillwater Elevations (**Table 10**) are thus considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced to NAVD88. Elevation reference marks used in this study, and their descriptions, are shown on the FIRM.

<u>Pre-Countywide Analyses</u>

Detailed Studies

Stark County, Unincorporated Areas. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections used in the hydraulic analyses on those stream reaches studied in detail, other than a portion of the Tuscarawas River and the streams previously studied by the SCS, were obtained from topographic maps having a scale of 1:2400 (References 53 and 54). The contour intervals shown on these maps vary from 2 feet for the northern two-thirds of the county to 5 feet for the southern one-third of the county. Field surveys were conducted on all but the above-mentioned detailed study reaches to obtain channel bottom profile and elevation data and the structural geometry of all bridges, dams, and culverts.

Bridge and channel cross-sections for the backwater analyses of a portion of the Tuscarawas River were obtained from the USACE. This cross-section data is consistent with the data used in the preparation of the Tuscarawas River Floodplain Information Report (Reference 37). The channel, floodplain and structure data for the detailed reaches previously studied by the SCS were updated, based on field surveys, in areas which had changed since the original model was developed.

Locations of selected cross-sections used in the hydraulic analyses area shown on the Flood Profiles. For stream segments where a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Published Separately).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness factors for the main channels generally range from 0.030 to 0.060 depending upon the characteristics of the channel bottom with floodplain roughness values ranging from 0.035 for cleared overbanks to 0.150 for high density housing and heavily wooded overbanks.

Starting water-surface elevations for all but one of the detailed study reaches, in which the HEC-2 program was used, were calculated using the slope-area method. Whenever possible, the hydraulic computations for these streams were started downstream of the lower study limit to insure reasonable results within the study reach. Starting elevations for the detailed study reach of Nimishillen Creek, which begins at the USGS gaging station just south of North Industry, were determined from a stage-discharge rating curve based on gage data provided by the USGS. The portions of Middle Branch and East Branch Nimishillen Creeks which were studied in detail using the WSP-2 program were started at the point where the HEC-2 model ended. The starting water-surface elevations at these locations coincided with the computed elevations from the HEC-2 program.

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using either the USACE's HEC-2 or SCS WSP-2 step- backwater computer model (References 55 and 56). The HEC-2 computer model was used for all detailed study reaches except for those reaches of Middle Branch Creek, Fairhope Ditch and Firestone Ditch which had been previously studied by the SCS as described in their "Flood Hazard Analyses Reports" (References 31 and 57).

Flood elevations for these reaches were determined using the WSP2 computer model developed by the SCS. The SCS models were updated to account for changes in the channel configuration, hydraulic structure data, channel and flood plain roughness factors and peak flood discharge values.

The acceptability of all hydraulic factors, cross sections and hydraulic structure data was checked whenever possible by comparing the computed flood profiles with profiles of past major floods. The computer model for the Tuscarawas River was verified by comparison with the July 1969 flood profile. The elevations observed for the 1969 flood are in close agreement with the computed 0.2-percent-annual-chance flood elevations. The January 1959 flood profile for Nimishillen Creek and Middle Branch Creek was determined to be between the 1- and 0.2-percent-annual-chance flood profiles. High water marks, established during the field surveying, and stream gage records also aided in verification of the computed flood elevations.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

City of Alliance. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections for the backwater analyses of Mahoning River Tributary No. 1 were obtained from topographic maps with a scale of 1:2400 and a two-foot contour interval (Reference 53). The channel bottom profile was obtained by field measurement. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry.

Channel roughness factors (Manning’s “n”) used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for the main channel of Mahoning River Tributary No. 1 range from 0.013 to 0.070 with floodplain roughness values ranging from 0.060 to 0.120 for all floods.

Flood elevations of the 10-, 2-, 1, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using the USACE’s HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations for Mahoning River Tributary No. 1 were calculated using the slope-area method. The hydraulic computations for this stream were started approximately 0.3 mile downstream from the beginning of the study limits located at Vine Street.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

Village of Canal Fulton. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Bridge and channel cross-sections for the backwater analyses of a portion of the Tuscarawas River were obtained from the USACE. This cross-section data is consistent with the data used in the preparation of the Tuscarawas River Flood Plain Information Report (Reference 37).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness factors for the main channel of the Tuscarawas River range from 0.030 to 0.050 with floodplain roughness values ranging from 0.060 to 0.120 for all floods. The acceptability of all assumed hydraulic factors, cross-sections and hydraulic structure data was checked by comparison with the July 1969 flood profile.

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for the Tuscarawas River were developed using the USACE's HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations were calculated using the slope-area method. The hydraulic computations for this river were started just north of Massillon to nurse the reasonableness of results within the study reach.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

City of Canton. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections used in the backwater analyses of the streams studied in detail were obtained from topographic maps having a scale of 1:24000 with two-foot contour intervals (References 53 and 54). The channel bottom profile was obtained by field measurement. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observation of the streams and floodplain areas. Roughness factors on all streams for the main channels generally range from 0.035 to 0.060 depending upon the characteristics of the channel bottom with floodplain roughness values ranging from 0.035 for cleared overbanks to 0.120 for high density housing and heavily wooded overbanks.

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using the USACE'S HEC-2 step-backwater computer model (Reference 55). The starting water surface elevations for these streams were calculated using the slope-area method. Whenever possible, the hydraulic computations for these streams were started downstream of the lower study limit to insure reasonable results within the study reach.

The accuracy of the computer analyses on Nimishillen Creek, and the original studies of East and West Branch and Middle Branch Nimishillen Creeks in Canton were checked with recorded high water marks of the January 1959 flood. It was found that the computed water-surface elevations are in close agreement with the actual water elevations observed during that flood. High water marks, established during the field surveying, and stream gage records also aided in verifying the computed flood elevations.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

City of Louisville. Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross-sections for the original portion of East Branch Nimishillen Creek were obtained from the SCS report titled Flood Hazard Analyses Report, East Branch Nimishillen Creek, and Stark County, Ohio (Reference 31). Cross-sections for Broad-Monter Creek were obtained from field surveys and topographic maps (Reference 47). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments where a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (published separately).

Flood profiles for the 2- and 1-percent-annual-chance floods for the original study of East Branch Nimishillen Creek were obtained from the SCS report, Flood Hazard Analyses Report, East Branch Nimishillen Creek. Stark County, Ohio (Reference 31). Stage- frequency curves constructed at the location of each cross-section were used to determine the 10- and 0.2-percent-annual-chance flood profiles for the original study of East Branch Nimishillen Creek.

For Broad-Monter Creek, water-surface elevations of floods of the selected recurrence interval were computed using the USGS WSPRO step-backwater model and the Federal Highway Administration's HY-8 culvert design software (References 57 and 58). The WSPRO/HY-8 model was subsequently converted to HEC-RAS by FEMA in March 1999 (Reference 59).

Starting water-surface elevations for Broad-Monter Creek were determined using a slope- conveyance computation using HEC-RAS (Reference 59). Slopes used for slope- conveyance computations were based on data extrapolated from surveyed cross-sections and from topographic maps (Reference 47). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on field observations. The channel "n" values for East Branch Nimishillen Creek ranged from 0.020 to 0.055, and the overbank "n" values ranged from 0.055 to 0.095. For Broad-Monter Creek, the channel "n" values ranged from 0.032 to 0.042, and the overbank "n" values ranged from 0.018 to 0.100.

