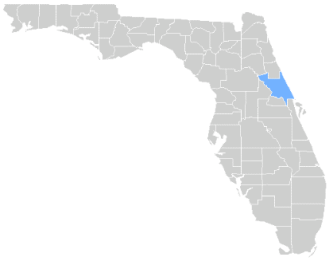
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 1



VOLUSIA COUNTY, FLORIDA

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
DAYTONA BEACH, CITY OF	125099	NEW SMYRNA BEACH, CITY OF	125132
DAYTONA BEACH SHORES, CITY OF	125100	OAK HILL, CITY OF	120624
DEBARY, CITY OF	120672	ORANGE CITY, CITY OF	120179
DELAND, CITY OF	120307	ORMOND BEACH, CITY OF	125136
DELTONA, CITY OF	120677	PIERSON, TOWN OF	120675
EDGEWATER, CITY OF	120308	PONCE INLET, TOWN OF	120312
FLAGLER BEACH, CITY OF	120087	PORT ORANGE, CITY OF	120313
HOLLY HILL, CITY OF	125112	SOUTH DAYTONA, CITY OF	120314
LAKE HELEN, CITY OF	120674	VOLUSIA COUNTY (UNINCORPORATED AREAS)	125155

REVISED:

FLOOD INSURANCE STUDY NUMBER
12127CV000D

Version Number 2.3.3.2

FEMA

PRELIMINARY
01/21/2016

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FLOOD INSURANCE STUDY REPORT
VOLUSIA COUNTY, FLORIDA

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

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

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

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

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

Participation in the NFIP is based on an agreement between local communities and the Federal Government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60.3, *Criteria for Land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as "Post-FIRM" buildings.

1.2 Purpose of this Flood Insurance Study Report

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

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

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Volusia County, Florida.

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

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

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Daytona Beach, City of	125099	03080103 03080201	12127C0193H 12127C0194J 12127C0213J 12127C0214J 12127C0218K 12127C0219J 12127C0350H 12127C0351H 12127C0352H 12127C0353H 12127C0354H 12127C0356J 12127C0357J 12127C0358H 12127C0359J 12127C0361H 12127C0362H 12127C0363H 12127C0364H 12127C0366H 12127C0367J 12127C0368H 12127C0378J 12127C0386J	
Daytona Beach Shores, City of	125100	03080201	12127C0378J 12127C0386J 12127C0388J 12127C0389J	
Debary, City of	120672	03080101	12127C0615J 12127C0620K 12127C0730H 12127C0735K	
Deland, City of	120307	03080101 03080103	12127C0460H 12127C0465H 12127C0470H 12127C0500H 12127C0610J 12127C0630K	

Table 1: Listing of NFIP Jurisdictions (continued)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Deltona, City of	120677	03080101	12127C0610J 12127C0620K 12127C0630K 12127C0635K 12127C0640K 12127C0645K 12127C0735K 12127C0755K 12127C0760K	
Edgewater, City of	120308	03080101 03080201 03080202	12127C0540J 12127C0543J 12127C0544J 12127C0675H 12127C0685J 12127C0700J 12127C0705J 12127C0715J	
Flagler Beach, City of	120087	03080201	12127C0061J	
Holly Hill, City of	125112	03080201	12127C0214J 12127C0218K 12127C0352H 12127C0356J 12127C0357J	
Lake Helen, City of	120674	03080101	12127C0500H 12127C0630K	
New Smyrna Beach, City of	125132	03080101 03080201 03080202	12127C0516H 12127C0517J 12127C0525H 12127C0528J 12127C0529J 12127C0533J 12127C0540J 12127C0541J 12127C0542J 12127C0543J 12127C0544J 12127C0563J 12127C0675H 12127C0685J 12127C0700J 12127C0705J	

Table 1: Listing of NFIP Jurisdictions (continued)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Oak Hill, City of	120624	03080202	12127C0715J 12127C0720J 12127C0830J 12127C0835J	
Orange City, City of	120179	03080101	12127C0605H 12127C0610J 12127C0615J 12127C0620K	
Ormond Beach, City of	125136	03080201	12127C0182J 12127C0184K 12127C0192J 12127C0193H 12127C0194J 12127C0200J 12127C0201J 12127C0202K 12127C0203K 12127C0204K 12127C0208K 12127C0211K 12127C0212K 12127C0213J 12127C0214J 12127C0216K 12127C0218K 12127C0219J 12127C0350H 12127C0351H 12127C0352H	
Port Orange, City of	120313	03080201	12127C0367J 12127C0368H 12127C0369J 12127C0386J 12127C0388J 12127C0389J 12127C0502J 12127C0506H 12127C0507J 12127C0508J 12127C0509J 12127C0516H 12127C0517J 12127C0526J 12127C0527J 12127C0528J	

Table 1: Listing of NFIP Jurisdictions (continued)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
South Daytona, City of	120314	03080201	12127C0367J 12127C0369J 12127C0378J 12127C0386J 12127C0388J	
Pierson, Town of	120675	03080101 03080103	12127C0150J 12127C0300H	
Ponce Inlet, Town of	120312	03080201 03080202	12127C0526J 12127C0527J 12127C0528J 12127C0529J 12127C0531J 12127C0533J	
Volusia County Unincorporated Areas	125155	03080101 03080103 03080201 03080202	12127C0025J 12127C0042J 12127C0044J 12127C0061J 12127C0062J 12127C0063J 12127C0064J 12127C0100H 12127C0125H 12127C0150J 12127C0175H 12127C0182J 12127C0184K 12127C0192J 12127C0193H 12127C0194J 12127C0200J 12127C0201J 12127C0202K 12127C0203K 12127C0204K 12127C0206K[1] 12127C0208K 12127C0211K 12127C0212K 12127C0213J 12127C0214J 12127C0216K 12127C0218K 12127C0219J 12127C0250H 12127C0275H	

[1] Panel Not Printed

Table 1: Listing of NFIP Jurisdictions (continued)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Volusia County Unincorporated Areas (continued)	125155	03080101 03080103 03080201 03080202	12127C0300H 12127C0325H 12127C0350H 12127C0351H 12127C0352H 12127C0356J 12127C0357J 12127C0359J 12127C0361H 12127C0362H 12127C0363H 12127C0364H 12127C0366H 12127C0367J 12127C0368H 12127C0369J 12127C0378J 12127C0386J 12127C0387K[1] 12127C0388J 12127C0389J 12127C0410H 12127C0430H 12127C0435H 12127C0440H 12127C0445H 12127C0455H 12127C0460H 12127C0465H 12127C0470H 12127C0500H 12127C0502J 12127C0504H 12127C0506H 12127C0508J 12127C0509J 12127C0516H 12127C0517J 12127C0525H 12127C0526J 12127C0527J 12127C0528J 12127C0529J 12127C0531J	

[1] Panel Not Printed

Table 1: Listing of NFIP Jurisdictions (continued)

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Volusia County Unincorporated Areas (continued)	125155	03080101 03080103 03080201 03080202	12127C0533J 12127C0534K 12127C0540J 12127C0541J 12127C0542J 12127C0543J 12127C0544J 12127C0563J 12127C0585H 12127C0605H 12127C0610J 12127C0615J 12127C0620K 12127C0630K 12127C0635K 12127C0640K 12127C0645K 12127C0675H 12127C0685J 12127C0700J 12127C0705J 12127C0715J 12127C0720J 12127C0730H 12127C0735K 12127C0755K 12127C0760K 12127C0765H 12127C0770H 12127C0780H 12127C0785H 12127C0790H 12127C0795H 12127C0825J 12127C0830J 12127C0835J 12127C0840J 12127C0845J 12127C0855J 12127C0865J 12127C0885H 12127C0895H 12127C0905H 12127C0915H 12127C0930H	

1.4 Considerations for using this Flood Insurance Study Report

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

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

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

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

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

  The initial Countywide FIS Report for Volusia County became effective on April 15, 2002. Refer to Table 28 for information about subsequent revisions to the FIRMs.

- Selected FIRM panels for the community may contain information (such as floodways and cross sections) that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels. In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (shaded)
C	X (unshaded)

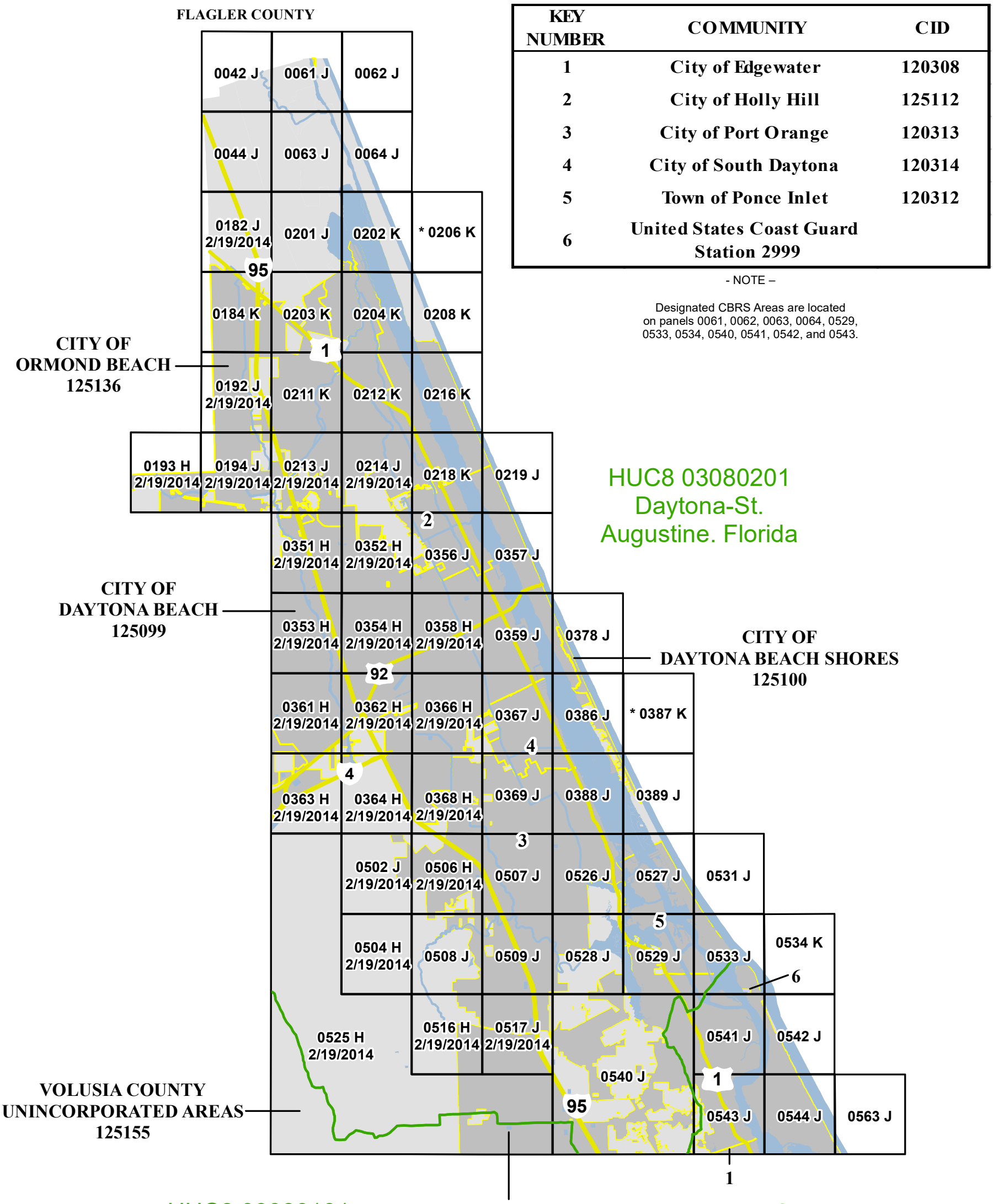
- FEMA does not impose floodplain management requirements or special insurance ratings based on Limit of Moderate Wave Action (LiMWA) delineations at this time. The LiMWA

represents the approximate landward limit of the 1.5-foot breaking wave. If the LiMWA is shown on the FIRM, it is being provided by FEMA as information only. For communities that do adopt Zone VE building standards in the area defined by the LiMWA, additional Community Rating System (CRS) credits are available. Refer to Section 2.5.4 for additional information about the LiMWA.

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

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

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Volusia County, and also displays the panel number and effective date for each FIRM panel in the county. Other information shown on the FIRM Index includes community boundaries, flooding sources, watershed boundaries, and United States Geological Survey (USGS) Hydrologic Unit Code – 8 (HUC-8) codes.



KEY NUMBER	COMMUNITY	CID
1	City of Edgewater	120308
2	City of Holly Hill	125112
3	City of Port Orange	120313
4	City of South Daytona	120314
5	Town of Ponce Inlet	120312
6	United States Coast Guard Station 2999	

- NOTE –

Designated CBRS Areas are located on panels 0061, 0062, 0063, 0064, 0529, 0533, 0534, 0540, 0541, 0542, and 0543.

N

1 inch = 15,000 feet 1:180,000

0 3,750 7,500 15,000 22,500 30,000 Feet

Map Projection:
State Plane Florida East; North American Datum 1983

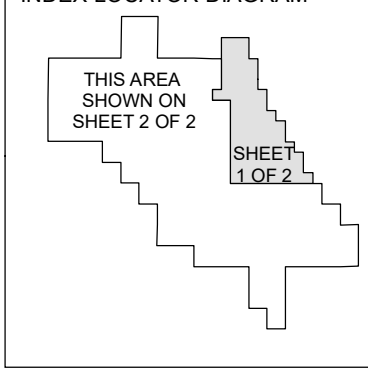
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

VOLUSIA COUNTY, FL
INDEX LOCATOR DIAGRAM



NATIONAL FLOOD INSURANCE PROGRAM

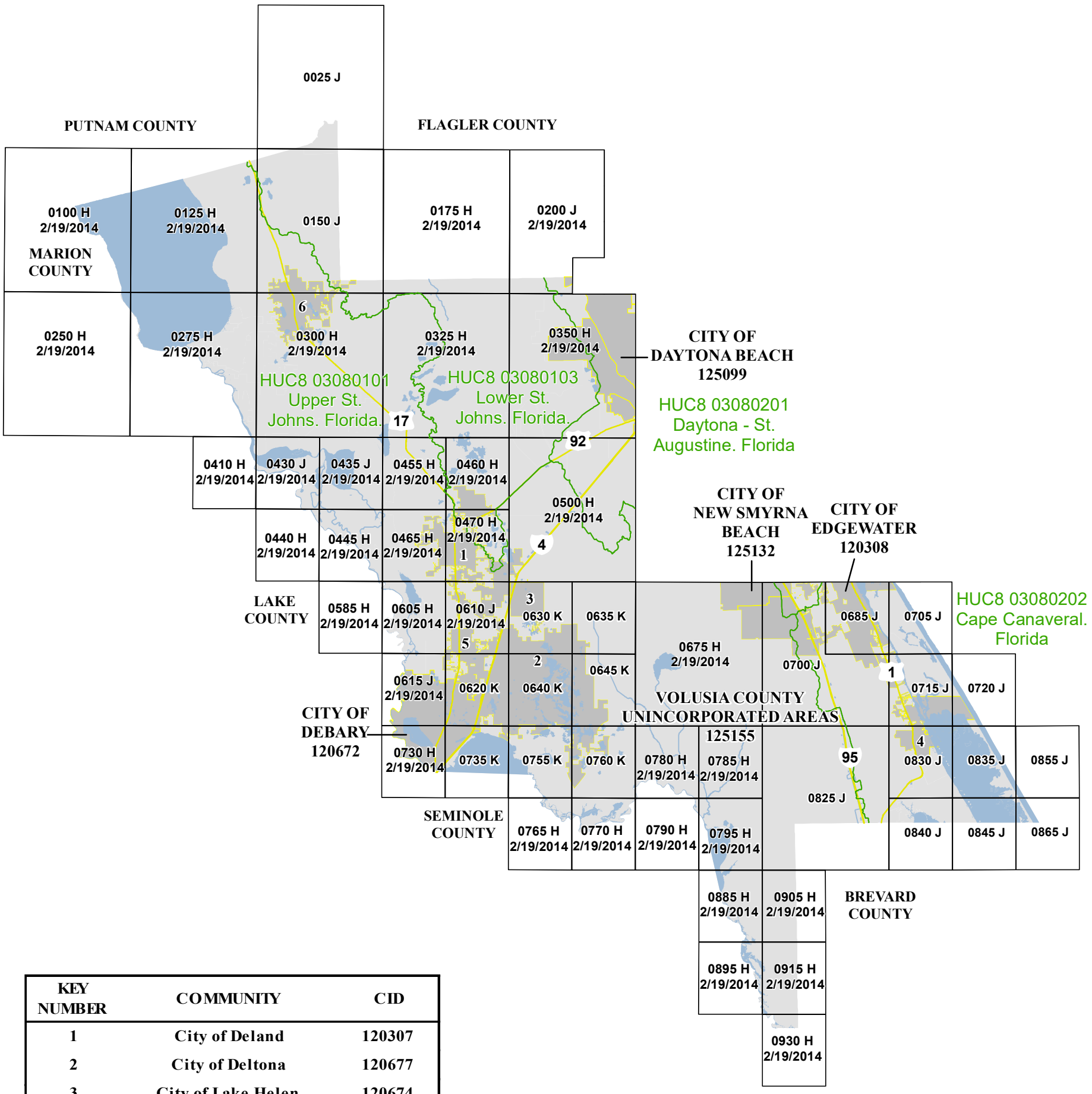
FLOOD INSURANCE RATE MAP INDEX

VOLUSIA COUNTY, FLORIDA and Incorporated Areas
SHEET 1 OF 2

PANELS PRINTED:
0042, 0044, 0061, 0062, 0063, 0064, 0182, 0184, 0192, 0193, 0194, 0201, 0202, 0203, 0204, 0208, 0211, 0212, 0213, 0214, 0216, 0218, 0219, 0351, 0352, 0353, 0354, 0356, 0357, 0358, 0359, 0361, 0362, 0363, 0365, 0366, 0367, 0368, 0369, 0378, 0386, 0388, 0389, 0502, 0504, 0506, 0507, 0508, 0509, 0516, 0517, 0525, 0526, 0527, 0528, 0529, 0531, 0533, 0534, 0540, 0541, 0542, 0543, 0544, 0563

FEMA

PRELIMINARY
MAP NUMBER
12127CIND1D



KEY NUMBER	COMMUNITY	CID
1	City of Deland	120307
2	City of Deltona	120677
3	City of Lake Helen	120674
4	City of Oak Hill	120624
5	City of Orange City	120179
6	Town of Pierson	120675

- NOTE –

Designated CBRS Areas are located on panels 0685, 0705, 0715, 0720, 0830, 0835, 0840, 0845, 0855, and 0865.