Approximate flood elevations for Tributary 2 were plotted using the Flood Hazard Analyses report prepared by the SCS (Reference 31).

City of Massillon. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections for the backwater analyses of East Sippo Creek were obtained from topographic maps having a scale of 1:2400 with two-foot contour intervals (Reference 53). The channel bottom profile was obtained by field measurement. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments where a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Published Separately).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness factors for the main channel of East Sippo Creek range from 0.011 to 0.050 with floodplain roughness values from 0.060 to 0.100 for all floods.

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using the USACE'S HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations for East Sippo Creek were calculated using the slope-area method. The hydraulic computations for this stream were started at the Tuscarawas River near the outlet of the East Sippo Creek Culvert.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

Village of Minerva. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections for the backwater analyses of Sandy Creek were obtained from topographic maps having a scale of 1:2400 with five-foot contour intervals (References 53 and 63). The channel bottom profile was obtained by field measurement. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments where a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Published Separately).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness factors for the main channel of Sandy Creek range from 0.035 to 0.060 depending upon the characteristics of the channel bottom with floodplain roughness values ranging from 0.030 for cleared overbanks to 0.120 for heavily wooded overbanks. The acceptability of all assumed hydraulic factors, cross-sections and hydraulic structure data were checked by comparison with recorded high water marks on Sandy Creek in the Village of Minerva.

Flood elevations of the 10-, 2-, 1-, and floods for reaches studied in detail were developed using the USACE'S HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations for Sandy Creek were calculated using the slope-area method.

The hydraulic computations for this stream were started 500 feet downstream of the corporate limits of Minerva.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

Village of Navarre. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Bridge and channel cross-sections for the backwater analyses of the Tuscarawas River were obtained from the USACE. This cross-section data is consistent with the data used in preparation of the Tuscarawas River Floodplain Information Report (Reference 37).

The channel roughness factors (Manning's "n") used in the hydraulic computations for this FIS equaled 0.050 for the main channel of the Tuscarawas River with floodplain roughness values ranging from 0.070 to 0.120 for all floods. These values were first obtained from a previous study done by the USACE (Reference 37). They were verified and adjusted by comparison with the July 1969 flood profile (Reference 37).

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using the USACE'S HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations for the Tuscarawas River were calculated using the slope-area method.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

City of North Canton. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections used in the backwater analyses of Chatham, and Zimber Ditches were obtained from topographic maps at a scale of 1:2400 with two-foot contour intervals (References 53 and 54). The channel bottom profile was obtained by field measurement. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness factors for the main channels generally range from 0.011 to 0.060 depending upon the characteristics of the channel bottom, with floodplain roughness values ranging from 0.025 for cleared overbanks to 0.150 for high density housing and heavily wooded overbanks.

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using the USACE'S HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations for these streams were calculated using the slope-area method. The hydraulic computations on the Zimber and Chatham Ditches were started at their confluence with West Branch Nimishillen Creek.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Village of Waynesburg. Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross-sections for the backwater analyses of Sandy Creek were obtained from topographic maps having a scale of 1:24000 with five-foot contour intervals (Reference 53). The channel bottom profile was obtained by field measurement. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness factors for the main channel of Sandy Creek range from 0.035 to 0.050 with floodplain roughness values ranging from 0.035 to 0.100 for all floods. The acceptability of all assumed hydraulic factors, cross-sections and hydraulic structure data was checked by comparison with the stage-discharge relationship for the USGS gaging station on Sandy Creek at Waynesburg (Reference 64).

Flood elevations of the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for reaches studied in detail were developed using the USACE'S HEC-2 step-backwater computer model (Reference 55). The starting water-surface elevations for Sandy Creek were calculated using the slope-area method.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

Initial Countywide Analyses (September 29, 2011)

Detailed Studies

In September 2009, Stantec performed an updated detailed hydraulic analysis using the USACE's HEC-RAS computer program (Version 3.1.3).

For the September 2011 countywide FIS, Stantec modified an existing detailed hydraulic analysis performed by the USGS on West Branch Nimishillen Creek to incorporate a bridge that was replaced after the original USGS survey data was obtained in 2003. The LOMR model and accompanying data for the new bridge (South Main Street, LOMR 07- 05-0969P) were utilized to revise the USGS HEC-RAS model. The cross-sections immediately upstream and downstream of the South Main Street Bridge were moved outward to accommodate an increase in the bridge width from 46 feet to 74 feet. Lettered cross section "S" was also moved approximately 50 feet upstream due to the increase in the bridge width. Elevation values for these three cross-sections were extracted from a Digital Elevation Model (DEM) created using 2-foot contour data obtained from Stark County in 2004.

The peak discharge values used in the original USGS model were not modified. Overbank Manning's "n" values for the two moved cross-sections immediately adjacent to the bridge were set to be equivalent to the values used in the original USGS model. For the new "S" cross section, overbank Manning's "n" values were estimated from a 2001 National Land Cover Dataset (NLCD) of Ohio prepared by United States Geological Survey (USGS). A field reconnaissance was not performed. The overbank "n" values were extracted to RAS directly from GIS using HEC-GeoRAS 4.1 and were then consolidated to single values for each overbank. **Table 11** shows the Overbank Manning's "n" values used for each corresponding land cover. These values were taken from Chow

(1959) and McCuen (1998). Channel “n” values in the model (ranging from 0.03 to 0.05 along the study reach) were not modified, with the exception of the internal South Main Street bridge sections. The channel “n” value at the bridge was set at 0.03, the value that was utilized in the LOMR model.

The encroachment data for the previously conducted floodway analysis was verified along the entire 9.6-mile detailed study reach length; this resulted in the adjustment of the floodway at several locations along West Branch Nimishillen Creek.

Table 11. Roughness Coefficients (Manning's "n")

Flooding Source	Roughness Coefficients
Barren Land	0.03
Cultivated Crops	0.04
Deciduous Forest	0.10
Developed, Open Space	0.04
Developed, Low Intensity	0.05
Developed, Medium Intensity	0.06
Developed, High Intensity	0.08
Emergent Herbaceous Wetlands	0.05
Evergreen Forest	0.10
Grassland / Herbaceous	0.05
Mixed Forest	0.10
Open Water	0.04
Pasture / Hay	0.05
Shrub / Scrub	0.05
Woody Wetlands	0.06

Approximate Studies

In January 2006, Stantec performed approximate hydraulic analyses on 50 separate stream reaches within Stark County, Ohio, using the USACE’s HEC-RAS computer program (version 3.1.3). A simplified HEC-RAS hydraulic model was created for each stream system. These models contain unsurveyed cross-sections with an average spacing of 1,000 to 2,000 feet apart.

The Manning’s “n” values for the approximate study streams were determined by calculating one composite value for the entire cross-section of the stream and multiple composite “n” values were calculated for different reaches of the stream based on whether the land use changed significantly. Separate “n” values were not determined for the channel and overbanks. The composite “n” values were obtained by the summation of basic “n” values obtained from Soil Conservation Service (Anonymous, 1963).

The basic “n” values (nb, n1, n3 and n4) for each stream were obtained using field photographs taken during field investigation of the approximate streams and orthophotography (MrSID of 1:10 compression ratio) obtained from the Stark County GIS Department. A composite “n” was arrived at by summing up the basic “n” values for each stream.

The Tributary to Middle Branch Nimishillen Creek in Plain Township flows into a storm sewer at Boettler Street for about 1 mile and comes back into an open channel about 250 feet downstream of Chesham Drive. Using storm sewer plans obtained from the Stark County Engineers Office, an estimated capacity of the storm sewer at Boettler Street was calculated.

The pipe capacity was subtracted from the flow calculated from regression equation to obtain an estimate of the flow that would overtop the road and continue overland. This reduced flow was then used to in the model between Boettler Street and Chesham Drive.

Osnaburg Ditch in Canton Township flows into a storm sewer at Noble street for about 1,300 feet and then outlets back into an open channel about 300 feet upstream of Werley Road.

Storm sewer information was obtained from the Village Engineer and an estimated capacity of the pipe at Noble Street was calculated. The capacity of the storm sewer exceeds the flow computed with the regression equations; therefore a hydraulic model is not needed in this area.

The methods of analysis and results of this study were reported in “Approximate Hydrologic and Hydraulics Report: Countywide DFIRM Production and Development of Updated Flood Data for Stark County, Ohio” which was prepared by Stantec on January 23, 2006.

In a September 2009, Stantec performed approximate hydraulic analyses on portions of Elm Run, Middle Fork Sugar Creek, Sugar Creek and the Tuscarawas River in Stark County, Ohio, in order to properly identify and map the area protected by PALs in Stark County. Stantec utilized the USACE’s HEC-RAS computer program (Version 4.0.0) to perform the analyses.

For these approximate study areas, a simplified HEC-RAS hydraulic model was created, containing the four study streams. These models contain unsurveyed cross-sections placed with an average spacing of approximately 1600 ft. Cross-section geometric data was extracted from DEMs created using 2-foot contour data obtained from Stark County in 2006.

Overbank Manning’s “n” values were estimated from a 2001 NLCD of Ohio prepared by United States Geological Survey (USGS). A field reconnaissance was not performed. Channel “n” values were assumed to be 0.035. The overbank “n” values were extracted to RAS directly from GIS using HEC-GeoRAS 4.1. **Table 11** shows the Overbank Manning’s “n” values used for each corresponding land cover. These values were taken from Chow (1959) and McCuen (1998).

The 1-percent-annual-chance flood discharges determined using the previously described hydrologic methods were used in the HEC-RAS models. Flow changes were entered at the upstream limit of each reach and at each sub-watershed location along the stream. Reach boundary conditions were selected in accordance with FEMA’s Guidelines and Specifications for Flood Hazard Mapping Partners (May 2005). The boundary conditions applied were either the known water surface elevation taken from existing detailed studies or the normal depth at the most downstream end of each stream.

For the approximate hydraulic analyses, three HEC-RAS runs were performed. The first run (WithLevees) models the existing stream conditions, with both the left and right levees in place. The resulting water surface will be mapped as Zone A on the DFIRM. The second run (NoLeftLevees) models the stream if the left levees are removed but the right levees remain. The resulting water surface will be mapped as shaded Zone X on the left (landward) side of the left levees. The third run (NoRightLevees) models the stream if the right levees are removed but the left levees remain. The resulting water surface will be mapped as shaded Zone X on the right (landward) side of the right levees.

Revised Countywide Analyses (February 16, 2012)

An updated interior drainage analysis for areas along the Brewster Levee performed by the USACE for an August 18, 2009, Levee System Report was incorporated into the February 16, 2012 revised countywide FIS (Reference 65).

Revised Countywide Analyses (To Be Determined)

For the new detailed study of Sandy Creek (Lower Reach), HEC-RAS was used to compute water surface elevations for the 10-, 4-, 2-, 1-, 0.2-percent-annual-chance flood events and the 1-percent-plus-annual-chance flood event. Cross section locations were leveraged from the HEC-RAS model created for the USACE Magnolia Levee certification report (Reference 26). Additional sections were added to address spacing issues and improve modeling. For the lower reach, cross sections were redrawn. Channel survey data was combined with the 2007 Ohio Statewide Imagery Program (OSIP) Digital Elevation Model (DEM) (Reference 4) to determine cross section elevations.

Structures were modeled using survey data, with the assumption that bridge openings would not be obstructed by debris. A low head dam located at the very upstream end of the study in Waynesburg was modeled as a weir.

Known water surface elevations at Bolivar Dam were used as downstream boundary conditions. When available, elevations were leveraged from the USACE HEC-RAS model. Elevations for the 4-percent-annual-chance, 1-percent-annual-chance plus, and the 0.2 percent-annual-chance profiles were obtained from Annual Exceedance Probability Curve for Bolivar Dam (Reference 26).

Manning's "n" values were selected from published values in Open-Channel Hydraulics (Reference 27) based on survey photos and orthophotography. Manning's "n" values for the channel range from 0.032 to 0.037. Manning's "n" values for the overbanks ranged from 0.03 to 0.1.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the NAVD88, many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between communities. Effective information for this FIS was converted from NGVD29 to NAVD88. An average conversion of -0.6 feet (NGVD29 - 0.6 = NAVD88) was applied uniformly across the county to convert all effective BFEs and other profile elevations.

For more information on NAVD88, see the FEMA publication entitled Converting the NFIP to the North American Vertical Datum of 1988 (FEMA, June 1992), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Silver Spring, Maryland 20910. (Internet address http://www.ngs.noaa.gov.)

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the TSDN associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 <u>FLOODPLAIN MANAGEMENT APPLICATIONS</u>

The NFIP encourages the State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance flood elevations and delineations of the 1- and 0.2-percent-annual-chance floodplain boundaries and 1-percent- annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data Tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 1- and 0.2-percent-chance-annual floodplain boundaries have been delineated using the flood elevations determined at each cross-section.

For each stream studied by detailed methods, the 1- and 0.2-percent-annual chance floodplain boundaries were delineated using 2-foot contours derived from digital base mapping information provided by the Stark County Auditor's Office. This data was acquired in February 2004. Further information about the base mapping is available by contacting the County. These files were compiled by photogrammetric methods and meet or exceed National Map Accuracy Standards. The projection used for the production of this FIRM is Ohio State Plane North (FIPSZONE 3401) referenced to the NAD83, GRS1980 spheroid. Differences in the datum, spheroid, projection or state plane zones used in the production of FIRMs in adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent-annual- chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. 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.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

4.2 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 this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. 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. Minimum standards of FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS and on the FIRMs were directly obtained from the Floodway Data tables of previous FIS reports. They were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross-sections. Between cross-sections, the floodway boundaries were interpolated. The results of the floodway computations were tabulated at selected cross-sections in **Table 12**. 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.

The area between the floodway and the 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water surface elevation of the 1-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in **Figure 2**.