N

1 inch = 36,000 feet 1:432,000

Feet

0 18,000 36,000 72,000

Map Projection:
State Plane Florida East; North American Datum 1983

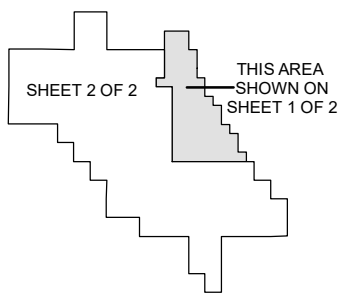
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

VOLUSIA COUNTY, FL
INDEX LOCATOR DIAGRAM



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

VOLUSIA COUNTY, FLORIDA and Incorporated Areas
SHEET 2 OF 2

PANELS PRINTED:
0025, 0100, 0125, 0150, 0175, 0200, 0250, 0275, 0300, 0325, 0350, 0410, 0430, 0435, 0440, 0455, 0460, 0465, 0470, 0500, 0585, 0605, 0610, 0615, 0620, 0630, 0635, 0640, 0645, 0675, 0685, 0700, 0705, 0715, 0720, 0730, 0735, 0755, 0760, 0765, 0770, 0780, 0785, 0790, 0795, 0825, 0830, 0835, 0840, 0845, 0855, 0865, 0885, 0895, 0905, 0915, 0930

FEMA

PRELIMINARY
MAP NUMBER
12127CIND2D

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

Figure 2: FIRM Notes to Users

NOTES TO USERS

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

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

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

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

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

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

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

Coastal Base Flood Elevations shown on the map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Coastal flood elevations are also provided in the Coastal Transect Parameters table in the FIS Report for this jurisdiction. Elevations shown in the Coastal Transect Parameters table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

Figure 2. FIRM Notes to Users

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

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

PROJECTION INFORMATION: The projection used in the preparation of the map was State Plane Transverse Mercator, Florida East Zone 0901. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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

BASE MAP INFORMATION: Base Map information shown on this FIRM was provided in digital format by Volusia County Growth and Resource Management, Volusia County GIS Department, Florida Department of Transportation, U.S. Fish and Wildlife Service, U.S.Geological Survey and FEMA. For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

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

NOTES FOR FIRM INDEX

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

Figure 2. FIRM Notes to Users

recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Volusia County, Florida, effective **TBD.**

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

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

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

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

Figure 3: Map Legend for FIRM

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

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

Figure 3: Map Legend for FIRM

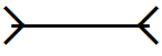
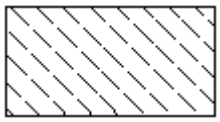
	Regulatory Floodway determined in Zone AE.
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
 *Bridge*	Bridge

Figure 3: Map Legend for FIRM

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*

CBRS AREA 09/30/2009

Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.



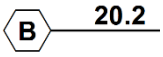
OTHERWISE PROTECTED AREA 09/30/2009

Otherwise Protected Area

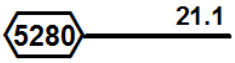
REFERENCE MARKERS

River mile Markers

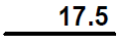
CROSS SECTION & TRANSECT INFORMATION



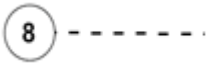
Lettered Cross Section with Regulatory Water Surface Elevation (BFE)



Numbered Cross Section with Regulatory Water Surface Elevation (BFE)



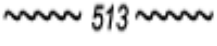
Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)



Coastal Transect

Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.

Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.



Base Flood Elevation Line

ZONE AE (EL 16)

Static Base Flood Elevation value (shown under zone label)

ZONE AO (DEPTH 2)

Zone designation with Depth

ZONE AO (DEPTH 2) (VEL 15 FPS)

Zone designation with Depth and Velocity

Figure 3: Map Legend for FIRM

BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}E$	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

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

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

Depending on the accuracy of available topographic data (Table 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1% and 0.2% annual chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1% annual chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary is shown on the FIRM. Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Volusia County. Figure 3, "Map Legend for FIRM", describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Volusia County, FL, respectively.

Table 2, "Flooding Sources Included in this FIS Report," lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Volusia County. Figure 3. On the map, the 1% annual chance floodplain corresponds to the SFHAs. The 0.2% annual chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

Small areas within the floodplain boundaries may lie above the flood elevations but cannot be

shown due to limitations of the map scale and/or lack of detailed topographic data. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

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

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Atlantic Ocean	City of Daytona Beach, City of Daytona Beach Shores, City of Flagler Beach, City of New Smyrna Beach, City of Oak Hill, City of Ormond Beach, City of Port Orange, Town of Ponce Inlet, Volusia County Unincorporated Areas	Entire Coastline	Entire Coastline	03080201, 03080202	49.6		N	A, AE, VE, X	2015
B-19 Canal	City of Daytona Beach, City of Port Orange, Volusia County Unincorporated Areas	Confluence with Spruce Creek	Approximately 400 feet upstream of Belville Road	03080201	6.6		Y	AE, X	2014
B-19 Canal Tributary No. 1	City of Port Orange	Confluence with B-19 Canal	Approximately 800 feet upstream of Interstate Highway 95	03080201	1.2		N	AE, X	2002
B-19 Canal Tributary No. 2	City of Port Orange	Confluence with B-19 Canal	Approximately 23,925 feet upstream of Confluence with B-19 Canal	03080201	4.5		N	AE, X	2002

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

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
B-27 Canal North	City of Holly Hill, City of Ormond Beach, Volusia County Unincorporated Areas	Confluence with LPGA Canal	Approximately 50 feet upstream of Calle Grande Street	03080201	1.2		N	AE, X	2014
B-27 Canal South	City of Daytona Beach, City of Holly Hill	Confluence with LPGA Canal	Approximately 75 feet upstream of Kingston Avenue	03080201	1.6		N	AE, X	2014
Bulow Creek	Volusia County Unincorporated Areas	Confluence with Halifax River	Approximately 22,325 feet upstream of confluence with Halifax River	03080201	4.2		Y	AE, X	2015
Crescent Lake	Volusia County Unincorporated Areas	Putnam County boundary	Putnam County boundary	03080103		0.04	N	AE	2002
E Canal	City of Edgewater	At U.S. Highway 1	Approximately 40 feet upstream of Florida East Coast Railroad	03080202	0.7		N	AE	2002
Groover Branch	City of Ormond Beach, Volusia County Unincorporated Areas	Confluence with Tomoka River	Approximately 75 feet upstream of Tymber Creek Road North	03080201	1.4		Y	AE, X	2003
Halifax Canal	City of Port Orange, Town of Ponce Inlet, Volusia County Unincorporated Areas	13,000 feet upstream of confluence with Halifax River	Approximately 75 feet upstream of Jackson Street	03080201	5.6		N	AE, X	2014

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

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Halifax River	City of Daytona Beach, City of Daytona Beach Shores, City of Holly Hill, City of New Smyrna Beach, City of Ormond Beach, City of Port Orange, City of South Daytona, Town of Ponce Inlet, Volusia County Unincorporated Areas	Ponce de Leon Inlet	Jones Island Road	03080201		11.5	N	AE, VE, X	2003
Indian River North	City of Edgewater, City of New Smyrna Beach, City of Oak Hill, Volusia County Unincorporated Areas	Ponce de Leon Inlet	Mosquito Lagoon	03080202		2.9	N	AE, VE, X	2002
Laurel Creek	City of Ormond Beach	Confluence with Thompson Creek	Approximately 325 feet upstream of Laurel Oaks Circle	03080201	3.2		Y	AE, X	2014
LPGA Canal	City of Holly Hill	Confluence with Halifax River	Approximately 1,950 feet upstream of Center Avenue	03080201	1.3		N	AE, X	2014
Misner Branch	City of Ormond Beach	Confluence with Tomoka River	Approximately 100 feet upstream of Hand Avenue	03080201	2.1		Y	AE, X	2003

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

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Mosquito Lagoon	City of Oak Hill, Volusia County Unincorporated Areas	Confluence with Indian River North	Brevard County Boundary	03080202		17.9	N	AE, VE, X	2015
Nova Canal North Reach 1	City of Holly Hill	Confluence with LPGA Canal/Nova Canal North Reach 2	Approximately 35 feet upstream of Alabama Avenue	03080201	1.2		N	AE, X	2014
Nova Canal North Reach 2	City of Daytona Beach, City of Holly Hill, Volusia County Unincorporated Areas	Confluence with LPGA Canal/Nova Canal North Reach 1	Confluence with Nova Canal South Reach 1	03080201	3.2		N	AE, X	2014
Nova Canal South Reach 1	City of Daytona Beach, City of South Daytona, Volusia County Unincorporated Areas	Confluence with Nova Canal South Reach 2	Confluence with Nova Canal North Reach 2	03080201	3.2		N	AE, X	2014
Nova Canal South Reach 2	City of Port Orange, City of South Daytona	Confluence with Nova Canal South Reach 1	Confluence with Halifax Canal	03080201	1.3		N	AE, X	2014
St. Johns River	City of Debary, City of Deltona, Volusia County Unincorporated Areas	Putnam County Boundary	Brevard County Boundary	03080101	82.8		N	AE, X	2003
South Canal	City of Edgewater, City of New Smyrna Beach	Confluence with Indian River North	Approximately 80 feet upstream of U.S. Highway 1	03080202	0.4		N	AE, X	2002

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

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Spruce Creek	City of Port Orange, Volusia County Unincorporated Areas	Approximately 29,800 feet upstream of U.S. Highway 1	Approximately 2,800 feet upstream of Branch Crossing Road	03080201	6.2		Y	AE, VE, X	2002
Spruce Creek Tributary No. 1	Volusia County Unincorporated Areas	Confluence with Spruce Creek	Approximately 1,300 feet upstream of Old Samsula Road	03080201	1.6		Y	AE	2002
Spruce Creek Tributary No. 2	Volusia County Unincorporated Areas	Confluence with Spruce Creek	Approximately 2,950 feet upstream of confluence with Spruce Creek	03080201	0.6		Y	AE	2002
Spruce Creek Tributary A	City of Port Orange, Volusia County Unincorporated Areas	Confluence with Spruce Creek	Approximately 4,475 feet upstream of confluence with Spruce Creek	03080201	0.8		N	AE, X	2002
Thompson Creek	City of Ormond Beach	Approximately 1,000 feet downstream of U.S. Highway 1	Approximately 550 feet upstream of Division Avenue	03080201	1.7		Y	AE, X	2014
Tomoka River	City of Daytona Beach, City of Ormond Beach, Volusia County Unincorporated Areas	Tomoka Basin	Approximately 5,100 feet upstream of U.S. Highway 92	03080201	17		Y	AE, X	2003

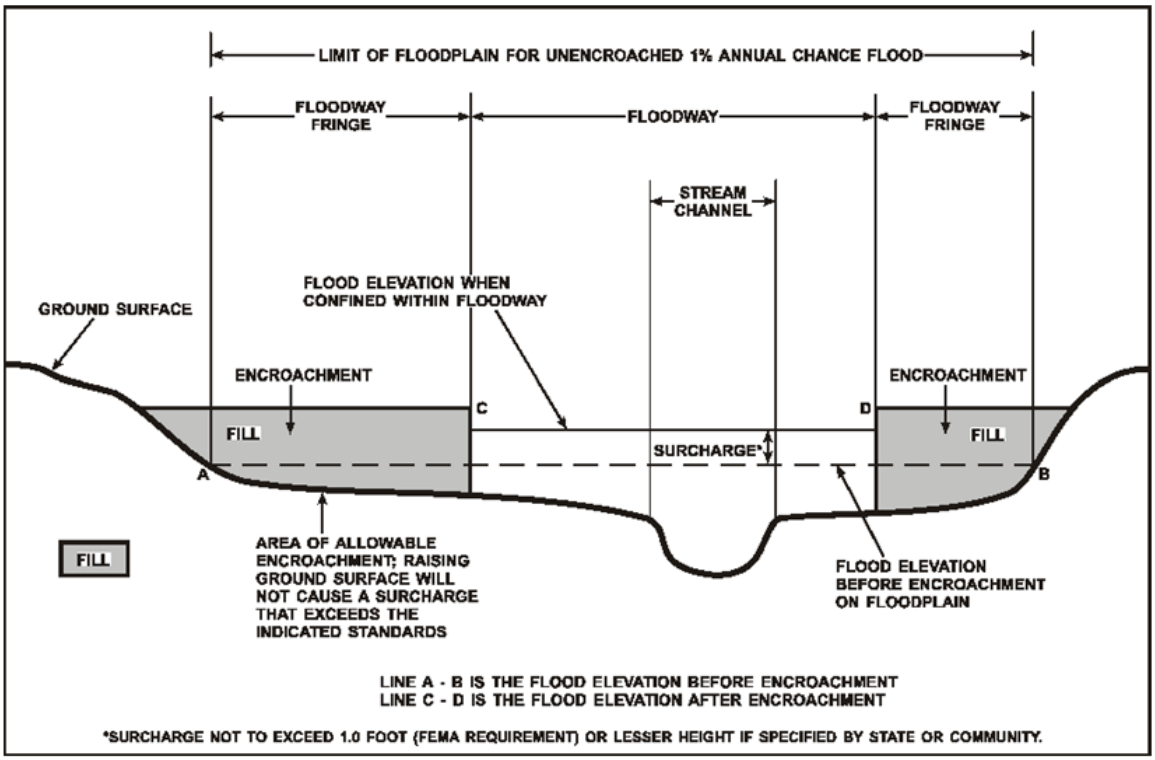
2.2 Floodways

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

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

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

Figure 4: Floodway Schematic



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

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

2.3 Base Flood Elevations

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

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

2.4 Non-Encroachment Zones

Some States and communities use non-encroachment zones to manage floodplain development. For flooding sources with medium flood risk, field surveys are often not collected and surveyed bridge and culvert geometry is not developed. Standard hydrologic and hydraulic analyses are still performed to determine BFEs in these areas. However, floodways are not typically determined, since specific channel profiles are not developed. To assist communities with managing floodplain development in these areas, a "non-encroachment zone" may be provided. While not a FEMA designated floodway, the non-encroachment zone represents that area around the stream that should be reserved to convey the 1% annual chance flood event. As with a floodway, all surcharges must fall within the acceptable range in the non-encroachment zone.

General setbacks can be used in areas of lower risk (e.g. unnumbered Zone A), but these are not considered sufficient where unnumbered Zone A is replaced by Zone AE. The NFIP requires communities to ensure that any development in a non-encroachment area causes no increase in BFEs. Communities must generally prohibit development within the area defined by the non-encroachment width to meet the NFIP requirement.

Non-encroachment determinations may be delineated where it is not possible to delineate floodways because specific channel profiles with bridge and culvert geometry were not developed. Any non-encroachment determinations for this Flood Risk Project have been tabulated for selected cross sections and are shown in Table 25, "Flood Hazard and Non-Encroachment Data for Selected Streams." Areas for which non-encroachment zones are provided show BFEs and the 1% annual chance floodplain boundaries mapped as zone AE on the FIRM but no floodways.

2.5 Coastal Flood Hazard Areas

For most areas along rivers, streams, and small lakes, BFEs and floodplain boundaries are based on the amount of water expected to enter the area during a 1% annual chance flood and the geometry of the floodplain. Floods in these areas are typically caused by storm events. However, for areas on or near ocean coasts, large rivers, or large bodies of water, BFE and floodplain boundaries may need to be based on additional components, including storm surges and waves. Communities on or near ocean coasts face flood hazards caused by offshore seismic events as well as storm events.

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

2.5.1 Water Elevations and the Effects of Waves

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

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

- *Astronomical tides* are periodic rises and falls in large bodies of water caused by the rotation of the earth and by the gravitational forces exerted by the earth, moon and sun.
- *Storm surge* is the additional water depth that occurs during large storm events. These events can bring air pressure changes and strong winds that force water up against the shore.
- *Freshwater inputs* include rainfall that falls directly on the body of water, runoff from surfaces and overland flow, and inputs from rivers.

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

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

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

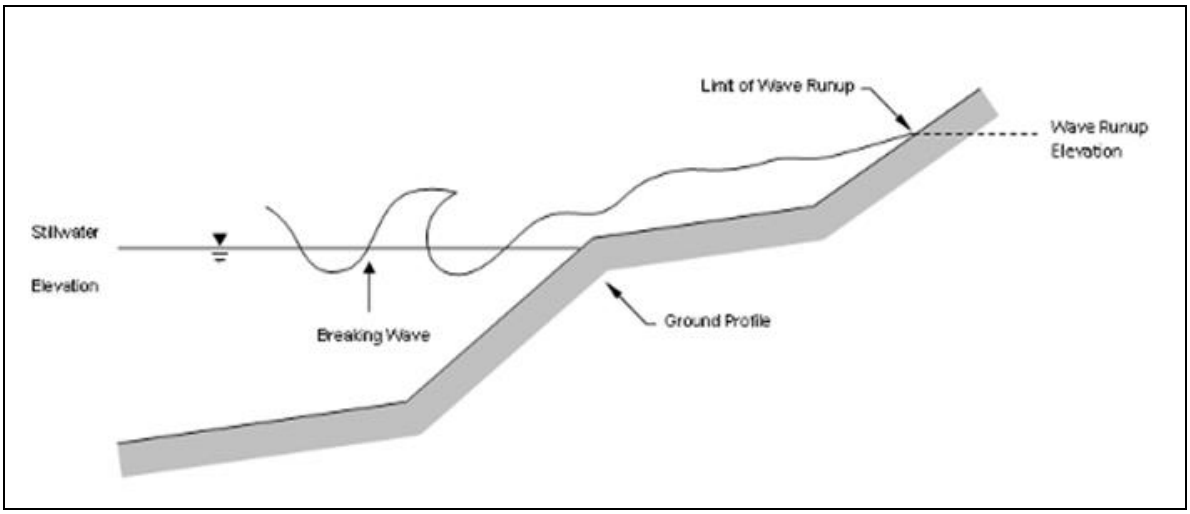
Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1% annual chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since tidal gages are often sited in areas sheltered

from wave action and do not capture this information.

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

- *Storm-induced erosion* is the modification of existing topography by erosion caused by a specific storm event, as opposed to general erosion that occurs at a more constant rate.
- *Overland wave propagation* describes the combined effects of variation in ground elevation, vegetation, and physical features on wave characteristics as waves move onshore.
- *Wave runup* is the uprush of water from wave action on a shore barrier. It is a function of the roughness and geometry of the shoreline at the point where the stillwater elevation intersects the land.
- *Wave overtopping* refers to wave runup that occurs when waves pass over the crest of a barrier.

Figure 5: Wave Runup Transect Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

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

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

Floodplain Boundaries

In many coastal areas, storm surge is the principle component of flooding. The extent of the 1% annual chance floodplain in these areas is derived from the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1% annual chance storm. The methods that were used for calculation of total stillwater elevations for coastal areas are described in Section

5.3 of this FIS Report. Location of total stillwater elevations for coastal areas are shown in Figure 8, "1% Annual Chance Total Stillwater Levels for Coastal Areas."

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

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

Coastal BFEs

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

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

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

2.5.3 Coastal High Hazard Areas

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

- *Coastal High Hazard Area (CHHA)* is a SFHA extending from offshore to the inland limit of the primary frontal dune (PFD) or any other area subject to damages caused by wave action and/or high-velocity water during the 1% annual chance flood.
- *Primary Frontal Dune (PFD)* is a continuous or nearly continuous mound or ridge of sand with relatively steep slopes immediately landward and adjacent to the beach. The PFD is subject to erosion and overtopping from high tides and waves during major coastal storms.

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

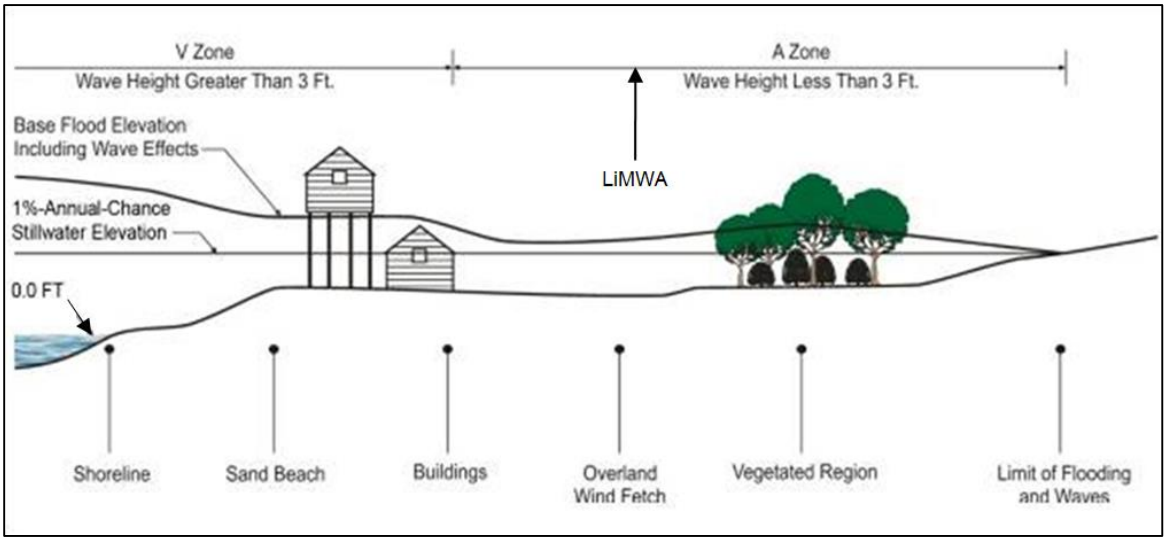
The landward limit of the PFD occurs at a point where there is a distinct change from a relatively steep slope to a relatively mild slope; this point represents the landward extension of Zone VE. Areas of lower risk in the CHHA are designated with Zone V on the FIRM. More detailed information about the identification and designation of Zone VE is presented in Section 6.4 of this

FIS Report.

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

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

Figure 6: Coastal Transect Schematic



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

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

2.5.4 Limit of Moderate Wave Action

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

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

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

Where wave runup elevations dominate over wave heights, there is no evidence to date of significant damage to residential structures by runup depths less than 3 feet. Examples of these areas include areas with steeply sloped beaches, bluffs, or flood protection structures that lie parallel to the shore. In these areas, the FIRM shows the LiMWA immediately landward of the VE/AE boundary. Similarly, in areas where the zone VE designation is based on the presence of a primary frontal dune or wave overtopping, the LiMWA is delineated immediately landward of the Zone VE/AE boundary.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

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

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

Table 3 lists the flood insurance zones in the unincorporated and incorporated areas of Volusia County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Daytona Beach Shores, City of	AE, VE, X
Daytona Beach, City of	A, AE, AH, VE, X
Debary, City of	A, AE, X
Deland, City of	A, AE, X
Deltona, City of	A, AE, X
Edgewater, City of	A, AE, X
Flagler Beach, City of	AE, X
Holly Hill, City of	A, AE, X
Lake Helen, City of	A, X
New Smyrna Beach, City of	A, AE, VE, X
Oak Hill, City of	A, AE, VE, X
Orange City, City of	A, X
Ormond Beach, City of	A, AE, AH, VE, X
Pierson, Town of	A, X
Ponce Inlet, Town of	AE, VE, X
Port Orange, City of	A, AE, AH, VE, X
South Daytona, City of	A, AE, VE, X
Volusia County, Unincorporated Areas	A, AE, AH, VE, X

3.2 Coastal Barrier Resources System

The Coastal Barrier Resources Act (CBRA) of 1982 was established by Congress to create areas along the Atlantic and Gulf coasts and the Great Lakes, where restrictions for Federal financial assistance including flood insurance are prohibited. In 1990, Congress passed the Coastal Barrier Improvement Act (CBIA), which increased the extent of areas established by the CBRA and added "Otherwise Protected Areas" (OPA) to the system. These areas are collectively referred to as the John. H Chafee Coastal Barrier Resources System (CBRS). The CBRS boundaries that have been identified in the project area are in Table 4, "Coastal Barrier Resource System Information.

Table 4: Coastal Barrier Resources System Information

Primary Flooding Source	CBRS/OPA Type	Date CBRS Area Established	FIRM Panel Number(s)
Atlantic Ocean	CBRS	10/1/1983	12127C0061J
			12127C0062J
			12127C0063J
			12127C0064J
Atlantic Ocean	CBRS	11/16/1990	12127C0061J
			12127C0063J
			12127C0064J
Atlantic Ocean	CBRS	10/1/1983	12127C0533J
			12127C0534K
			12127C0541J
			12127C0542J
Atlantic Ocean	CBRS	11/16/1991	12127C0061J
Atlantic Ocean	CBRS	11/16/1990	12127C0529J
			12127C0533J
			12127C0540J
			12127C0541J
			12127C0542J
			12127C0543J
Atlantic Ocean	OPA	11/16/1991	12127C0685J
			12127C0705J
			12127C0715J
			12127C0720J
			12127C0830J
			12127C0835J
			12127C0840J
			12127C0845J
			12127C0855J
			12127C0865J

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

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

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Lower St. Johns	03080103	St. Johns River	Lies in-between Upper St. Johns and Daytona-St. Augustine Florida watersheds in the northern portion of Volusia County	3,022.97
Upper St. Johns	03080101	St. Johns River	Largest watershed within Volusia County, encompassing western half of the county	3,633.03
Daytona-St. Augustine	03080201	Atlantic Ocean	Encompasses the northern portion of Volusia County's coastline extending approximately 10 miles inland	3,424.35
Cape Canaveral	03080202	Atlantic Ocean	Encompasses the southern portion of Volusia County's coastline extending approximately 7 miles inland	4,096.65

4.2 Principal Flood Problems

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

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
All sources	Flooding in Volusia County results from tidal surges associated with hurricanes, northeasters, and tropical storm activity and from overflow of streams and swamps associated with rainfall runoff. Major rainfall events occur from hurricanes, tropical storms, and thundershowers associated with frontal systems. Some of the worst floods to occur in the area recently were the result of high intensity rainfall during hurricanes or tropical storms such as Gordon and Faye in 1994 and 2008. Having a relatively short time of concentration, the smaller streams tend to reach peak flood flow concurrently with elevated tailwater conditions associated with the coastal storm surge. This greatly increases the likelihood of inundation of low lying areas along the coast observed on several occasions. Areas along the Halifax River, Indian River North, and Mosquito Lagoon are particularly vulnerable to this flooding. In the eastern portion of the county, most of the flood-prone areas feature relatively impermeable soil, a high water table, and flat terrain. These characteristics contribute significantly to flooding problems. Furthermore, the flat slopes and heavily vegetated floodplains promote backwater effects and aggravate the flood problems by preventing the rapid drainage of floodwaters. However, the vast extent of some floodplains, particularly those of the Tomoka River, serve to mitigate some of the flooding and lower peak discharges by providing overbank storage of floodwaters.

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

Table 7: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Tomoka River	Eleventh Street	11.6	1964	*	USGS gage
Tomoka River	Eleventh Street	11.8	1968	*	USGS gage
Tomoka River	Eleventh Street	10.7	1969	*	USGS gage
Tomoka River	Eleventh Street	11.4	1976	*	USGS gage
Tomoka River	U.S. Highway 92	20.9	1983	*	USGS gage
Tomoka River	U.S. Highway 92	21.2	1984	*	USGS gage
Tomoka River	Eleventh Street	10.4	1994	*	USGS gage
B-19 Canal	State Route 415	17.3	1989	*	USGS gage
B-19 Canal	State Route 415	17.8	1989	*	USGS gage
B-19 Canal	State Route 415	17.7	1991	*	USGS gage
B-19 Canal	Willow Run	21.0	1991	*	USGS gage

4.3 Non-Levee Flood Protection Measures

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

Table 8: Non-Levee Flood Protection Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Atlantic Ocean	N/A	Seawall	Various locations throughout the coast of Volusia County	Various seawalls along Volusia County's coastline have been placed to protect properties

4.4 Levees

This section is not applicable to this Flood Risk Project.

Table 9: Levees

[Not Applicable to this Flood Risk Project]

SECTION 5.0 – ENGINEERING METHODS

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

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

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

5.1 Hydrologic Analyses

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

A summary of the discharges is provided in Table 10. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in

Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 11. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 17.) Stream gage information is provided in Table 12.

Table 10: Summary of Discharges

Flooding Source	Location	Drainage Area (Acres)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
B-19 Canal	At Confluence of Spruce Creek	10.2	791	*	1,087	1,267	1,548
B-19 Canal	At Willow Run Boulevard	6.7	510	*	723	857	1,064
B-19 Canal	At Madeline Avenue	4.4	326	*	472	561	695
B-19 Canal	At Confluence of B-19 Canal Tributary No. 7	2.1	211	*	319	391	511
B-19 Canal Tributary No. 1	At Interstate 95	0.9	112	*	210	261	428
B-19 Canal Tributary No. 2	At mouth	0.3	45	*	86	108	180
B-19 Canal Tributary No. 7	At Bellville Road	0.4	*	*	*	148	*
B-27 Canal North	At Walker Street	1.4	81	*	102	110	113
B-27 Canal North	At Calle Grande Avenue	0.4	204	*	250	297	388
B-27 Canal South	At 10th Street	0.8	92	*	110	120	133
B-27 Canal South	At State Route 430	0.1	333	*	422	480	573
Bulow Creek	At Washington Avenue	28.3	1,282	*	2,258	2,744	4,067
Canal Between	At mouth	0.49	*	*	*	154	*

Table 10: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Acres)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
E Canal	At mouth	3.87	192	*	236	256	280
E Canal	At Fem Palm Drive	2.66	132	*	162	176	192
Eleventh Street Canal	At mouth	4.2	*	*	*	1,070	*
Eleventh Street Canal Tributary No. 2	At Confluence with Eleventh Street Canal	0.76	*	*	*	678	*
Eleventh Street Canal Tributary No. 2A	Just upstream of Daytona Beach corporate limits	0.28	*	*	*	678	*
Groover Branch	At Durrance Lane	6.5	*	*	*	848	*
Groover Branch Tributary No. 1	At mouth	3	*	*	*	291	*
Groover Branch Tributary No. 2	At mouth	0.1	*	*	*	163	*
Halifax Canal	At Nova Road	2.6	486	*	612	686	782
Halifax Canal	At Commonwealth Boulevard	1.9	264	*	365	435	552
Halifax Canal	At Jackson Street	0.4	148	*	166	172	189
Halifax Canal	At Oak Street	1	59	*	75	84	97
Laurel Creek	At U.S. Highway 1	2.4	331	*	479	579	747
Laurel Creek	At Wilmette Avenue	1.8	242	*	348	421	541

Table 10: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Acres)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Laurel Creek	At Granada Boulevard	1.2	166	*	238	287	369
Laurel Creek	At Division Avenue	0.5	143	*	207	249	319
Laurel Creek	At Hand Avenue	0.3	104	*	146	175	224
Little Tomoka River	At Tymber Creek Road North	21.16	3,205	*	4,417	5,222	6,552
Little Tomoka River	At Breakway Trail	18.14	2,844	*	3,907	4,613	5,776
Little Tomoka River	At State Route 40	8.78	1,508	*	2,066	2,438	3,046
LPGA Canal	At Fec Railroad	8.8	448	*	464	568	631
LPGA Canal	At Center Avenue	6.6	377	*	405	419	443
Misner Branch	At mouth	2.68	562	*	775	923	1,177
Misner Branch	At Main Trail Road	2.49	501	*	704	841	1,071
Misner Branch	At State Route 40	2.21	473	*	666	796	1,011
Misner Branch	At Falls Way Boulevard	1.61	415	*	573	677	847
Nova North Reach 1	At Confluence With LPGA Canal	2	121	*	144	155	177
Nova North Reach 1	At 15th Street	1.4	68	*	89	108	137
Nova North Reach 1	At Alabama Avenue	0.8	70	*	94	110	130