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or used as a basis for additional studies.

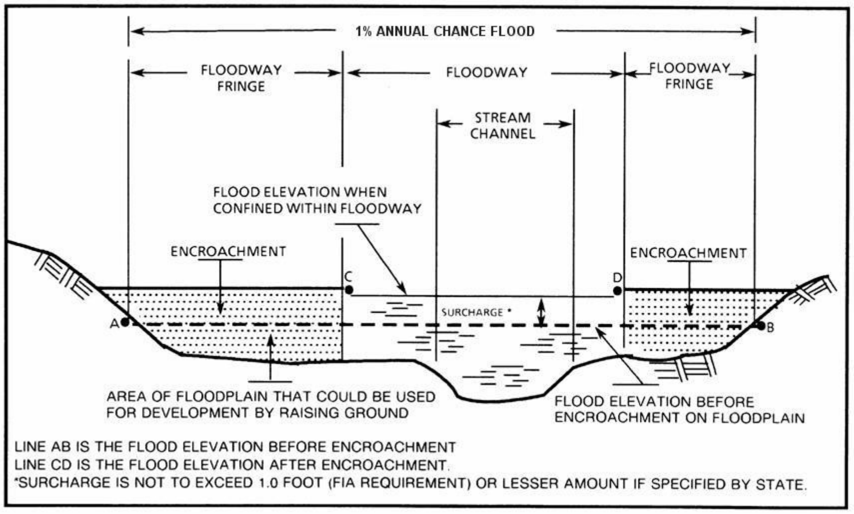


Figure 2. Floodway Schematic

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Beech Creek								
A	17,164	65	452	6.5	1053.2	1053.2	1053.4	0.2
B	19,224	70	474	5.9	1056.9	1056.9	1057.6	0.7
C	20,749	95	668	4.2	1061.8	1061.8	1061.8	0.0
D	21,429	90	488	5.7	1062.1	1062.1	1062.3	0.2
E	22,179	70	357	7.8	1064.0	1064.0	1064.7	0.7

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Beech Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Black Run								
A	12,992	95	334	5.2	1064.1	1064.1	1064.1	0.0
B	13,900	60	418	4.1	1068.9	1068.9	1068.9	0.0
C	14,850	59	274	6.3	1070.5	1070.5	1071.4	0.9
D	16,126	80	356	4.5	1076.0	1076.0	1076.0	0.0
E	17,126	65	290	5.6	1078.6	1078.6	1079.6	1.0
F	18,015	65	332	4.9	1081.8	1081.8	1082.5	0.7

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Black Run

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Broad-Monter Creek								
A	1,808	70	904	0.9	1109.5	1109.5	1109.5	0.0
B	2,972	96	675	1.2	1109.5	1109.5	1109.5	0.0
C	3,030	160	512	1.6	1109.6	1109.6	1109.6	0.0
D	3,421	55	302	2.4	1109.6	1109.6	1109.6	0.0
E	3,510	51	230	3.1	1110.1	1110.1	1110.1	0.0
F	4,138	75	113	6.4	1114.1	1114.1	1114.3	0.2
G	4,152	48	96	7.5	1114.7	1114.7	1114.8	0.1
H	4,248	22	90	8.0	1115.0	1115.0	1115.0	0.0
I	4,260	120	288	2.5	1117.1	1117.1	1117.2	0.1
J	5,618	8	474	10.6	1128.8	1128.8	1128.8	0.0
K	5,838	125	389	1.9	1130.7	1130.7	1130.7	0.0
L	5,846	151	452	1.6	1130.8	1130.8	1130.8	0.0
M	6,250	190	846	0.9	1136.3	1136.3	1136.6	0.3
N	6,290	84	435	1.7	1136.4	1136.4	1136.7	0.3
O	7,780	10	57	7.8	1138.5	1138.5	1138.9	0.4
P	7,930	17	69	6.4	1139.0	1139.0	1139.3	0.3
Q	9,891	100	84	5.3	1151.3	1151.3	1151.4	0.1
R	9,950	45	169	2.6	1151.6	1151.6	1151.8	0.2
S	10,470	38	172	2.6	1155.5	1155.5	1156.0	0.5
T	10,517	50	202	2.2	1156.7	1156.7	1156.9	0.2

[1] Stream distance in feet above confluence with East Branch Nimishillen Creek

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Broad-Monter Creek

Table 12

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Chatham Ditch								
A	75	17	101	4.1	1089.8	1085.9 [2]	1086.9	1.0
B	765	35	150	2.7	1089.8	1088.2 [2]	1089.0	0.8
C	1,565	32	82	5.1	1092.0	1092.0	1092.0	0.0
D	2,333	26	128	3.2	1099.8	1099.8	1099.9	0.1
E	2,733	22	84	4.9	1099.9	1099.9	1100.7	0.8

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effects from West Branch Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Chatham Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Clays Ditch								
A	35	24	74	3.2	1031.5	1024.8 [2]	1024.8	0.0
B	786	22	66	3.6	1031.5	1026.1 [2]	1026.2	0.1
C	917	25	105	2.2	1031.5	1027.4 [2]	1027.5	0.1
D	1,444	20	86	2.7	1031.5	1028.6 [2]	1028.9	0.3
E	1,632	21	115	2.0	1031.5	1029.9 [2]	1030.0	0.1
F	2,847	21	76	2.5	1031.5	1031.2 [2]	1031.4	0.2
G	3,253	18	67	2.8	1032.6	1032.6	1032.7	0.1
H	3,423	22	58	3.3	1033.1	1033.1	1033.2	0.1
I	3,569	22	91	2.1	1034.4	1034.4	1034.5	0.1
J	4,224	19	85	2.2	1035.4	1035.4	1035.6	0.2
K	4,839	16	83	2.3	1036.2	1036.2	1036.5	0.3
L	5,135	29	165	1.2	1038.0	1038.0	1038.3	0.3
M	5,265	25	166	1.1	1039.2	1039.2	1039.5	0.3
N	5,609	21	142	1.3	1039.3	1039.3	1039.6	0.3
O	5,783	19	123	1.5	1039.3	1039.3	1039.7	0.4

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effects from Johney Ditch

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Clays Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
East Branch Nimishillen Creek								
A	64,670	95	804	6.2	1011.0	1011.0	1011.2	0.2
B	66,031	112	953	5.2	1014.4	1014.4	1014.7	0.3
C	67,409	92	917	5.4	1018.1	1018.1	1018.3	0.2
D	68,701	109	955	5.2	1019.7	1019.7	1020.1	0.4
E	69,964	125	1,056	4.7	1020.7	1020.7	1021.2	0.5
F	70,936	88	764	6.5	1022.2	1022.2	1022.8	0.6
G	72,751	94	742	6.7	1025.9	1025.9	1026.3	0.4
H	73,598	88	759	6.5	1028.1	1028.1	1028.6	0.5
I	74,673	81	658	7.5	1030.6	1030.6	1030.9	0.3
J	75,653	83	761	6.4	1034.0	1034.0	1034.1	0.1
K	76,733	116	1,033	4.7	1037.6	1037.6	1037.9	0.3
L	78,401	598	3,468	1.4	1039.9	1039.9	1040.6	0.7
M	80,316	400	2,305	1.6	1040.6	1040.6	1041.6	1.0
N	81,837	132	923	4.1	1045.0	1045.0	1045.7	0.7
O	83,337	63	652	5.8	1047.1	1047.1	1048.1	1.0
P	84,035	115	1,093	3.5	1049.3	1049.3	1049.8	0.5
Q	85,273	129	996	3.8	1053.4	1053.4	1053.9	0.5
R	86,533	85	830	4.6	1055.0	1055.0	1055.5	0.5
S	88,133	71	715	5.3	1057.1	1057.1	1058.0	0.9
T	89,687	73	697	5.2	1059.5	1059.5	1060.5	1.0
U	90,957	300	925	3.9	1063.4	1063.4	1064.4	1.0
V	92,577	297	1,595	2.3	1068.0	1068.0	1069.0	1.0
W	94,227	312	1,638	2.0	1070.8	1070.8	1071.8	1.0
X	95,927	57	678	4.6	1075.3	1075.3	1076.3	1.0