Table 10: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Acres)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Nova North Reach 2	At 10th Street	4.6	526	*	665	715	877
Nova North Reach 2	At Jersey Avenue	4.4	245	*	268	281	304
Nova North Reach 2	At 4th Street	3.3	227	*	256	279	321
Nova North Reach 2	At 6th Street	3.7	219	*	259	282	311
Nova South Reach 1	At Confluence with Reed Canal	5.2	524	*	574	593	657
Nova South Reach 1	At Old Big Tree Road	4.2	856	*	1,028	1,305	1,696
Nova South Reach 1	At Beville Road	3.4	370	*	407	424	440
Nova South Reach 1	At Bellevue Avenue	2.3	282	*	295	288	263
Nova South Reach 2	At Confluence with Reed Canal	2.2	641	*	710	742	773
Nova South Reach 2	At Madeline Avenue	1.2	249	*	249	249	249
Nova South Reach 2	At Herbert Street	0.4	84	*	102	115	132
Shooting Range Canal	At Interstate 95	0.5	100.4	*	188.2	232.7	361.9

Table 10: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Acres)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
South Canal	At mouth	4.43	372	*	429	439	491
Spruce Creek	At Interstate 95	72.71	1,843	*	2,667	3,039	3,889
Spruce Creek	Just upstream of Fly-In Road	52.28	1,365	*	1,976	2,253	2,906
Spruce Creek	At unnamed road	43.05	1,101	*	1,594	1,820	2,366
Spruce Creek Tributary No. 2	At Confluence with Spruce Creek	8.49	626	*	919	1,047	1,326
Spruce Creek Tributary A	At Confluence with Spruce Creek	*	*	*	*	8,600	*
Thompson Creek	Approximately 20' upstream of U.S. Highway 1	0.6	232	*	303	352	427
Thompson Creek	Approximately 20' upstream of Wilmette Avenue	0.6	229	*	300	350	433
Thompson Creek	At Granada Boulevard	0.3	166	*	231	275	341
Thompson Creek	At Division Avenue	0.1	66	*	89	105	129
Tomoka River	At Old Dixie Highway	145.1	5,470	*	7,396	8,914	11,522
Tomoka River	At U.S. Highway 1	136.6	7,489	*	10,380	12,366	15,670
Tomoka River	At Interstate 95	127.3	8,393	*	11,622	13,784	17,385
Tomoka River	At State Route 40	88.1	4,521	*	6,206	7,332	9,185

Table 10: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Acres)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Tomoka River	At Eleventh Street	74.7	3,520	*	4,786	5,628	7,015
Tomoka River	At U.S. Route 92	6.1	928	*	1,268	1,494	1,866
Wally Hoffmeyer Canal	At mouth	2.29	*	*	*	833	*

*Not calculated for this Flood Risk Project

Figure 7: Frequency Discharge-Drainage Area Curves

[Not Applicable to this Flood Risk Project]

Table 11: Summary of Non-Coastal Stillwater Elevations

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Blue Lake	Volusia County	*	*	*	57	*
Crescent Lake	Volusia County	4.1	*	5.6	6.2	7.5
Duck Decoy Depression	Volusia County	*	*	*	57.3	*
Fish Memorial Pond-1	Orange City	*	*	*	32.5	*
Fish Memorial Pond-2	Orange City	*	*	*	32.5	*
Fish Memorial Pond-3	Orange City	*	*	*	32.5	*
Fish Memorial Pond-4	Orange City	*	*	*	26.5	*
Jacobs Pond	Volusia County	*	*	*	63.1	*
Lake Hammock	Volusia County	*	*	*	57.3	*
Lori Pond	Volusia County	*	*	*	63.6	*
Miller Lake	Volusia County	*	*	*	57	*
North Lake Talmadge	Volusia County	*	*	*	57	*
South Lake Talmadge	Volusia County	*	*	*	57	*
Ponding Area 1	City of Ormond Beach	*	*	*	22.9	*

Table 11: Summary of Non-Coastal Stillwater Elevations (continued)

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Ponding Area 2	City of Ormond Beach	*	*	*	22.9	*
Ponding Area 3	City of Ormond Beach	*	*	*	21.9	*
Ponding Area 4	City of Ormond Beach	*	*	*	22.9	*
Ponding Area 5	City of Deltona	*	*	*	34.9	*
Ponding Area 6	City of Deltona	*	*	*	33.9	*
Ponding Area 5	City of Daytona Beach	*	*	*	25.9	*
Ponding Area 6	City of Daytona Beach	*	*	*	25.9	*
Ponding Area 7	City of Daytona Beach	*	*	*	27.9	*
Ponding Area 8	City of Daytona Beach	*	*	*	27.9	*
Ponding Area 9	City of Daytona Beach	*	*	*	24.9	*
Ponding Area 10	City of Daytona Beach	*	*	*	24.9	*
Ponding Area 11	Volusia County	*	*	*	26.6	*
Ponding Area 12	Volusia County	*	*	*	26.6	*
Ponding Area 13	Volusia County	*	*	*	26.6	*
Ponding Area 14	Volusia County	*	*	*	26.3	*

Table 11: Summary of Non-Coastal Stillwater Elevations (continued)

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Ponding Area 15	Volusia County	*	*	*	26.3	*
Ponding Area 16	Volusia County	*	*	*	26.4	*
Ponding Area 17	Volusia County	*	*	*	26.4	*
Ponding Area 18	Volusia County	*	*	*	27.4	*
Ponding Area 19	Volusia County	*	*	*	29.1	*
Ponding Area 20	Volusia County	*	*	*	28.3	*
Ponding Area 21	Volusia County	*	*	*	28.3	*
Ponding Area 22	Volusia County	*	*	*	26.3	*
Ponding Area 23	Volusia County	*	*	*	27.8	*
Ponding Area 24	Volusia County	*	*	*	28.1	*
Ponding Area 25	Volusia County	*	*	*	27.3	*
Ponding Area 26	Volusia County	*	*	*	26.3	*
Ponding Area 27	Volusia County	*	*	*	26.3	*
Ponding Area 28	Volusia County	*	*	*	27.3	*
Ponding Area 29	Volusia County	*	*	*	27.7	*
Ponding Area 30	Volusia County	*	*	*	27.2	*
Ponding Area 31	Volusia County	*	*	*	27.2	*
Ponding Area 32	Volusia County	*	*	*	27.4	*
Ponding Area 33	Volusia County	*	*	*	26.7	*
Ponding Area 34	Volusia County	*	*	*	25.5	*
Ponding Area 35	Volusia County	*	*	*	25.6	*

Table 11: Summary of Non-Coastal Stillwater Elevations (continued)

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Ponding Area 36	Volusia County	*	*	*	26.2	*
Ponding Area 37	Volusia County	*	*	*	26.1	*
Ponding Area 38	Volusia County	*	*	*	26.3	*
Ponding Area 39	Volusia County	*	*	*	25.4	*
Ponding Area 40	Volusia County	*	*	*	26.4	*
Ponding Area 41	Volusia County	*	*	*	26.4	*
Ponding Area 42	Volusia County	*	*	*	25.6	*
Ponding Area 43	Volusia County	*	*	*	25.4	*
Ponding Area 44	Volusia County	*	*	*	25.4	*
Ponding Area 45	Volusia County	*	*	*	28	*
Ponding Area 46	Volusia County	*	*	*	29.1	*
Ponding Area 47	Volusia County	*	*	*	30	*
Ponding Area 48	Volusia County	*	*	*	27.8	*
Ponding Area 49	Volusia County	*	*	*	27.8	*
Ponding Area 50	Volusia County	*	*	*	27.8	*
Ponding Area 51	Volusia County	*	*	*	27.8	*
Ponding Area 52	Volusia County	*	*	*	27.8	*
Ponding Area 53	Volusia County	*	*	*	26.3	*
Ponding Area 54	Volusia County	*	*	*	28.1	*
Ponding Area 55	Volusia County	*	*	*	27.4	*
Ponding Area 56	Volusia County	*	*	*	25.6	*

Table 11: Summary of Non-Coastal Stillwater Elevations (continued)

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Ponding Area 57	Volusia County	*	*	*	26.4	*
Ponding Area 58	Volusia County	*	*	*	25.6	*
Ponding Area 59	Volusia County	*	*	*	27.2	*
Ponding Area 60	Volusia County	*	*	*	27.1	*
Ponding Area 61	Volusia County	*	*	*	27.1	*
Ponding Area 62	Volusia County	*	*	*	27.2	*
Ponding Area 63	Volusia County	*	*	*	26.2	*
Ponding Area 64	Volusia County	*	*	*	29.1	*
Ponding Area 65	Volusia County	*	*	*	25.5	*
Ponding Area 66	Volusia County	*	*	*	26.2	*
Ponding Area 67	Volusia County	*	*	*	26.2	*
Ponding Area 68	Volusia County	*	*	*	25.6	*
Ponding Area 69	Volusia County	*	*	*	28	*
Ponding Area 70	Volusia County	*	*	*	27.8	*

*Not calculated for this Flood Risk Project

Table 12: Stream Gage Information used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
Tomoka River	TR11	USGS	Tomoka River at Eleventh Street	3.5	1964	Present
Tomoka River	TR92	USGS	Tomoka River at U.S. Highway 92		1982	1985
B-19 Canal	B19WR	USGS	B-19 Canal at Willow Run		1982	1991
B-19 Canal	B19415	USGS	B-19 Canal at State Route 415	7.6	1982	1991

5.2 Hydraulic Analyses

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

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

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

Table 13: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
B-19 Canal	Confluence with Spruce Creek	Approximately 400 feet upstream of Belville Road	HEC-HMS	HEC-RAS 4.1.0	2/19/2014	AE w/ Floodway	
B-19 Canal Tributary No. 1	Confluence with B-19 Canal	Approximately 800 feet upstream of Interstate Highway 95	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE	
B-19 Canal Tributary No. 2	Confluence with B-19 Canal	Approximately 23,925 feet upstream of confluence with B-19 Canal	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE	
B-19 Canal Tributary No. 7	Confluence with B-19 Canal	Approximately 800 feet upstream of State Route 400	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE w/ Floodway	
B-27 Canal North	Confluence with LPGA Canal	Approximately 50 feet upstream of Calle Grande Street	SWMM 5.0	SWMM 5.0	2/19/2014	AE, A	
B-27 Canal South	Confluence with LPGA Canal	Approximately 75 feet upstream of Kingston Avenue	SWMM 5.0	SWMM 5.0	2/19/2014	AE	
Bulow Creek	Confluence with Halifax River	Approximately 22,325 feet upstream of confluence with Halifax River	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE w/ Floodway	
Canal Between	Confluence with Tomoka River	Approximately 3,275 feet upstream of Interstate Highway 95	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE	

Table 13: Summary of Hydrologic amd Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Crescent Lake	Putnam County boundary	Putnam County boundary	*	*	4/15/2002	AE	
E Canal	At U.S. Highway 1	Approximately 40 feet upstream of Florida East Coast Railroad	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE	
Eleventh Street Canal	Confluence with Tomoka River	Approximately 3,000 feet upstream of Clyde Morris Boulevard	SWMM 4.3	SWMM	4/15/2002	AE	
Groover Branch	Confluence with Tomoka River	Approximately 75 feet upstream of Tymber Creek Road North	HEC-I 4.0.1 E	HEC-2	4/15/2002	A, AE, AE w/ Floodway	
Halifax Canal	13,000 feet upstream of confluence with Halifax River	Approximately 75 feet upstream of Jackson Street	SWMM 5.0	SWMM 5.0	2/19/2014	AE	
Laurel Creek	Confluence with Thompson Creek	Approximately 325 feet upstream of Laurel Oaks Circle	HEC-HMS	HEC-RAS 4.1.0	2/19/2014	AE w/ Floodway	
Little Tomoka River	Confluence with Tomoka River	Approximately 100 feet upstream of State Route 40	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE w/ Floodway	
LPGA Canal	Confluence with Halifax River	Approximately 1,950 feet upstream of Center Avenue	SWMM 5.0	SWMM 5.0	2/19/2014	AE	
Misner Branch	Confluence with Tomoka River	Approximately 100 feet upstream of Hand Avenue	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE w/ Floodway	

Table 13: Summary of Hydrologic amd Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Nova Canal North Reach 1	Confluence with LPGA Canal/Nova Canal North Reach 2	Approximately 35 feet upstream of Alabama Avenue	SWMM 5.0	SWMM 5.0	2/19/2014	AE, A	
Nova Canal North Reach 2	Confluence with LPGA Canal/Nova Canal North Reach 1	Confluence with Nova Canal South Reach 1	SWMM 5.0	SWMM 5.0	2/19/2014	AE	
Nova Canal South Reach 1	Confluence with Nova Canal South Reach 2	Confluence with Nova Canal North Reach 2	SWMM 5.0	SWMM 5.0	2/19/2014	AE	
Nova Canal South Reach 2	Confluence with Nova Canal South Reach 1	Confluence with Halifax Canal	SWMM 5.0	SWMM 5.0	2/19/2014	AE	
Shooting Range Canal/Eleventh Street Canal Tributary No. 2/Eleventh Street Canal Tributary No. 2A	Confluence with Tomoka River	Confluence with Eleventh Street Canal	SWMM 4.3	HEC-2	4/15/2002	AE	
South Canal	Confluence with Indian River North	Approximately 80 feet upstream of U.S. Highway 1	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE	
Spruce Creek	Approximately 29,800 feet upstream of U.S. Highway 1	Approximately 2,800 feet upstream of Branch Crossing Road	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE w/ Floodway, VE w/ Floodway	

Table 13: Summary of Hydrologic amd Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Spruce Creek Tributary No. 1	Confluence with Spruce Creek	Approximately 1,300 feet upstream Old Samsula Road	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE w/ Floodway	
Spruce Creek Tributary No. 2	Confluence with Spruce Creek	Approximately 2,950 feet upstream confluence with Spruce Creek	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE w/ Floodway	
Spruce Creek Tributary A	Confluence with Spruce Creek	Approximately 4,475 feet upstream confluence with Spruce Creek	HEC-I 4.0.1 E	HEC-2	6/4/1990	AE	
St. Johns River	Putnam County Boundary	Brevard County Boundary	HEC-1	HEC-RAS 4.0	4/15/2002	AE	
Thompson Creek	Approximately 1,000 feet downstream of U.S. Highway 1	Approximately 550 feet upstream of Division Avenue	HEC-HMS	HEC-RAS 4.1.0	2/19/2014	AE, AE w/ Floodway	
Tomoka River	Tomoka Basin	Approximately 5,100 feet upstream of U.S. Highway 92	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE w/ Floodway	
Wally Hoffmeyer Canal	Confluence with Tomoka River	Approximately 100 feet upstream of Williamson Boulevard	SWMM	SWMM	4/15/2002	AE	
Laurel Creek	Confluence with Thompson Creek	Approximately 325 feet upstream of Laurel Oaks Circle	HEC-HMS	HEC-RAS 4.1.0	2/19/2014	AE w/ Floodway	

Table 13: Summary of Hydrologic amd Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Little Tomoka River	Confluence with Tomoka River	Approximately 100 feet upstream of State Route 40	HEC-I 4.0.1 E	HEC-2	4/15/2002	AE w/ Floodway	
LPGA Canal	Confluence with Halifax River	Approximately 1,950 feet upstream of Center Avenue	SWMM 5.0	SWMM 5.0	2/19/2014	AE	

Table 14: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
B-19 Canal	0.025-0.06	0.10-0.20
B-19 Canal Tributary No. 1	0.035-0.06	0.045-0.12
B-19 Canal Tributary No. 2	0.035-0.06	0.045-0.12
B-19 Canal Tributary No. 7	0.03-0.04	0.12-0.20
B-27 Canal North	0.04	0.065-0.07
B-27 Canal South	0.04-0.05	0.065-0.07
Bulow Creek	0.03	0.08-0.15
Canal Between	0.035-0.06	0.045-0.15
E Canal	0.012-0.045	0.055
Eleventh Street Canal	0.035-0.06	0.045-0.15
Eleventh Street Canal Tributary No. 2	0.035-0.06	0.045-0.12
Eleventh Street Canal Tributary No. 2A	0.035-0.06	0.045-0.12
Groover Branch	0.035-0.04	0.15-0.20
Halifax Canal	0.02-0.05	0.045-0.08
Laurel Creek	0.035	0.1
Little Tomoka River	0.035-0.04	0.15-0.20
LPGA Canal	0.035-0.05	0.045-0.1
Misner Branch	0.035-0.04	0.15-0.20
Nova Canal	0.04-0.065	0.045-0.07
Shooting Range Canal	0.035-0.06	0.045-0.12
South Canal	0.012-0.045	0.055
Spruce Creek	0.035-0.06	0.045-0.12
Spruce Creek Tributary No. 1	0.04-0.06	0.08-0.15
Spruce Creek Tributary No. 2	0.04-0.06	0.08-0.15
Spruce Creek Tributary A	0.04-0.06	0.08-0.15
St. Johns River	0.040-0.06	0.035-0.06
Thompson Creek	0.030-0.033	0.1
Tomoka River	0.035-0.04	0.15-0.20
Wally Hoffmeyer Canal	0.035-0.06	0.045-0.15

5.3 Coastal Analyses

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

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

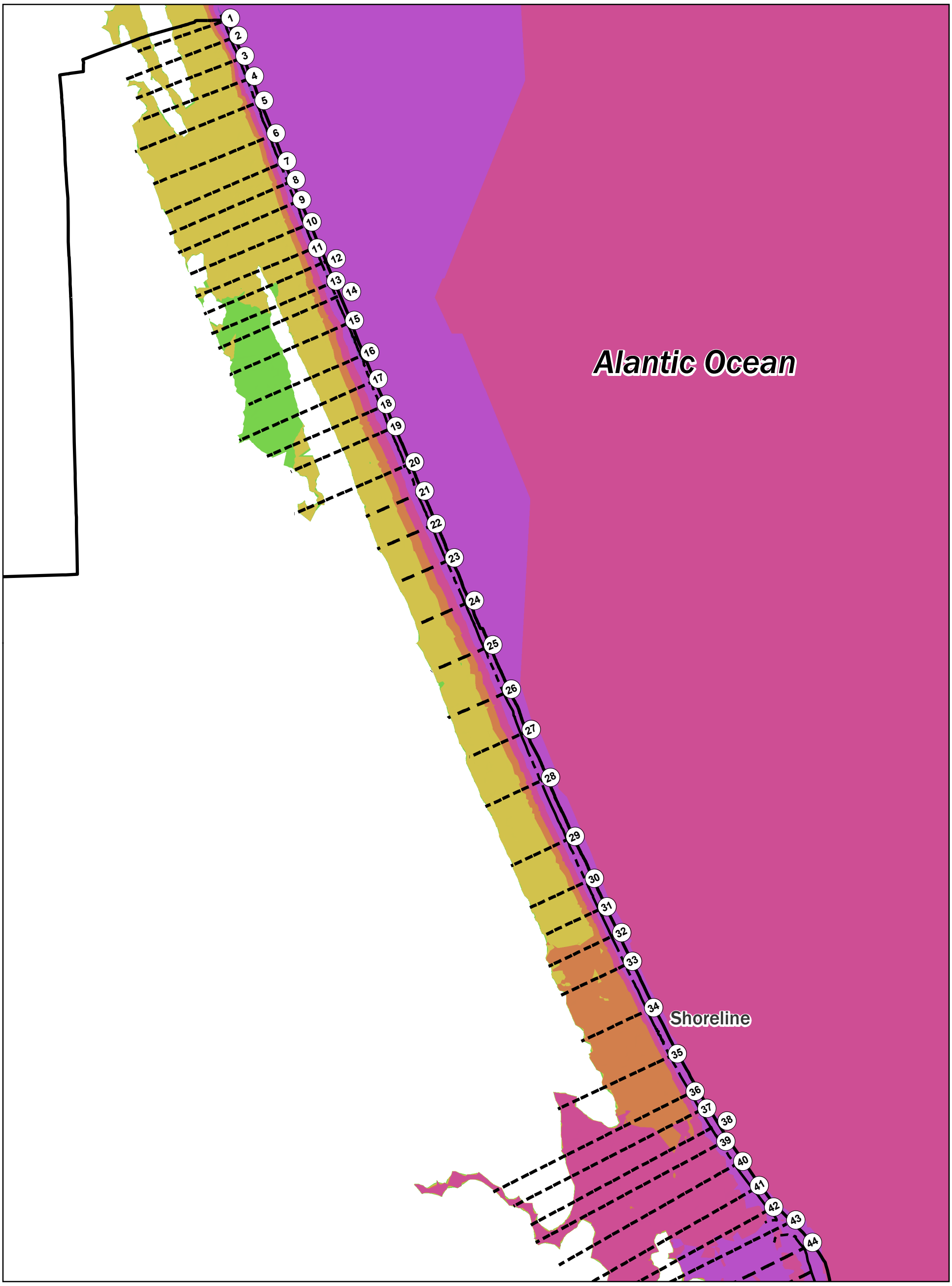
Table 15: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Atlantic Ocean	Entire coastline of Volusia County	Entire coastline of Volusia County	Storm Surge	ADCIRC (2003)	9/1/2013
Atlantic Ocean	Entire coastline of Volusia County	Entire coastline of Volusia County	Overland Wave Propagation	WHAFIS (2007)	2/24/2015
Atlantic Ocean	Entire coastline of Volusia County	Entire coastline of Volusia County	Wave Runup	Runup 2.0 (1990)	12/11/2014
Atlantic Ocean	Entire coastline of Volusia County	Entire coastline of Volusia County	Erosion	FEMA 540 SF Rule	12/11/2014
Halifax River	Confluence with Ponce Inlet	Volusia and Flagler County border	Storm Surge	ADCIRC (2003)	9/1/2013
Halifax River	Confluence with Ponce Inlet	Volusia and Flagler County border	Overland Wave Propagation	WHAFIS (2007)	2/24/2015
Indian River North	Confluence with Mosquito Lagoon	Confluence with Ponce Inlet	Storm Surge	ADCIRC (2003)	9/1/2013
Indian River North	Confluence with Mosquito Lagoon	Confluence with Ponce Inlet	Overland Wave Propagation	WHAFIS (2007)	2/24/2015
Mosquito Lagoon	Volusia and Brevard County border	Confluence with Indian River North	Storm Surge	ADCIRC (2003)	9/1/2013
Mosquito Lagoon	Volusia and Brevard County border	Confluence with Indian River North	Overland Wave Propagation	WHAFIS (2007)	2/24/2015

5.3.1 Total Stillwater Elevations

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

Figure 8: 1% Annual Chance Total Stillwater Elevation for Coastal Areas



Elevation (Feet, NAVD88)

8 - 9	5 - 6	2 - 3
7 - 8	4 - 5	
6 - 7	3 - 4	

Coastal Transect — County Boundary

Transect Baseline

N

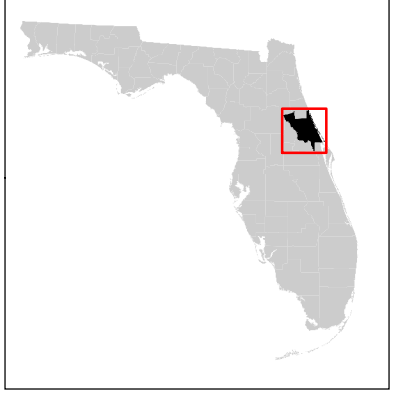
1 inch = 10,000 feet 1:120,000

Feet

0 2,500 5,000 10,000 15,000 20,000

Map Projection:
State Plane Florida East; North American Datum 1983

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

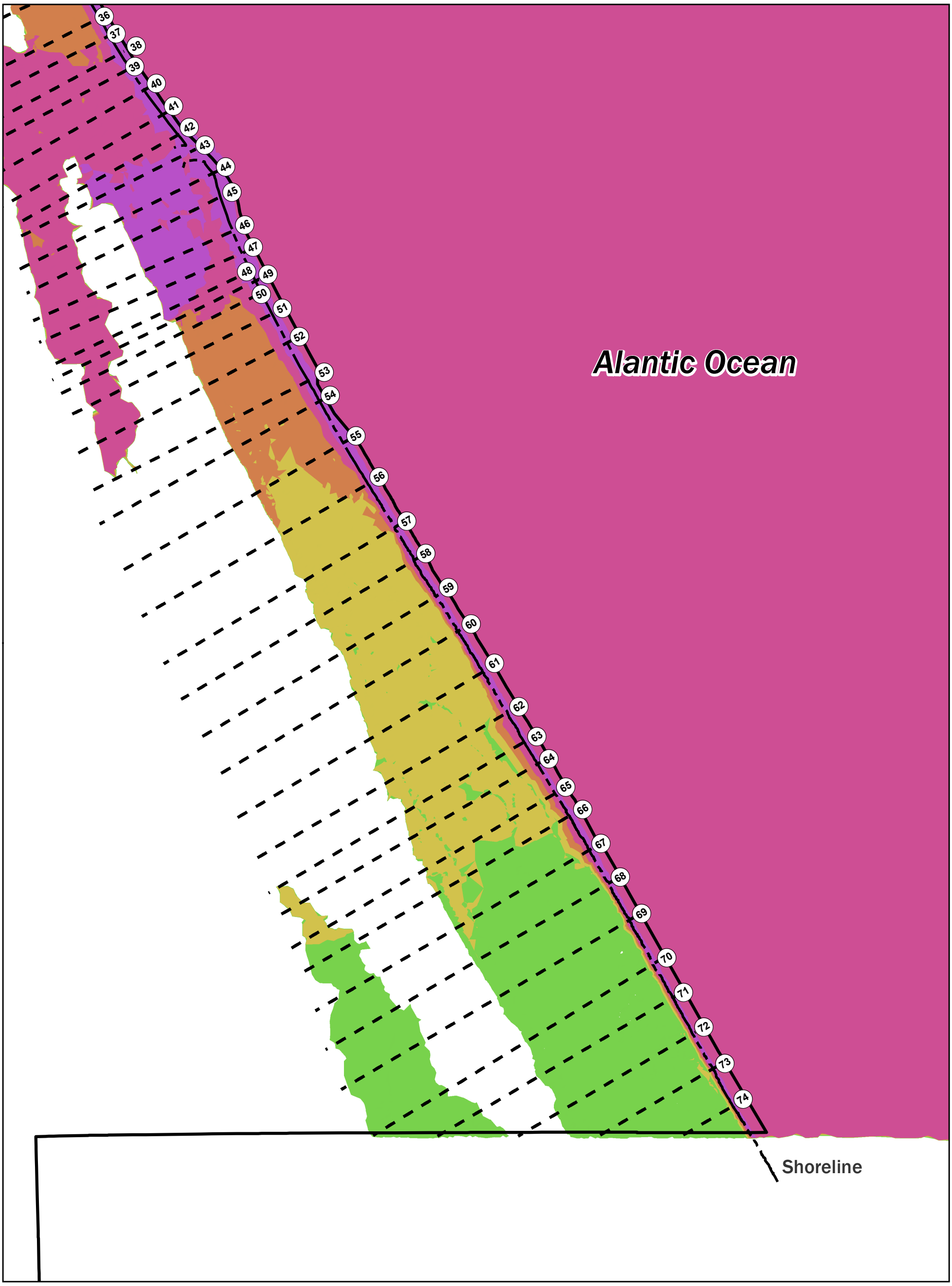
1 Percent-Annual-Chance Stillwater Elevation Map

VOLUSIA COUNTY, FLORIDA

FEMA

Note: This figure displays 1%-annual-chance stillwater elevations (including wave-set up). Overland wave height information is not included. Base Flood Elevations are not displayed.

Figure 8 (cont): 1% Annual Chance Total Stillwater Elevation for Coastal Areas



Elevation (Feet, NAVD88)

8 - 9	5 - 6	2 - 3
7 - 8	4 - 5	
6 - 7	3 - 4	

Coastal Transect — County Boundary

Transect Baseline

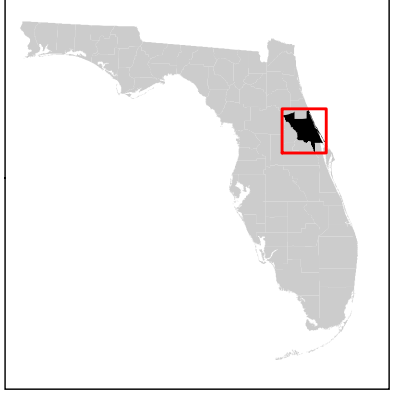
N

1 inch = 10,000 feet 1:120,000

0 2,500 5,000 10,000 15,000 20,000 Feet

Map Projection:
State Plane Florida East; North American Datum 1983

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

1 Percent-Annual-Chance Stillwater Elevation Map

VOLUSIA COUNTY, FLORIDA

FEMA

Note: This figure displays 1%-annual-chance stillwater elevations (including wave-set up). Overland wave height information is not included. Base Flood Elevations are not displayed.

Astronomical Tide

Astronomical tidal statistics were generated directly from local tidal constituents by sampling the predicted tide at random times throughout the tidal epoch.

Storm Surge Statistics

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

When historic records are used to calculate storm surge, characteristics such as the strength, size, track, etc., of storms are identified by site. Storm data was used in conjunction with numerical hydrodynamic models to determine the corresponding storm surge levels.

Statistical analyses were performed to determine the annual chance flood elevations for the GANEFL study. The study considered both high frequency (i.e., 50-, 25-, 10-, and 4-percent annual-chance) events as well as low frequency (i.e., 2-, 1-, and 0.2-percent-annual-chance) events.

Flood estimates for the low frequency events were derived by simulating a large number of storm events using a coupling of hydrodynamic and wave models (i.e., the ADCIRC-ADvanced CIRCulation model and the SWAN-Simulating Waves Nearshore model). Key storm parameters (central pressure deficit, radius to maximum winds, forward speed, track heading, and the Holland's B parameter) were used to represent a population of historic and synthetic storm events. The Joint Probability Method with Optimal Sampling (JPM-OS), developed by Resio (2007) and Toro et. al. (2010), was applied to compute Stillwater Elevations (SWELs), which include the storm surge component and the wave setup component.

High frequency events were computed based on the approach described in the report "Tide Gage Analysis for the Atlantic and Gulf Open Coast" dated December 2, 2008 (Federal Emergency Management Agency, 2008). The methods from this previous study were applied to updated tide records, through the end of 2012, which added six years of additional data to the analysis. In addition, the regionalization of the tide gages from the previous study was re-evaluated and revised using the additional data and observations of revised statistical parameters.

Tidal gages can be used instead of historic records of storms when the available tidal gage record for the area represents both the astronomical tide component and the storm surge component. Table 16 provides the gage name, managing agency, gage type, gage identifier, start date, end date, and statistical methodology applied to each gage used to determine the stillwater elevations.

Table 16: Tide Gage Analysis Specifics

Gage Name	Managing Agency of Tide Gage Record	Gage Type	Start Date	End Date	Statistical Methodology
41008	NDBC	Wave Height	1988	2008	L-moments, GEV
41009	NDBC	Wave Height	1988	2008	L-moments, GEV
41012	NDBC	Wave Height	2002	2008	L-moments, GEV
41112	NDBC	Wave Height	2008	2008	L-moments, GEV
41113	NDBC	Wave Height	2008	2008	L-moments, GEV
Bings Landing (8720757)	NOAA	Tide	2004	2005	L-moments, GEV
Buffalo Bluff SJR (8720767)	NOAA	Tide	2004	2005	L-moments, GEV
Crescent Bch (8720651)	NOAA	Tide	2004	2004	L-moments, GEV
Dames Pt SJR (8720219)	NOAA	Tide	2002	2002	L-moments, GEV
Dungeness GA (8679758)	NOAA	Tide	2005	2005	L-moments, GEV
Fernandina (8720030)	NOAA	Tide	1964	2005	L-moments, GEV
Ft Pulaski GA (8670870)	NOAA	Tide	1964	2005	L-moments, GEV
I295 SJR (8720357)	NOAA	Tide	2004	2005	L-moments, GEV
Longbranch SJR (8720242)	NOAA	Tide	2002	2002	L-moments, GEV
Main St Brdg SJR (8720226)	NOAA	Tide	2002	2004	L-moments, GEV

Table 16: Tide Gage Analysis Specifics (continued)

Gage Name	Managing Agency of Tide Gage Record	Gage Type	Start Date	End Date	Statistical Methodology
Mayport Ferry (8720220)	NOAA	Tide	1964	1999	L-moments, GEV
Mayport NS (8720218)	NOAA	Tide	2004	2004	L-moments, GEV
Palatka SJR (8720774)	NOAA	Tide	2004	2004	L-moments, GEV
Racy Pt SJR (8720625)	NOAA	Tide	2004	2004	L-moments, GEV
Red Bay SJR (8720503)	NOAA	Tide	1999	2005	L-moments, GEV
SPAG1	NDBC	Wave Height	2004	2008	L-moments, GEV
SR312 St Aug (8720582)	NOAA	Tide	2004	2004	L-moments, GEV
St Aug Bch (8720587)	NOAA	Tide	1999	1999	L-moments, GEV
St Simons GA (8677344)	NOAA	Tide	1999	2005	L-moments, GEV
Trident Pier (8721604)	NOAA	Tide	1999	2005	L-moments, GEV
TYBG1	NDBC	Wave Height	2004	2008	L-moments, GEV
Welaka SJR (8720774)	NOAA	Tide	1999	1999	L-moments, GEV

Combined Riverine and Tidal Effects

Riverine and surge rates for the lower reaches of the B-19 Canal, Laurel Creek, Spruce Creek, Thompson Creek, and Tomoka River were combined by developing curves for rate of occurrence vs. flood level for each flood source.