[1] Stream distance in feet above mouth of Nimishillen Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
East Branch Nimishillen Creek (continued)								
Y	98,477	149	1,262	2.5	1078.9	1078.9	1079.9	1.0
Z	100,777	322	1,867	1.6	1080.8	1080.8	1081.8	1.0
AA	101,843	300	1,277	2.3	1081.5	1081.5	1082.3	0.8
AB	102,043	250	1,251	2.4	1082.3	1082.3	1082.8	0.5
AC	103,198	250	1,030	2.9	1083.1	1083.1	1083.9	0.8
AD	104,893	280	783	3.0	1085.0	1085.0	1085.7	0.7
AE	106,805	330	1,034	2.3	1086.8	1086.8	1087.8	1.0
AF	108,694	350	1,115	2.1	1089.3	1089.3	1089.9	0.6
AG	110,711	350	826	2.7	1092.0	1092.0	1092.5	0.5
AH	112,200	170	611	3.6	1093.9	1093.9	1094.7	0.8
AI	113,410	140	413	5.3	1096.6	1096.6	1097.0	0.4
AJ	113,699	120	453	4.9	1098.4	1098.4	1098.4	0.0
AK	113,917	130	666	3.3	1099.1	1099.1	1099.3	0.2
AL	114,815	60	424	5.2	1100.4	1100.4	1100.9	0.5
AM	114,975	80	688	3.2	1100.8	1100.8	1101.5	0.7
AN	115,209	125	820	2.7	1102.0	1102.0	1102.7	0.7
AO	117,400	114	487	3.8	1103.5	1103.5	1104.5	1.0
AP	117,672	110	560	3.3	1104.3	1104.3	1105.1	0.8
AQ	119,038	110	616	3.0	1105.4	1105.4	1106.3	0.9
AR	120,253	110	426	3.2	1107.4	1107.4	1107.9	0.5
AS	121,370	50	328	4.1	1108.9	1108.9	1109.7	0.8
AT	124,490	142	518	2.4	1115.1	1115.1	1116.1	1.0
AU	126,410	90	387	2.2	1119.0	1119.0	1120.0	1.0

[1] Stream distance in feet above mouth of Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

East Branch Nimishillen Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
East Sippo Creek								
A	3,334	24	142	13.9	948.2	948.2	948.2	0.0
B	3,724	46	300	6.6	958.7	958.7	959.1	0.4
C	4,174	45	288	6.9	960.4	960.4	961.3	0.9
D	4,854	59	276	7.2	966.5	966.5	967.4	0.9
E	5,604	40	288	6.9	971.4	971.4	972.3	0.9

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

East Sippo Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Fairhope Ditch								
A	490	50	505	1.7	1074.2	1074.2	1075.2	1.0
B	2,670	61	429	1.8	1079.6	1079.6	1080.6	1.0
C	3,870	124	476	1.7	1082.4	1082.4	1083.4	1.0
D	6,020	37	188	4.0	1087.8	1087.8	1088.8	1.0
E	9,570	235	584	1.2	1094.6	1094.6	1095.6	1.0
F	10,640	96	495	1.4	1100.5	1100.5	1101.5	1.0
G	11,870	16	115	5.5	1101.7	1101.7	1102.7	1.0
H	14,060	20	96	5.5	1108.0	1108.0	1109.0	1.0

[1] Stream distance in feet above mouth

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Fairhope Ditch

Table 12

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Firestone Ditch								
A	450	32	113	6.7	1077.9	1075.8 [2]	1075.8	0.0
B	1,558	24	81	9.3	1080.8	1080.8	1080.8	0.0
C	3,064	29	140	5.3	1088.7	1088.7	1088.7	0.0
D	4,194	33	160	4.7	1092.0	1092.0	1092.1	0.1
E	5,749	33	136	5.2	1095.6	1095.6	1095.6	0.0
F	6,909	35	133	5.3	1098.5	1098.5	1098.5	0.0

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from Middle Branch Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Firestone Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Hayden Ditch								
A	400	41	161	5.2	1050.1	1050.1	1050.8	0.7
B	680	29	193	4.4	1055.6	1055.6	1055.6	0.0
C	1,730	62	332	2.5	1056.1	1056.1	1056.8	0.7
D	2,580	192	786	1.1	1056.7	1056.7	1057.6	0.9

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Hayden Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Indian Run								
A	250	136	381	3.6	961.7	959.9 [2]	960.9	1.0
B	870	73	285	4.8	961.7	961.7 [2]	962.5	0.8
C	1,870	70	351	3.9	964.3	964.3	965.3	1.0
D	2,848	47	228	6.0	968.1	968.1	969.0	0.9

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from Sandy Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Indian Run

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Johney Ditch								
A	24,962	750	5,801	0.2	1030.9	1030.9	1031.6	0.7
B	26,952	50	263	4.2	1034.0	1034.0	1034.7	0.7
C	27,578	100	709	1.6	1039.1	1039.1	1040.0	0.9
D	29,313	59	304	3.6	1039.8	1039.8	1040.7	0.9

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Johney Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Little Sandy Creek								
A	1,550	159	1,065	3.3	965.6	963.8 [2]	964.8	1.0

[1] Stream distance in feet above mouth [2] Elevation without considering overflow from Sandy Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Little Sandy Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Mahoning River								
A	232	500	2,928	2.9	1031.8	1031.8	1032.8	1.0
B	1,537	240	1,362	6.2	1033.1	1033.1	1033.9	0.8
C	1,793	160	1,383	6.1	1034.1	1034.1	1034.7	0.6
D	3,108	160	1,629	5.1	1035.9	1035.9	1036.5	0.6
E	4,116	120	1,100	7.6	1036.5	1036.5	1037.5	1.0
F	4,554	150	1,828	4.6	1039.9	1039.9	1040.8	0.9
G	5,059	120	1,473	5.7	1040.9	1040.9	1041.9	1.0
H	5,623	160	1,966	4.3	1041.7	1041.7	1042.5	0.8
I	6,436	170	1,444	5.8	1042.7	1042.7	1042.9	0.2
J	6,730	150	1,943	4.3	1043.1	1043.1	1043.5	0.4
K	7,486	130	1,436	5.8	1043.3	1043.3	1043.8	0.5
L	7,698	110	1,370	6.1	1043.9	1043.9	1044.3	0.4
M	8,113	125	1,622	5.2	1044.7	1044.7	1045.0	0.3
N	9,108	250	2,713	3.1	1045.4	1045.4	1045.8	0.4
O	10,188	250	2,526	3.3	1045.7	1045.7	1046.2	0.5
P	11,599	250	2,570	3.3	1046.1	1046.1	1046.8	0.7
Q	12,136	250	2,448	3.4	1046.3	1046.3	1047.1	0.8

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Mahoning River

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Mahoning River Tributary No. 1								
A	4,262	55	459	2.3	1061.3	1061.3	1062.3	1.0
B	4,762	42	215	5.0	1062.1	1062.1	1062.9	0.8
C	5,514	86	492	2.2	1069.1	1069.1	1069.8	0.7
D	5,864	28	102	4.9	1069.2	1069.2	1070.1	0.9
E	7,331	35	266	1.9	1087.3	1087.3	1088.1	0.8
F	7,743	45	327	1.5	1091.8	1091.8	1092.4	0.6
G	8,503	29	103	4.9	1092.1	1092.1	1093.1	1.0

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Mahoning River Tributary No. 1

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
McDowell Ditch								
A	206	240	722	3.3	1043.1	1043.1	1043.4	0.3
B	647	145	458	5.2	1043.5	1043.5	1043.7	0.2
C	800	250	1,260	1.9	1045.1	1045.1	1045.9	0.8
D	1,485	300	1,799	1.3	1045.3	1045.3	1046.0	0.7
E	1,629	300	1,700	1.4	1045.3	1045.3	1046.1	0.8
F	2,320	300	1,432	1.6	1045.4	1045.4	1046.2	0.8
G	2,546	300	1,671	1.4	1045.8	1045.8	1046.7	0.9
H	3,917	300	1,312	1.4	1046.1	1046.1	1047.0	0.9
I	4,066	300	1,258	1.5	1046.2	1046.2	1047.1	0.9
J	4,876	57	329	4.4	1046.5	1046.5	1047.4	0.9
K	5,344	70	337	4.3	1047.5	1047.5	1048.0	0.5
L	6,185	50	279	5.2	1049.1	1049.1	1049.3	0.2
M	6,630	45	430	3.5	1054.2	1054.2	1054.2	0.0
N	6,897	60	515	2.9	1054.3	1054.3	1054.3	0.0
O	7,042	130	820	2.2	1054.6	1054.6	1054.7	0.1
P	8,373	45	385	4.8	1054.9	1054.9	1055.0	0.1
Q	9,541	43	376	4.9	1056.3	1056.3	1056.5	0.2
R	10,060	70	760	2.4	1061.0	1061.0	1061.9	0.9
S	11,120	70	699	2.6	1061.4	1061.4	1062.2	0.8
T	11,815	70	722	2.5	1061.5	1061.5	1062.4	0.9

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

McDowell Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Metzger Ditch								
A	1,136	150	220	1.4	1106.9	1106.9	1107.0	0.1
B	1,241	80	268	1.1	1107.3	1107.3	1108.0	0.7
C	1,799	50	151	2.0	1108.2	1108.2	1108.6	0.4
D	2,332	40	154	2.0	1108.6	1108.6	1109.1	0.5
E	2,434	40	176	1.7	1108.9	1108.9	1109.7	0.8
F	3,449	37	172	1.8	1109.5	1109.5	1110.3	0.8
G	4,848	30	136	2.3	1110.8	1110.8	1111.5	0.7
H	6,013	26	110	2.8	1112.7	1112.7	1113.0	0.3
I	6,174	30	192	1.6	1115.1	1115.1	1115.4	0.3
J	6,969	25	171	1.4	1115.3	1115.3	1115.6	0.3
K	7,790	25	113	2.2	1115.5	1115.5	1115.9	0.4
L	8,028	23	147	1.6	1117.4	1117.4	1117.7	0.3
M	9,107	25	312	0.8	1123.8	1123.8	1124.1	0.3
N	10,523	26	247	1.0	1123.8	1123.8	1124.2	0.4
O	11,593	21	169	1.4	1123.9	1123.9	1124.3	0.4
P	12,865	24	182	1.0	1123.9	1123.9	1124.4	0.5
Q	13,906	24	168	1.1	1123.9	1123.9	1124.5	0.6
R	15,202	19	133	1.4	1123.9	1123.9	1124.7	0.8

[1] Stream distance in feet above mouth

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Metzger Ditch

Table 12

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Middle Branch Nimishillen Creek								
A	664	96	636	3.4	1040.4	1040.2 [2]	1041.2	1.0
B	1,740	99	603	3.6	1041.5	1041.5	1042.4	0.9
C	2,726	86	542	4.0	1043.0	1043.0	1043.9	0.9
D	4,525	62	538	4.1	1046.1	1046.1	1046.8	0.7
E	5,952	150	938	2.3	1047.0	1047.0	1047.9	0.9
F	8,604	175	962	2.3	1048.4	1048.4	1049.3	0.9
G	9,457	195	958	2.3	1049.4	1049.4	1050.1	0.7
H	11,727	240	1,275	1.7	1050.2	1050.2	1051.0	0.8
I	13,886	85	644	3.2	1053.4	1053.4	1053.9	0.5
J	15,631	200	1,128	1.8	1055.0	1055.0	1055.8	0.8
K	17,575	282	1,184	1.7	1057.9	1057.9	1058.7	0.8
L	19,622	100	444	4.5	1060.8	1060.8	1061.1	0.3
M	21,837	150	1,783	1.1	1063.0	1063.0	1063.7	0.7
N	25,694	65	495	4.0	1065.7	1065.7	1066.0	0.3
O	28,443	74	442	4.3	1068.9	1068.9	1069.0	0.1
P	31,418	76	478	3.6	1073.1	1073.1	1073.1	0.0
Q	33,133	87	584	3.0	1075.1	1075.1	1075.1	0.0
R	34,940	87	534	3.2	1076.9	1076.9	1076.9	0.0
S	36,495	161	1,177	1.5	1077.9	1077.9	1077.9	0.0
T	38,097	59	466	3.6	1078.7	1078.7	1079.7	1.0
U	41,030	221	608	2.7	1086.9	1086.9	1087.9	1.0
V	42,460	77	347	4.8	1090.9	1090.9	1091.9	1.0
W	45,175	125	618	2.7	1095.9	1095.9	1096.9	1.0

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from East Branch Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Middle Branch Nimishillen Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Middle Branch Nimishillen Creek (continued)								
X	47,990	83	337	4.9	1100.3	1100.3	1101.3	1.0
Y	49,590	88	498	3.2	1102.0	1102.0	1103.0	1.0

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Middle Branch Nimishillen Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Middle Branch Nimishillen Creek Tributary No. 1								
A	980	85	226	3.8	1053.5	1052.3 [2]	1053.1	0.8
B	2,290	130	435	2.0	1056.5	1056.5	1057.5	1.0
C	3,540	50	166	5.2	1058.9	1058.9	1059.7	0.8