Wave Setup Analysis

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

5.3.2 Waves

Offshore wave conditions were modeled as part of the regional hydrodynamic and wave modeling (ADCIRC + SWAN). The regional model results provided valuable information on the wave conditions that could be expected to occur during the types of extreme storm events that would produce storm surge elevations with 1- and 0.2-percent-annual-chance probabilities of occurrence. Wave heights and periods derived from the SWAN model results were used as inputs to the wave hazard analyses described in Section 5.3.4.

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated to determine the modification to existing topography that is expected to be associated with flooding events. Erosion was evaluated using the methods listed in Table 15. The post-event eroded profile was used for the subsequent transect-based onshore wave hazard analyses.

5.3.4 Wave Hazard Analyses

Overland wave hazards were evaluated to determine the combined effects of ground elevation, vegetation, and physical features on overland wave propagation and wave runup. These analyses were performed at representative transects along all shorelines for which waves were expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1% annual chance flood.

Transect locations were chosen with consideration given to the physical land characteristics as well as development type and density so that they would closely represent conditions in their locality. Additional consideration was given to changes in the total stillwater elevation. Transects were spaced close together in areas of complex topography and dense development or where total stillwater elevations varied. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects shown in Figure 9, “Transect Location Map,” are also depicted on the FIRM. Table 17 provides the location, stillwater elevations, and starting wave conditions for each transect evaluated for overland wave hazards. In this table, “starting” indicates the parameter value at the beginning of the transect.

Wave Height Analysis

Wave height analyses were performed to determine wave heights and corresponding wave crest elevations for the areas inundated by coastal flooding and subject to overland wave propagation hazards. Refer to Figure 6 for a schematic of a coastal transect evaluated for overland wave propagation hazards.

Wave heights and wave crest elevations were modeled using the methods and models listed in Table 15, “Summary of Coastal Analyses”.

Wave Runup Analysis

Wave runup analyses were performed to determine the height and extent of runup beyond the limit of stillwater inundation for the 1% annual chance flood. Wave runup elevations were modeled using the methods and models listed in Table 15.

Table 17: Coastal Transect Parameters

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	1	19.2	13.82	*	*	*	7.2 3.3 - 7.2	9.7 4.8 - 9.7
Atlantic Ocean	2	19.26	13.8	*	*	*	7.2 7 - 7.2	9.7 4.8 - 9.7
Atlantic Ocean	3	19.3	13.75	*	*	*	7.1 6.8 - 7.1	9.6 4.8 - 9.6
Atlantic Ocean	4	19.15	13.76	*	*	*	7.2 3.3 - 7.2	9.7 5 - 9.7
Atlantic Ocean	5	19.31	13.66	*	*	*	7.2 6 - 7.2	9.7 5 - 9.7
Atlantic Ocean	6	19.15	13.24	*	*	*	7.1 6.9 - 7.1	9.6 4.8 - 9.6
Atlantic Ocean	7	19.27	13.24	*	*	*	7.1 3.6 - 7.1	9.6 4.7 - 9.6

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	8	19.38	13.21	*	*	*	7.1 3.3 - 7.1	9.6 4.7 - 9.6
Atlantic Ocean	9	19.34	13.19	*	*	*	7.1 3.2 - 7.1	9.6 4.7 - 9.6
Atlantic Ocean	10	19.53	13.21	*	*	*	7 3.5 - 7	9.5 4.6 - 9.5
Atlantic Ocean	11	19.72	13.6	*	*	*	7.1 6.8 - 7.1	9.6 4.5 - 9.6
Atlantic Ocean	12	19.69	13.61	*	*	*	7.1 3 - 7.1	9.5 4.3 - 9.5
Atlantic Ocean	13	19.45	13.59	*	*	*	7.1 3.5 - 7.1	9.6 4.1 - 9.6
Atlantic Ocean	14	19.82	13.29	*	*	*	7.15 3.4 - 7.15	9.6 4 - 9.6

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	15	19.81	13.31	*	*	*	6.9 3.4 - 6.9	9.3 3.9 - 9.3
Atlantic Ocean	16	19.37	13.67	*	*	*	7.2 2.3 - 7.2	9.7 3.7 - 9.7
Atlantic Ocean	17	19.08	13.39	*	*	*	6.8 2.4 - 6.8	9.6 3.9 - 9.6
Atlantic Ocean	18	19.46	13.34	*	*	*	6.9 2.4 - 6.9	9.4 4.5 - 9.4
Atlantic Ocean	19	19	13.33	*	*	*	6.9 3.3 - 6.9	9.3 2.7-9.3
Atlantic Ocean	20	19.55	13.28	*	*	*	6.8 3.2 - 6.8	9.3 4.4 - 9.3
Atlantic Ocean	21	19.55	13.25	*	*	*	7 3.3 - 7	9.4 4.5 - 9.4

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	22	19.18	13.54	*	*	*	6.9 3.3 - 6.9	9.3 4.5 - 9.3
Atlantic Ocean	23	19.09	13.8	*	*	*	7 3.3 - 7	9.4 4.5 - 9.4
Atlantic Ocean	24	19.23	13.8	*	*	*	6.9 3.3 - 6.9	9.4 4.3 - 9.4
Atlantic Ocean	25	19.27	13.68	*	*	*	6.9 3.2 - 6.9	9.4 4.5 - 9.4
Atlantic Ocean	26	19.22	13.46	*	*	*	6.9 3.4 - 6.9	9.3 4.7 - 9.3
Atlantic Ocean	27	19.3	13.38	*	*	*	6.9 3.3 - 6.9	9.3 5 - 9.3
Atlantic Ocean	28	19.51	13.41	*	*	*	7 3.1 - 7	9.4 5.2 - 9.4

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	29	19.29	13.41	*	*	*	7 3.7 - 7	9.4 5.4 - 9.4
Atlantic Ocean	30	19.71	13.88	*	*	*	6.9 3.9 - 6.9	9.3 5.3 - 9.3
Atlantic Ocean	31	19.71	13.84	*	*	*	6.8 3.9 - 6.8	9.2 5.2 - 9.2
Atlantic Ocean	32	19.76	13.88	*	*	*	6.8 3.6 - 6.8	9.2 5.2 - 9.2
Atlantic Ocean	33	19.38	13.66	*	*	*	6.7 4.1 - 6.7	9.2 5.3 - 9.2
Atlantic Ocean	34	19.01	13.71	*	*	*	6.7 4.2 - 6.7	9.1 5.6 - 9.1
Atlantic Ocean	35	19.01	13.59	*	*	*	6.7 4.5 - 6.7	9.1 6 - 9.1

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	36	19.33	13.6	*	*	*	6.6 4.8 - 6.6	9 6.3 - 9
Atlantic Ocean	37	19.21	13.6	*	*	*	6.7 5 - 6.7	9 6.4 - 9
Atlantic Ocean	38	19.24	13.59	*	*	*	6.7 5.1 - 6.7	9 6.6 - 9
Atlantic Ocean	39	18.99	13.45	*	*	*	6.7 5.2 - 6.7	9 6.8 - 9
Atlantic Ocean	40	19.07	13.4	*	*	*	6.7 5.2 - 6.7	9.2 7 - 9.2
Atlantic Ocean	41	18.96	13.06	*	*	*	6.7 5.1 - 6.7	9.1 7.2 - 9.1
Atlantic Ocean	42	19.25	13.1	*	*	*	6.7 5.1 - 6.7	9 7.2 - 9

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	43	19.06	12.84	*	*	*	6.2 5 - 6.2	8.6 7.2 - 8.6
Atlantic Ocean	44	17.2	13.7	*	*	*	6.6 5 - 6.6	9 7.1 - 9
Atlantic Ocean	45	17.4	13.7	*	*	*	6.6 5.1 - 6.6	8.9 7.1 - 8.9
Atlantic Ocean	46	18	13.2	*	*	*	6.5 5.2 - 6.5	8.8 7.2 - 8.8
Atlantic Ocean	47	18.4	13.2	*	*	*	6.45 5 - 6.45	8.7 7.1 - 8.7
Atlantic Ocean	48	18.5	13.2	*	*	*	6.4 5.1 - 6.4	8.6 7.1 - 8.6
Atlantic Ocean	49	17.9	13.1	*	*	*	6.4 5 - 6.4	8.6 6.8 - 8.6

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	50	18.6	12.9	*	*	*	6.45 4.5 - 6.45	8.7 6.3 - 8.7
Atlantic Ocean	51	18.1	13.2	*	*	*	6.6 4.3 - 6.6	8.9 5.9 - 8.9
Atlantic Ocean	52	18.2	13.2	*	*	*	6.6 4.3 - 6.6	8.8 5.7 - 8.8
Atlantic Ocean	53	18	13	*	*	*	6.5 4.1 - 6.5	9 5.5 - 9
Atlantic Ocean	54	18.3	13	*	*	*	6.55 4 - 6.55	8.8 5.4 - 8.8
Atlantic Ocean	55	18.5	13	*	*	*	6.55 3.9 - 6.55	8.8 5.2 - 8.8
Atlantic Ocean	56	18.1	12.9	*	*	*	6.5 3.5 - 6.5	8.8 5 - 8.8

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	57	18.2	12.7	*	*	*	6.5 3.4 - 6.5	8.8 4.8 - 8.8
Atlantic Ocean	58	18.2	12.3	*	*	*	6.6 3.3 - 6.6	8.8 4.6 - 8.8
Atlantic Ocean	59	18.3	12	*	*	*	6.6 3.2 - 6.6	8.8 4.5 - 8.8
Atlantic Ocean	60	18.2	11.8	*	*	*	6.6 2.8 - 6.6	8.9 4.3 - 8.9
Atlantic Ocean	61	18.1	12.4	*	*	*	6.6 2.7 - 6.6	8.9 4.3 - 8.9
Atlantic Ocean	62	18.1	12.5	*	*	*	6.4 2.8 - 6.4	8.7 4.3 - 8.7
Atlantic Ocean	63	18.1	12.6	*	*	*	6.3 2.8 - 6.3	8.6 4.3 - 8.6

Table 17: Coastal Transect Parameters (continued)

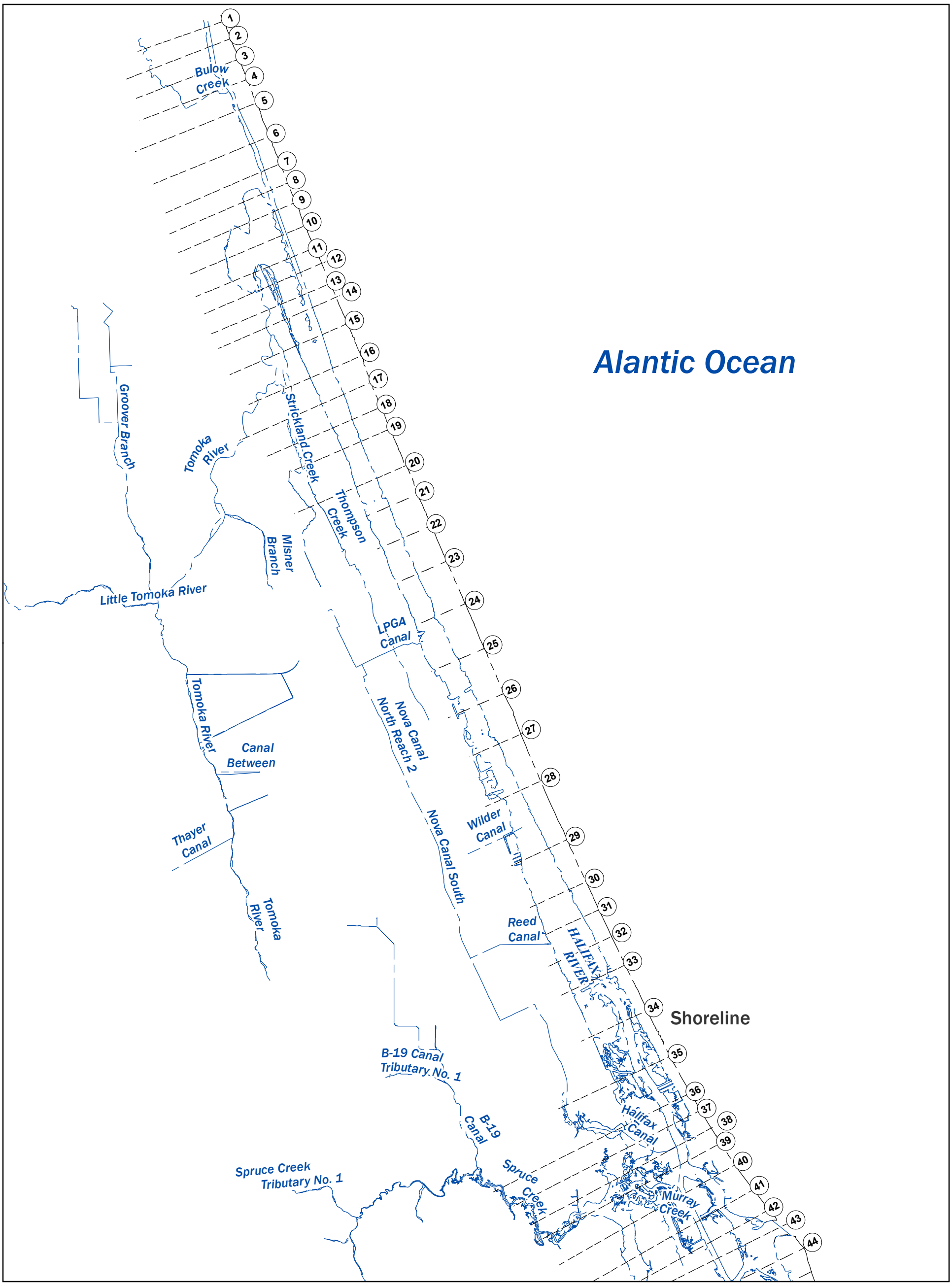
Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	64	18.4	12.2	*	*	*	6.3 3.0 - 6.3	8.6 4.3 - 8.6
Atlantic Ocean	65	18.5	12.4	*	*	*	6.2 2.7 - 6.3	8.6 4.3 - 8.6
Atlantic Ocean	66	18.3	12.4	*	*	*	6.3 2.5 - 6.3	8.6 4 - 8.6
Atlantic Ocean	67	18.3	12.4	*	*	*	6.45 2.5 - 6.5	8.8 4 - 8.8
Atlantic Ocean	68	18.3	12.4	*	*	*	6.4 2.3 - 6.4	8.7 3.8 - 8.7
Atlantic Ocean	69	18.3	12.4	*	*	*	6.6 2.2 - 6.6	8.9 3.7 - 8.9
Atlantic Ocean	70	18.3	12.4	*	*	*	6.4 2.2 - 6.4	8.7 3.6 - 8.7

Table 17: Coastal Transect Parameters (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	71	18.3	12.4	*	*	*	6.4 2.1 - 6.4	8.8 3.5 - 8.8
Atlantic Ocean	72	18.3	12.4	*	*	*	6.45 2.4 - 6.5	8.8 3.5 - 8.8
Atlantic Ocean	73	18.3	12.4	*	*	*	6.5 2.5 - 6.5	8.8 3.5 - 8.8
Atlantic Ocean	74	18.3	12.4	*	*	*	6.2 2.5 - 6.2	8.7 3.5 - 8.7