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from Middle Branch Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Middle Branch Nimishillen Creek Tributary No. 1

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Middle Tributary								
A	81	17	38	5.6	1108.1	1108.1	1108.2	0.1
B	514	14	33	6.5	1112.3	1112.3	1112.3	0.0
C	858	16	49	4.3	1115.3	1115.3	1115.8	0.5
D	950	16	43	5.0	1116.3	1116.3	1116.4	0.1
E	1,401	18	41	5.2	1121.0	1121.0	1121.1	0.1
F	1,628	15	32	6.7	1124.2	1124.2	1124.2	0.0
G	1,778	65	586	0.4	1134.3	1134.3	1134.3	0.0
H	2,165	68	233	0.9	1134.3	1134.3	1134.3	0.0
I	2,617	55	206	1.0	1138.6	1138.6	1138.6	0.0
J	3,015	24	60	3.6	1138.7	1138.7	1138.8	0.1
K	3,610	20	56	3.8	1143.9	1143.9	1143.9	0.0
L	4,086	21	50	4.2	1147.9	1147.9	1147.9	0.0

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Middle Tributary

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Nimishillen Creek								
A	43,348	140	1,612	5.1	983.2	983.2	983.8	0.6
B	44,798	175	1,790	4.6	985.9	985.9	986.6	0.7
C	46,198	109	1,285	6.4	987.1	987.1	988.0	0.9
D	47,758	145	1,847	4.5	990.2	990.2	991.0	0.8
E	49,578	300	2,502	3.3	992.4	992.4	993.2	0.8
F	51,671	143	1,356	6.1	994.7	994.7	995.7	1.0
G	53,291	250	2,352	3.5	997.1	997.1	997.9	0.8
H	55,231	250	2,554	3.2	998.9	998.9	999.8	0.9
I	56,911	350	2,604	3.2	1000.0	1000.0	1000.8	0.8
J	58,511	598	3,102	2.7	1001.4	1001.4	1002.1	0.7
K	59,483	284	2,038	4.1	1003.0	1003.0	1004.0	1.0
L	60,933	300	2,009	3.5	1004.2	1004.2	1005.0	0.8
M	62,501	170	1,417	4.6	1006.4	1006.4	1007.2	0.8

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Nimishillen Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
North Chapel Creek								
A	17	70	292	2.6	1103.0	1101.0 [2]	1102.0	1.0
B	234	54	241	3.1	1103.0	1101.8 [2]	1102.6	0.8
C	862	30	117	5.2	1103.0	1102.9 [2]	1103.3	0.4
D	950	50	187	3.3	1104.0	1104.0	1104.2	0.2
E	1,345	35	147	4.2	1104.7	1104.7	1104.9	0.2
F	1,564	32	169	3.6	1105.0	1105.0	1105.2	0.2
G	1,834	26	96	6.4	1105.5	1105.5	1105.8	0.3
H	2,336	27	106	4.8	1109.1	1109.1	1109.4	0.3
I	2,525	27	89	5.7	1109.4	1109.4	1110.1	0.7
J	3,430	25	109	4.6	1114.4	1114.4	1115.0	0.6
K	3,616	25	91	5.6	1116.0	1116.0	1116.1	0.1
L	4,238	27	96	5.3	1119.5	1119.5	1119.6	0.1
M	4,369	34	157	3.2	1120.1	1120.1	1120.2	0.1
N	5,218	36	113	4.5	1124.2	1124.2	1124.9	0.7
O	5,826	26	99	5.1	1128.3	1128.3	1129.0	0.7
P	6,583	26	113	4.5	1132.8	1132.8	1133.7	0.9
Q	7,131	26	115	4.4	1137.1	1137.1	1137.9	0.8
R	7,950	50	121	4.2	1141.9	1141.9	1142.4	0.5
S	8,514	41	167	3.0	1144.4	1144.4	1144.8	0.4

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from East Branch Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

North Chapel Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Plum Creek								
A	229	388	2,112	0.2	946.0	945.1 [2]	945.2	0.1
B	661	75	480	1.0	946.0	945.1 [2]	945.2	0.1
C	792	210	1,993	0.2	946.2	946.2	947.2	1.0
D	2,323	174	752	0.9	946.3	946.3	947.3	1.0
E	4,001	740	2,659	0.3	946.4	946.4	947.4	1.0
F	5,293	773	600	1.7	947.6	947.6	948.6	1.0
G	5,378	981	1,126	0.9	948.1	948.1	948.9	0.8
H	5,621	301	833	1.1	948.5	948.5	949.4	0.9
I	6,384	210	690	1.5	949.2	949.2	950.2	1.0
J	6,703	190	641	1.6	949.6	949.6	950.6	1.0
K	7,250	276	746	1.3	950.7	950.7	951.7	1.0
L	8,785	93	219	4.4	954.2	954.2	955.2	1.0
M	8,915	360	2,148	0.4	957.9	957.9	958.9	1.0
N	10,397	90	277	3.4	960.5	960.5	961.5	1.0
O	11,006	182	466	1.7	961.7	961.7	962.7	1.0
P	11,165	170	512	1.5	962.8	962.8	963.8	1.0
Q	11,341	68	259	3.0	962.9	962.9	963.9	1.0
R	14,129	27	122	5.7	969.4	969.4	970.4	1.0
S	15,752	75	157	75.3	974.8	974.8	975.7	0.9
T	18,249	20	64	3.8	986.4	986.4	987.4	1.0
U	19,497	9	35	7.0	995.4	995.4	996.4	1.0
V	21,515	11	33	3.8	1007.9	1007.9	1008.8	0.9
W	22,044	9	28	4.5	1010.2	1010.2	1011.1	0.8
X	22,132	9	18	7.1	1011.4	1011.4	1011.7	0.3

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from Tuscarawas River

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Plum Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Reemsnyder Ditch								
A	366	41	161	2.6	1047.8	1047.8	1048.8	1.0
B	654	30	232	1.8	1050.7	1050.7	1051.1	0.4
C	1,944	40	363	1.2	1050.7	1050.7	1051.5	0.8
D	3,152	60	201	1.9	1050.7	1050.7	1051.7	1.0
E	3,787	25	115	3.3	1055.2	1055.2	1055.9	0.7
F	4,522	23	121	3.1	1058.0	1058.0	1058.8	0.8

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Reemsnyder Ditch

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Sandy Creek (Lower Reach)								
B	10,900	1,764/2,467[2]	118,248	0.2	951.8	951.8	952.8	1.0
C	14,193	2,545	114,404	0.2	951.8	951.8	952.8	1.0
D	16,517	2,456	108,218	0.2	951.8	951.8	952.8	1.0
E	21,138	1,199/1,717[2]	70,544	0.3	951.8	951.8	952.8	1.0
S	78,056	623/753[2]	6,540	1.8	953.9	953.9	954.7	0.8
T	79,995	630/733[2]	5,616	2.1	954.2	954.2	955.2	1.0
U	83,838	934	5,332	2.2	956.0	956.0	956.6	0.6
V	85,954	1,048	5,497	2.1	957.1	957.1	957.8	0.7
W	88,502	856	4,816	2.3	959.0	959.0	960.0	1.0
X	88,671	373	2,644	4.2	959.2	959.2	960.2	1.0
Y	88,731	472	2,234	5.0	959.7	959.7	960.7	1.0
Z	89,731	645	3,906	2.8	961.2	961.2	962.1	0.9
AA	90,731	513	3,647	3.0	962.1	962.1	963.0	0.9
AB	91,781	458	2,721	3.9	962.9	962.9	963.7	0.8
AC	92,781	984	5,839	1.8	963.6	963.6	964.5	0.9
AD	93,925	820	4,450	2.4	964.4	964.4	965.4	1.0
AE	94,925	1,200	6,167	1.6	965.2	965.2	966.1	0.9
AF	96,925	922	6,630	1.5	966.0	966.0	966.9	0.9

[1] Feet above confluence with Tuscarawas River [2]Width Within Stark County/Total Width

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

Sandy Creek (Lower Reach)

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Sandy Creek (Upper Reach)								
I	143,540	103/134[2]	1,211	5.4	1031.6	1031.6	1032.4	0.8
J	146,060	265	2,610	2.5	1033.5	1033.5	1034.5	1.0
K	148,082	71/350[2]	2,449	1.6	1034.6	1034.6	1035.6	1.0
L	149,292	68	550	6.9	1036.7	1036.7	1037.5	0.8
M	150,075	75	591	6.4	1039.7	1039.7	1040.4	0.7
N	152,044	77	435	8.8	142.5	1042.5	1043.1	0.6
O	153,225	100	885	4.3	1047.2	1047.2	1047.5	0.3
P	153,778	115	875	4.4	1048.0	1048.0	1048.4	0.4
Q	154,226	67	585	6.5	1048.5	1048.5	1048.9	0.4
R	154,932	85	582	6.6	1049.4	1049.4	1050.1	0.7
S	156,087	50	282	13.5	1052.7	1052.7	1052.7	0.0
T	156,582	106	704	5.1	1056.3	1056.3	1057.2	0.9
U	157,852	70	494	6.9	1058.5	1058.5	1059.4	0.9
V	159,636	101	770	4.5	1061.8	1061.8	1062.3	0.5

[1] Feet above confluence with Tuscarawas River [2]Width Within Village of Minerva/Total Width

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

Sandy Creek (Upper Reach)

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Sherrick Run								
A	579	55	336	4.5	1004.1	1004.1	1004.1	0.0
B	1,559	43	172	8.8	1005.2	1005.2	1005.8	0.6
C	2,102	78	390	3.9	1011.6	1011.6	1011.6	0.0
D	2,982	44	198	7.7	1013.9	1013.9	1014.7	0.8
E	4,731	55	481	3.2	1028.9	1028.9	1028.9	0.0
F	6,681	121	580	2.6	1029.7	1029.7	1029.7	0.0
G	8,605	43	240	6.3	1032.7	1032.7	1033.4	0.7
H	9,807	99	572	2.7	1035.4	1035.4	1036.4	1.0
I	11,091	103	677	2.2	1041.5	1041.5	1041.7	0.2
J	12,466	74	390	3.8	1045.8	1045.8	1045.8	0.0
K	13,597	68	416	3.2	1046.9	1046.9	1047.8	0.9
L	16,032	114	602	2.2	1049.7	1049.7	1050.5	0.8
M	17,682	66	247	4.1	1053.1	1053.1	1054.1	1.0

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Sherrick Run

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Sippo Creek								
A	13,033	80	706	3.2	1016.7	1016.7	1017.5	0.8
B	14,881	95	662	3.4	1017.5	1017.5	1018.5	1.0
C	16,417	150	1,152	2.0	1020.0	1020.0	1020.8	0.8
D	18,033	200	1,602	1.3	1023.6	1023.6	1024.5	0.9
E	19,947	125	1,016	2.1	1026.8	1026.8	1027.7	0.9
F	22,229	150	1,206	1.6	1028.7	1028.7	1029.4	0.7
G	23,708	425	3,091	0.6	1030.3	1030.3	1030.8	0.5

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Sippo Creek

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Tuscarawas River								
A	437,740	342	2,988	3.0	919.3	919.3	920.3	1.0
B	440,225	190	3,865	2.3	920.4	920.4	921.4	1.0
C	442,780	210	2,620	3.4	921.5	921.5	922.4	0.9
D	444,066	200	2,519	3.5	923.0	923.0	923.6	0.6
E	444,961	250	3,670	2.4	923.3	923.3	924.0	0.7
F	508,944	158	2,140	3.7	938.3	938.3	939.3	1.0
G	515,169	204	2,444	3.2	940.1	940.1	941.1	1.0
H	520,569	420	4,205	1.8	941.4	941.4	942.4	1.0
I	524,239	309	3,391	2.2	942.1	942.1	943.1	1.0
J	528,459	282	3,206	2.3	942.6	942.6	943.6	1.0
K	534,359	124	1,644	4.5	943.9	943.9	944.9	1.0
L	537,174	208	2,282	3.3	945.2	945.2	946.2	1.0
M	537,580	150	2,068	3.6	945.6	945.6	946.5	0.9
N	648,135	140	1,026	1.1	1114.0	1114.0	1114.9	0.9
O	650,090	113	517	2.0	1115.0	1115.0	1115.8	0.8
P	650,725	97	482	2.2	1117.4	1117.4	1117.8	0.4
Q	651,453	60	273	3.8	1118.1	1118.1	1119.0	0.9
R	652,828	29	193	5.4	1120.7	1120.7	1121.7	1.0
S	654,228	37	224	4.6	1124.0	1124.0	1124.4	0.4
T	654,988	35	206	5.0	1125.2	1125.2	1125.7	0.5

[1] Stream distance in feet above mouth

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Tuscarawas River

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE (FEET)
Unnamed Tributary to East Branch Nimishillen Creek								
A	23	95	393	3.4	1085.4	1084.4 [2]	1085.3	0.9
B	997	75	236	5.6	1086.5	1086.5	1087.5	1.0
C	1,158	58	333	4.0	1087.8	1087.8	1088.5	0.7
D	2,278	80	289	4.6	1088.7	1088.7	1089.7	1.0
E	3,240	120	402	3.3	1091.3	1091.3	1091.8	0.5
F	3,985	119	303	4.4	1092.7	1092.7	1093.1	0.4
G	4,734	120	331	4.0	1093.8	1093.8	1094.8	1.0
H	5,942	75	253	5.2	1097.4	1097.4	1098.0	0.6
I	6,135	75	322	4.1	1098.8	1098.8	1098.9	0.1
J	7,095	120	445	3.0	1100.4	1100.4	1101.0	0.6
K	8,374	150	413	2.8	1102.9	1102.9	1103.8	0.9
L	8,416	180	354	3.3	1103.0	1103.0	1103.9	0.9
M	9,727	40	231	5.1	1105.5	1105.5	1106.2	0.7

[1] Stream distance in feet above mouth [2] Elevation without considering backwater effect from East Branch Nimishillen Creek

Table 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

STARK COUNTY, OHIO
AND INCORPORATED AREAS

FLOODWAY DATA

Unnamed Tributary to
East Branch Nimishillen Creek