*Not calculated for this Flood Risk Project

Figure 9: Transect Location Map



N

1 inch = 10,000 feet 1:120,000

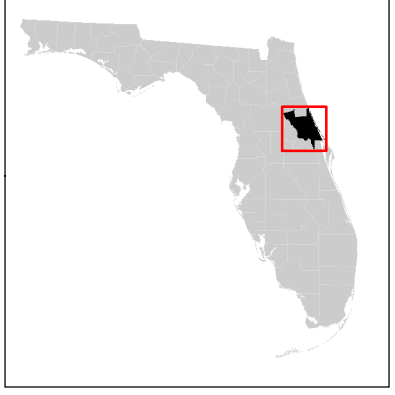
Feet
0 2,500 5,000 10,000 15,000 20,000

Map Projection:
State Plane Florida East; North American Datum 1983

Coastal Features

- Coastal Transect Baseline
- Coastal Transect
- Hydrographic Feature

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

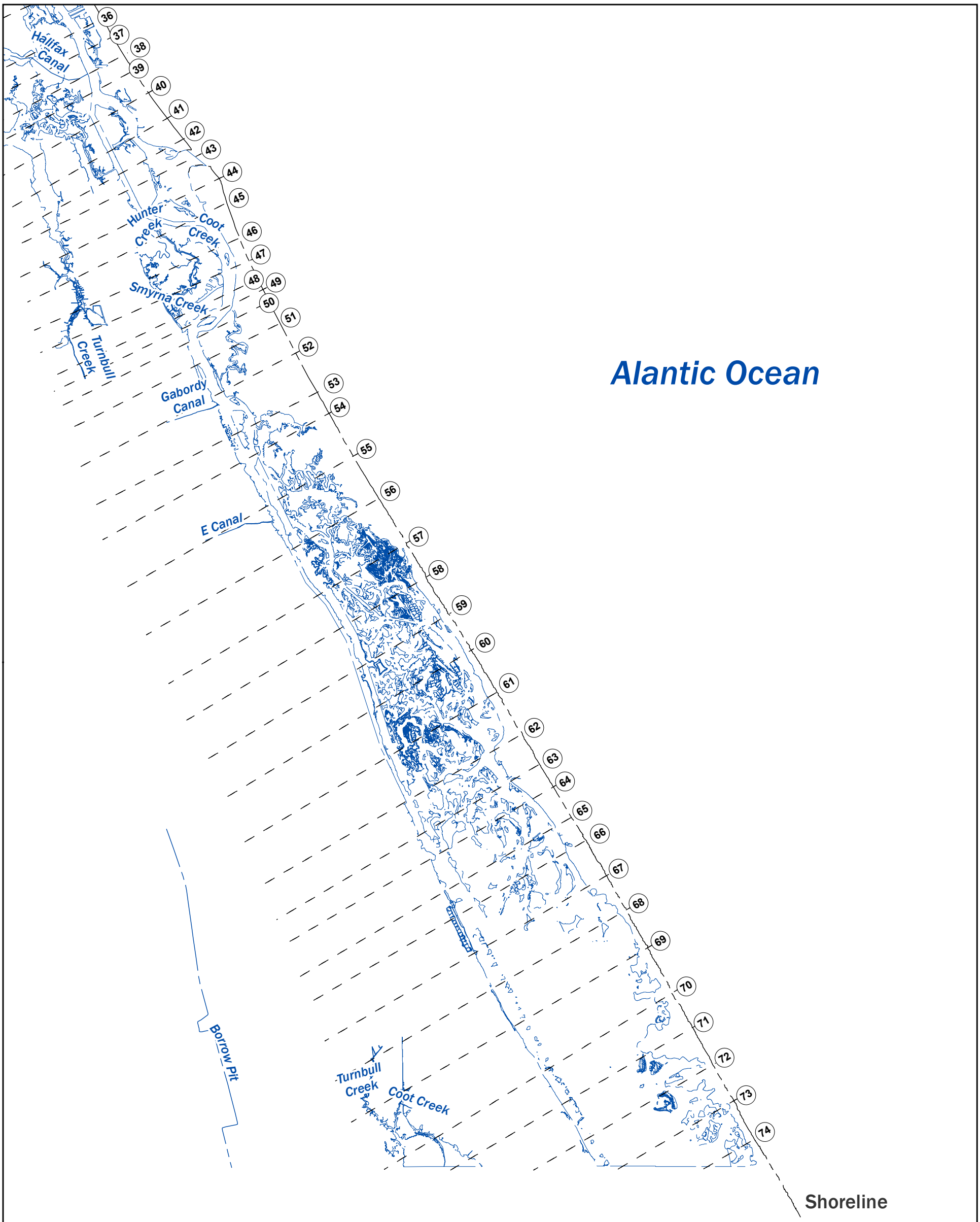
Transect Location Map

PANELS WITH TRANSECTS

0042J, 0044J, 0061J, 0062J, 0064J, 0201J, 0202K, 0203K, 0204K, 0208K, 0211K, 0212K, 0216K, 0218K, 0219J, 0356J, 0357J, 0359J, 0367J, 0378J, 0386J, 0388J, 0389J, 0509J, 0526J, 0527J, 0528J, 0529J, 0531J, 0533J, 0534K, 0540J, 0541J, 0542J, 0543J, 0544J, 0563J, 0685J, 0700J, 0705J, 0715J, 0720J, 0825J, 0830J, 0835J, 0840J, 0845J, 0865J

FEMA

Figure 9 (cont): Transect Location Map



1 inch = 10,000 feet 1:120,000

N

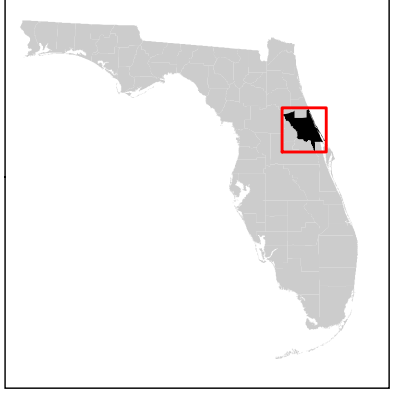
0 2,500 5,000 10,000 15,000 20,000 Feet

Map Projection:
State Plane Florida East; North American Datum 1983

Coastal Features

- Coastal Transect Baseline
- Coastal Transect
- Hydrographic Feature

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

Transect Location Map

PANELS WITH TRANSECTS

0042J, 0044J, 0061J, 0062J, 0064J, 0201J, 0202K, 0203K, 0204K, 0208K, 0211K, 0212K, 0216K, 0218K, 0219J, 0356J, 0357J, 0359J, 0367J, 0378J, 0386J, 0388J, 0389J, 0509J, 0526J, 0527J, 0528J, 0529J, 0531J, 0533J, 0534K, 0540J, 0541J, 0542J, 0543J, 0544J, 0563J, 0685J, 0700J, 0705J, 0715J, 0720J, 0825J, 0830J, 0835J, 0840J, 0845J, 0865J

FEMA

5.4 Alluvial Fan Analyses

This section is not applicable to this Flood Risk Project.

Table 18: Summary of Alluvial Fan Analyses

[Not Applicable to this Flood Risk Project]

Table 19: Results of Alluvial Fan Analyses

[Not Applicable to this Flood Risk Project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

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 used for newly created or revised FIS Reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS Reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS Report and on the FIRMs are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between NGVD29 and NAVD88 or other datum conversion, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey (NGS) at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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 archived project documentation associated with the FIS Report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks in the area, please contact information services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for Volusia County are provided in Table 20.

Table 20: Countywide Vertical Datum Conversion

[Not applicable to this Flood Risk Project]

Table 21: Stream-Based Vertical Datum Conversion

[Not applicable to this Flood Risk Project]

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA's FIRM database specifications and geographic information standards. This information is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community. The FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA's *Guidelines and Standards for Flood Risk Analysis and Mapping*, http://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping.

Base map information shown on the FIRM was derived from the sources described in Table 22.

Table 22: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
Community Boundaries	Volusia County Growth and Resource Management	2013	1:12,000	Municipal boundaries were provided for the incorporated areas of the county
Water Areas	Volusia County Growth and Resource Management	2009	1:12,000	Polygonal hydrographic features
Transportation Features	Volusia County Growth and Resource Management	2013	1:12,000	Road and railroad data
County Boundary	Federal Emergency Management Agency	2014	1:12,000	County boundary
Airports	Volusia County GIS Department	2005	1:12,000	Airport runway data
Water Lines	Federal Emergency Management Agency	2014	1:3,000	Linear hydrographic features
Aerial Photographs	Florida Department of Transportation	2015	1:2,400	Volusia County, FL orthophotography
Aerial Photographs	Florida Department of Transportation	2015	1:2,400	Brevard County, FL orthophotography
Aerial Photographs	Florida Department of Transportation	2014	1:2,400	Flagler County, FL orthophotography
Aerial Photographs	Florida Department of Transportation	2012	1:2,400	Seminole County, FL orthophotography
Aerial Photographs	Florida Department of Transportation	2014	1:2,400	Putnam County, FL orthophotography
CBRS	U.S. Fish and Wildlife Service	2010	1:24,000	John H. Chafee Coastal Barrier Resources System
Subbasins	United States Geological Survey	2014	1:24,000	USGS Hydrologic Unit Code 8 (HUC8) Subbasins

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23. For each coastal flooding source studied as part of this FIS Report, the mapped floodplain boundaries on the FIRM have been delineated using the flood and wave elevations determined at each transect; between transects, boundaries were delineated using land use and land cover data, the topographic elevation data described in Table 23, and knowledge of coastal flood processes. In ponding areas, flood elevations were determined at each junction of the model; between junctions, boundaries were interpolated using the topographic elevation data described in Table 23.

In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% 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.

The floodway widths presented in this FIS Report and on the FIRM 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. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 24, "Floodway Data."

Table 23: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data					
		Description	Scale	Contour Interval	$RMSE_z$	$Accuracy_z$	Citation
Volusia County and Incorporated Areas	All within HUC's 03080101, 03080103, 03080201, 03080202	LiDAR	1:100	1 ft	Woolpert, Inc.	Volusia County and Incorporated Areas	All within HUC's 03080101, 03080103, 03080201, 03080202

BFEs shown at cross sections on the FIRM represent the 1% annual chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations.

Table 24: Floodway Data

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	647	74	312	4.1	5.6[2]	2.7[3]	3.0	0.3
B	1,874	70	336	3.7	5.6[2]	4.7[3]	5.1	0.4
C	3,462	60	335	3.7	9.1	9.1	9.1	0.0
D	5,039	30	210	5.7	10.0	10.0	10.1	0.1
E	6,137	69	215	5.6	16.9	16.9	16.9	0.0
F	6,822	58	308	3.8	19.0	17.9	17.9	0.0
G	8,849	79	427	2.7	22.7	20.0	20.0	0.0
H	9,629	38	220	5.2	23.3	21.1	21.1	0.0
I	11,988	35	214	4.6	24.8	24.0	24.5	0.5
J	13,710	58	347	2.5	26.1	25.7	26.1	0.4
K	15,924	74	392	1.9	27.0	26.9	27.3	0.4
L	17,578	55	313	2.1	27.3	27.2	27.6	0.4
M	18,351	44	338	1.8	27.4	27.3	27.7	0.4
N	19,346	53	345	1.7	27.4	27.4	27.8	0.4
O	22,399	760	1,573	0.4	27.5	27.4	28.3	0.9
P	23,790	2159	6,081	0.1	27.5	27.5	28.4	0.9
Q	26,196	742	1,609	0.3	27.6	27.5	28.4	0.9
R	28,138	1273	4,683	0.1	27.6	27.6	28.5	0.9
S	31,035	135	506	0.8	27.8	27.7	28.6	0.9
T	34,316	176	1,027	0.2	28.8	28.8	29.7	0.9

[1]Feet above mouth
[2]Combined coastal and riverine effects from Atlantic Ocean
[3]Elevation computed without consideration of backwater effects from Spruce Creek

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FLORIDA

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: B-19 CANAL

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	163	301	1049	0.6	3.4[2]	0.0[3]	0.0	0.0
B	2427	69	323	1.8	3.3[2]	1.5[3]	1.5	0.0
C	3417	109	859	0.6	5.5	5.5	6.4	0.9
D	5940	236	1313	0.3	5.5	5.5	6.5	1.0
E	7751	822	2966	0.1	5.5	5.5	6.5	1.0
F	7987	777	2241	0.2	5.6	5.6	6.5	0.9
G	10808	192	539	0.5	6.7	6.7	7.6	0.9
H	11090	55	271	1.0	6.7	6.7	7.6	0.9
I	12474	55	298	0.8	6.7	6.7	7.7	1.0
J	13148	1349	8059	0.0	6.7	6.7	7.7	1.0
K	13399	145	523	0.4	6.7	6.7	7.7	1.0
L	13604	2120	7301	0.0	6.7	6.7	7.7	1.0
M	14113	1639	3377	0.1	6.7	6.7	7.7	1.0
N	14558	248	518	0.5	6.7	6.7	7.7	1.0
O	15639	971	2280	0.1	6.7	6.7	7.7	1.0
P	15898	403	793	0.2	6.8	6.8	7.7	1.0
Q	16425	1145	3064	0.0	6.8	6.8	7.8	1.0
R	16675	1019	2425	0.1	6.8	6.8	7.8	1.0
S	16980	544	3277	0.0	6.8	6.8	7.8	1.0
T	34457	176	1027	0.2	28.8	28.8	29.7	0.9

[1]Feet above confluence with Tomoka River
[2]Combined coastal and riverine effects form Atlantic Ocean
[3]Elevation computed without consideration of backwater effects from Tomoka River

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY **VOLUSIA COUNTY, FLORIDA** AND INCORPORATED AREAS	**FLOODWAY DATA** **FLOODING SOURCE: LAUREL CREEK**

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
B-19 Canal Tributary No. 7								
A	1004	46	359	0.4	28.6	28.6	29.6	1.0
Bulow Creek								
A	10830	328	1449	1.9	2.9[2]	2.5[3]	3.4	0.9
B	12000	600	2637	1.0	2.9[2]	2.8[3]	3.8	1.0
C	16702	538	3181	0.9	5.2	4.9	5.8	0.9
D	21649	834	4835	0.5	5.4	5.2	6.2	1.0
Groover Branch								
A	650	385	2547	1.2	8.9	5.5[4]	6.5	1.0
B	1735	77	541	5.5	8.9	7.0[4]	8.0	1.0
C	3071	77	698	4.2	9.0	9.0	10.0	1.0
D	3510	122	802	3.7	9.8	9.8	10.7	0.9
E	4562	176	1534	1.8	12.3	12.3	13.1	0.8
F	5858	109	1081	2.7	16.7	16.7	17.3	0.6
G	7207	51	583	4.7	18.8	18.8	19.8	1.0

[1]Feet above mouth
[2]Coastal flooding elevation; extracted from FIRM
[3]Elevation computed without consideration of storm surge from Halifax River/Intracoastal Waterway
[4]Elevation computed without consideration of backwater effects from Tomoka River

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Tomoka River								
A	800	406	2,670	2.0	9.1	5.4[2]	6.4	1.0
B	1,851	55	820	6.4	9.9	9.9	10.8	0.9
C	3,998	484	5,196	1.0	12.1	12.1	13.1	1.0
D	5,686	316	3,297	1.5	13.7	13.7	14.7	1.0
E	6,577	87	930	5.0	14.5	14.5	15.5	1.0
F	7,706	411	3,879	1.2	16.1	16.1	17.1	1.0
G	8,757	237	2,206	2.1	17.1	17.1	18.0	0.9
H	10,664	138	1,188	3.6	20.3	20.3	20.9	0.6
I	13,866	432	2,717	0.9	25.6	25.6	26.6	1.0
J	15,062	115	718	3.4	28.2	28.2	28.6	0.4
Misner Branch								
A	275	49	349	2.6	7.3	4.1[2]	5.1	1.0
B	2,161	265	1,311	0.6	7.3	4.9[2]	5.8	0.9
C	4,578	29	227	3.5	7.3	6.1[2]	7.0	0.9
D	6,436	37	248	2.7	7.5	7.5	8.5	1.0
E	8,705	16	147	4.6	12.6	12.6	13.6	1.0
F	10,856	16	131	0.7	13.6	13.6	14.5	0.9

[1]Feet above mouth
[2]Elevation computed without consideration of backwater effects from Tomoka River

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	4,700	908	4,630	0.8	7.6[2]	1.0[3]	2.0	1.0
B	5,655	624	3,072	1.2	6.5[2]	1.3[3]	2.2	0.9
C	11,275	196	1,792	2.0	6.5[2]	2.2[3]	2.9	0.7
D	19,100	299	2,617	1.4	6.5[2]	3.1[3]	3.8	0.7
E	24,525	228	2,278	1.5	6.5[2]	3.6[3]	4.2	0.6
F	29,050	481	2,855	1.1	6.5[2]	3.9	4.6	0.7
G	29,780	496	3,149	1.0	5.7[2]	4.0	4.7	0.7
H	33,370	244	1,694	1.8	5.8[2]	4.5	5.5	1.0
I	40,145	275	2,086	1.4	6.1[2]	5.3	6.3	1.0
J	47,645	545	2,344	1.2	6.9[2]	6.6	7.4	0.8
K	49,278	498	2,753	1.1	8.4[2]	8.3	9.0	0.7
L	50,903	249	1,181	1.9	9.2	9.1	10.0	0.9
M	52,303	373	2,215	1.0	10.1	10.1	11.1	1.0
N	53,138	172	924	2.0	10.7	10.7	11.7	1.0
O	57,568	113	764	2.4	16.0	16.0	17.0	1.0
P	58,568	66	612	3.0	17.1	17.1	18.0	0.9
Q	59,283	130	751	2.4	17.7	17.7	18.6	0.9
R	62,399	51	570	3.2	21.2	21.2	21.6	0.4

[1]Feet above U.S. Highway 1

[2]Combined coastal and riverine effects from Atlantic Ocean

[3]Elevation computed without consideration of backwater effects from Tomoka River

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FLORIDA

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: SPRUCE CREEK

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Spruce Creek Tributary No. 1								
A	575	111	501	2.4	8.8	6.7[2]	7.7	1.0
B	3,105	52	286	4.2	10.3	10.3	11.2	0.9
C	5,014	101	392	2.1	13.3	13.3	14.3	1.0
D	6,665	47	216	3.9	19.9	19.9	20.2	0.3
E	8,466	174	522	1.6	26.0	26.0	26.5	0.5
Spruce Creek Tributary No. 2								
A	590	76	286	3.7	10.4	7.9[2]	8.8	0.9
B	2,954	46	221	4.7	16.7	16.7	17.7	1.0

[1]Feet above mouth

[2]Elevation computed without consideration of backwater effects from Spruce Creek

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	794	67	247	1.4	3.3[2]	1.6[3]	1.6	0.0
B	2,059	60	444	0.8	5.6	5.6	6.2	0.6
C	2,437	87	467	0.6	5.6	5.6	6.3	0.7
D	4,218	95	617	0.5	7.5	7.5	8.4	0.9
E	4,869	54	460	0.7	7.5	7.5	8.4	0.9
F	5,735	49	345	0.8	7.5	7.5	8.5	1.0
G	6,448	238	1,339	0.2	7.5	7.5	8.5	1.0
H	7,562	402	2,852	0.0	7.5	7.5	8.5	1.0
I	9,060	411	1,769	0.1	7.5	7.5	8.5	1.0

[1]Feet above U.S. Highway 1
[2]Combined coastal and riverine effects from Atlantic Ocean
[3]Elevation computed without consideration of backwater effects from Tomoka River

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	3345	203	2174	4.1	3.6[2]	1.8[3]	1.8	0.0
B	7,428	272	2,729	3.3	4.0[2]	3.4	3.8	0.4
C	14,219	418	4,165	2.1	4.8[2]	4.6	5.5	0.9
D	20,034	2,445	15,745	0.7	5.5[2]	5.4	6.4	1.0
E	22,925	241	3,677	3.4	5.7	5.7	6.7	1.0
F	23,484	249	3,905	3.2	5.9	5.9	6.9	1.0
G	25,739	659	7,158	1.7	6.3	6.3	7.3	1.0
H	30,663	281	4,786	2.7	7.0	7.0	8.0	1.0
I	35,095	756	8,739	1.5	7.5	7.5	8.5	1.0
J	38,241	309	4,866	2.8	7.8	7.8	8.7	0.9
K	43,152	477	6,335	2.2	8.5	8.5	9.5	1.0
L	45,210	542	6,734	2.1	8.9	8.9	9.9	1.0
M	46,912	311	4,754	1.3	9.2	9.2	10.2	1.0
N	49,810	448	4,298	1.8	9.4	9.4	10.4	1.0
O	52,677	774	8,499	0.9	10.4	10.4	11.4	1.0
P	54,934	536	6,267	1.0	11.3	11.3	12.3	1.0
Q	58,152	522	5,686	1.0	12.6	12.6	13.6	1.0
R	60,216	629	6,323	0.9	13.4	13.4	14.4	1.0
S	63,130	249	2,026	2.8	14.7	14.7	15.7	1.0

[1]Feet above Tomoka Basin
[2]Combined coastal and riverine effects from Atlantic Ocean
[3]Elevation computed without consideration of storm surge effects from Tomoka River

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY VOLUSIA COUNTY, FLORIDA AND INCORPORATED AREAS	FLOODWAY DATA FLOODING SOURCE: TOMOKA RIVER

Table 24: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
T	66,328	534	5,327	1.0	16.5	16.5	17.5	1.0
U	69,247	557	5,904	0.8	17.5	17.5	18.5	1.0
V	71,744	432	4,063	1.1	18.2	18.2	19.2	1.0
W	74,895	394	2,859	1.5	19.9	19.9	20.9	1.0
X	76734	319	2812	1.5	21.0	21.0	22.0	1.0
Y	80125	640	4346	1.0	22.5	22.5	23.5	1.0
Z	84475	191	1269	1.2	24.0	24.0	24.8	0.8
AA	86737	399	2490	0.6	24.1	24.1	24.9	0.8
AB	88161	422	2336	0.8	24.1	24.1	24.9	0.8
AC	89559	780	3773	0.2	24.1	24.1	24.9	0.8

[1]Feet above confluence with Tomoka Basin

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FLORIDA

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: TOMOKA RIVER

Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams

[Not applicable to this Flood Risk Project]

6.4 Coastal Flood Hazard Mapping

Flood insurance zones and BFEs including the wave effects were identified on each transect based on the results from the onshore wave hazard analyses. Between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and knowledge of coastal flood processes to determine the aerial extent of flooding. Sources for topographic data are shown in Table 23.

Zone VE is subdivided into elevation zones and BFEs are provided on the FIRM.

The limit of Zone VE shown on the FIRM is defined as the farthest inland extent of any of these criteria (determined for the 1% annual chance flood condition):

- The *primary frontal dune zone* is defined in 44 CFR Section 59.1 of the NFIP regulations. The primary frontal dune represents a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes that occur immediately landward and adjacent to the beach. The primary frontal dune zone is subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune zone occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

- The *wave runup zone* occurs where the (eroded) ground profile is 3.0 feet or more below the 2-percent wave runup elevation.

- The *wave overtopping splash zone* is the area landward of the crest of an overtopped barrier, in cases where the potential 2-percent wave runup exceeds the barrier crest elevation by 3.0 feet or more.

- The *breaking wave height zone* occurs where 3-foot or greater wave heights could occur (this is the area where the wave crest profile is 2.1 feet or more above the total stillwater elevation).

- The *high-velocity flow zone* is landward of the overtopping splash zone (or area on a sloping beach or other shore type), where the product of depth of flow times the flow velocity squared (hv^2) is greater than or equal to 200 ft^3/sec^2. This zone may only be used on the Pacific Coast.

The SFHA boundary indicates the limit of SFHAs shown on the FIRM as either “V” zones or “A” zones.Table 26 indicates the coastal analyses used for floodplain mapping and the criteria used to determine the inland limit of the open-coast Zone VE and the SFHA boundary at each transect.

Table 26: Summary of Coastal Transect Mapping Considerations

Coastal Transect	Primary Frontal Dune (PFD) Identified	Wave Runup Analysis	Wave Height Analysis	Zone VE Limit	SFHA Boundary
		Zone Designation and BFE (ft NAVD88)	Zone Designation and BFE (ft NAVD88)		
1		11 VE	8 AE	540[1]	540[1]
2		11 VE	8 AE	540[1]	540[1]
3		11 VE	8 AE	540[1]	540[1]
4		11 VE	8 AE	540[1]	540[1]
5		11 VE	8 AE	540[1]	540[1]
6		10 VE	8 AE	540[1]	540[1]
7		11 VE	8 AE	540[1]	540[1]
8		11 VE	8 AE	540[1]	540[1]
9		11 VE	8 AE	540[1]	540[1]
10		11 VE	8 AE	540[1]	540[1]
11		11 VE	8 AE	540[1]	540[1]
12		11 VE	8 AE	540[1]	540[1]
13		11 VE	8 AE	540[1]	540[1]
14		11 VE	8 AE	540[1]	540[1]
15		11 VE	8 AE	540[1]	540[1]
16		11 VE	8 AE	540[1]	540[1]
17		10 VE	8 AE	540[1]	540[1]
18		11 VE	8 AE	540[1]	540[1]
19		11 VE	8 AE	540[1]	540[1]
20		11 VE	8 AE	540[1]	540[1]
21		11 VE	8 AE	540[1]	540[1]
22		10 AE	8 AE	Structure	Structure
23		10 VE	8 AE	540[1]	540[1]
24		9 AE	8 AE	Structure	Structure
25		9 AE	8 AE	Structure	Structure

[1]540 sq ft is the minimum cross sectional area measured perpendicular to the shoreline, above the 100-yr SWEL and seaward of the crest of the dune; for a PFD to be considered a barrier to base flood storm surges.

Table 26: Summary of Coastal Transect Mapping Considerations (continued)

Coastal Transect	Primary Frontal Dune (PFD) Identified	Wave Runup Analysis	Wave Height Analysis	Zone VE Limit	SFHA Boundary
		Zone Designation and BFE (ft NAVD88)	Zone Designation and BFE (ft NAVD88)		
26		9 AE	8 AE	Structure	Structure
27		9 AE	8 AE	Structure	Structure
28		10 AE	8 AE	Structure	Structure
29		10 AE	9 AE	Structure	Structure
30		10 VE	8 AE	540[1]	540[1]
31		9 AE	8 AE	Structure	Structure
32		9 AE	8 AE	Structure	Structure
33		9 AE	8 AE	Structure	Structure
34		9 AE	8 AE	Structure	Structure
35		10 VE	8 AE	540[1]	540[1]
36	✓	10 VE	9 VE	PFD	PFD
37		10 AE	8 AE	Structure	Structure
38		10 VE	8 AE	540[1]	540[1]
39		10 VE	8 AE	540[1]	540[1]
40		10 VE	8 AE	540[1]	540[1]
41		10 VE	8 AE	540[1]	540[1]
42		N/A	8 AE	540[1]	540[1]
43		N/A	13 VE	N/A	N/A
44		8 AE	8 AE	540[1]	540[1]
45		8 AE	8 AE	540[1]	540[1]
46		10 VE	8 AE	540[1]	540[1]
47		10 VE	8 AE	540[1]	540[1]
48		9 AE	8 AE	540[1]	540[1]
49		9 AE	8 AE	540[1]	540[1]
50		9 VE	8 AE	540[1]	540[1]

[1]540 sq ft is the minimum cross sectional area measured perpendicular to the shoreline, above the 100-yr SWEL and seaward of the crest of the dune; for a PFD to be considered a barrier to base flood storm surges.

Table 26: Summary of Coastal Transect Mapping Considerations (continued)

Coastal Transect	Primary Frontal Dune (PFD) Identified	Wave Runup Analysis	Wave Height Analysis	Zone VE Limit	SFHA Boundary
		Zone Designation and BFE (ft NAVD88)	Zone Designation and BFE (ft NAVD88)		
51		10 VE	8 AE	540[1]	540[1]
52		9 AE	8 AE	Structure	Structure
53		9 AE	8 AE	Structure	Structure
54		9 AE	8 AE	Structure	Structure
55		10 VE	8 AE	540[1]	540[1]
56		9 AE	8 AE	Structure	Structure
57	✓	10 VE	8 VE	PFD	PFD
58	✓	10 VE	8 VE	PFD	PFD
59	✓	N/A	9 VE	PFD	PFD
60	✓	10 VE	9 VE	PFD	PFD
61	✓	10 VE	9 VE	PFD	PFD
62	✓	10 VE	9 VE	PFD	PFD
63	✓	10 VE	8 VE	PFD	PFD
64		10 VE	8 VE	540[1]	540[1]
65		10 VE	8 VE	540[1]	540[1]
66		10 VE	8 VE	540[1]	540[1]
67		10 VE	9 VE	540[1]	540[1]
68	✓	10 VE	9 VE	PFD	PFD
69	✓	10 VE	9 VE	PFD	PFD
70	✓	10 VE	9 VE	PFD	PFD
71	✓	10 VE	9 VE	PFD	PFD
72	✓	N/A	9 VE	PFD	PFD
73	✓	N/A	9 VE	PFD	PFD
74	✓	N/A	8 VE	PFD	PFD

[1]540 sq ft is the minimum cross sectional area measured perpendicular to the shoreline, above the 100-yr SWEL and seaward of the crest of the dune; for a PFD to be considered a barrier to base flood storm surges.

A LiMWA boundary has also been added in coastal areas subject to wave action for use by local communities in safe rebuilding practices. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave.

6.5 FIRM Revisions

This FIS Report and the FIRM are based on the most up-to-date information available to FEMA at the time of its publication; however, flood hazard conditions change over time. Communities or private parties may request flood map revisions at any time. Certain types of requests require submission of supporting data. FEMA may also initiate a revision. Revisions may take several forms, including Letters of Map Amendment (LOMAs), Letters of Map Revision Based on Fill (LOMR-Fs), Letters of Map Revision (LOMRs) (referred to collectively as Letters of Map Change (LOMCs)), Physical Map Revisions (PMRs), and FEMA-contracted restudies. These types of revisions are further described below. Some of these types of revisions do not result in the republishing of the FIS Report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data (shown in Table 31, "Map Repositories").

6.5.1 Letters of Map Amendment

A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative process that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in a SFHA. A LOMA cannot be issued for properties located on the PFD (primary frontal dune).

To obtain an application for a LOMA, visit https://www.fema.gov/floodplain-management/letter-map-amendment-loma and download the form "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill". Visit the "Flood Map-Related Fees" section to determine the cost, if any, of applying for a LOMA.

FEMA offers a tutorial on how to apply for a LOMA. The LOMA Tutorial Series can be accessed at http://www.fema.gov/online-tutorials.

For more information about how to apply for a LOMA, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627).

6.5.2 Letters of Map Revision Based on Fill

A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the base flood elevation and is, therefore, excluded from the SFHA.

Information about obtaining an application for a LOMR-F can be obtained in the same manner as that for a LOMA, by visiting https://www.fema.gov/floodplain-management/letter-map-amendment-loma for the "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill" or by calling the FEMA Map Information eXchange, toll free, at 1-877-FEMA MAP (1-877-336-2627). Fees for applying for a LOMR-F, if any, are listed in the "Flood Map-Related Fees" section.

A tutorial for LOMR-F is available at http://www.fema.gov/online-tutorials.

6.5.3 Letters of Map Revision

A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations and planimetric features. All requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

To obtain an application for a LOMR, visit https://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/mt-2-application-forms-and-instructions and download the form "MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision". Visit the "Flood Map-Related Fees" section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

Previously issued mappable LOMCs (including LOMRs) that have been incorporated into the Volusia County FIRM are listed in Table 27. Please note that this table only includes LOMCs that have been issued on the FIRM panels updated by this map revision. For all other areas within this county, users should be aware that revisions to the FIS Report made by prior LOMRs may not be reflected herein and users will need to continue to use the previously issued LOMRs to obtain the most current data.

Table 27: Incorporated Letters of Map Change

Case Number	Effective Date	Flooding Source	FIRM Panel(s)
14-04-0649P	12/2/2014	Fish Memorial Pond 1, Fish Memorial Pond 2, Fish Memorial Pond 3, Fish Memorial Pond 4	12127C0620K

6.5.4 Physical Map Revisions

Physical Map Revisions (PMRs) are an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit http://www.fema.gov and visit the "Flood Map Revision Processes" section.

6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of Volusia County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 28, "Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.

- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first Flood Hazard Boundary Map (FHBM). This date may be the same date as the Initial NFIP Map Date.

- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.

- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community.

- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in

countywide format, as Physical Map Revisions (PMR) of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Volusia County FIRMs in countywide format was 04/15/2002.

Table 28: Community Map History

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Daytona Beach, City of	09/07/1973	N/A	N/A	09/07/1973	07/01/1974 05/27/1977 09/16/1982 06/04/1990 04/15/2002 02/19/2003 02/19/2014
Daytona Beach Shores, City of	01/29/1971	N/A	N/A	09/07/1973	07/01/1974 09/26/1975 05/27/1977 09/16/1982 04/15/2002 02/19/2014
Debary, City of	11/23/1973	N/A	N/A	02/02/1996	07/01/1974 07/01/1977 04/04/1983 10/01/1983 02/02/1996 04/15/2002 09/29/2011 02/19/2014
Deland, City of	08/02/1974	08/02/1974	08/20/1976	07/03/1995	04/15/2002 09/29/2011 02/19/2014
Deltona, City of	11/23/1973	N/A	N/A	11/23/1973	04/15/2002 09/29/2011 02/19/2014
Edgewater, City of	08/23/1974	08/23/1974	01/14/1977	09/03/1980	06/04/1990 04/15/2002 02/19/2014
Flagler Beach, City of	11/23/1973	02/01/1974	02/06/1976	05/15/1985	02/19/2014

Table 28: Community Map History (continued)

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Holly Hill, City of	09/07/1973	09/07/1973	07/01/1974 10/31/1975 04/22/1977	09/07/1973	07/01/1974 10/31/1975 04/22/1977 04/15/2002 02/19/2003 02/19/2014
Lake Helen, City of	04/15/2002	N/A	N/A	04/15/2002	02/19/2003 09/29/2011 02/19/2014
New Smyrna Beach, City of	12/07/1973	12/07/1973	07/01/1974	12/07/1973	07/01/1974 05/27/1977 12/12/1979 09/16/1982 10/01/1983 06/16/1992 04/15/2002 02/19/2014
Oak Hill, City of	06/04/1990	N/A	N/A	06/04/1990	07/15/1992 04/15/2002 02/19/2014
Orange City, City of	09/02/1994	N/A	N/A	09/02/1994	04/15/2002 09/29/2011 02/19/2014
Ormond Beach, City of	11/20/1970	11/20/1970	07/01/1974 05/27/1977	07/01/1974	05/27/1977 09/16/1982 06/04/1990 04/15/2002 02/19/2003 02/19/2014
Pierson, Town of	04/15/2002	N/A	N/A	04/15/2002	02/19/2014
Ponce Inlet, Town of	08/09/1974	08/09/1974	02/13/1976 10/08/1976	10/08/1976	09/16/1982 10/01/1983 06/16/1992 04/15/2002 02/19/2014
Port Orange, City of	07/19/1974	07/19/1974	05/16/1977	05/16/1977	09/05/1984 06/04/1990 04/15/2002 02/19/2014

Table 28: Community Map History (continued)

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
South Daytona, City of	06/28/1974	06/28/1974	09/05/1975 10/08/1976	10/08/1976	06/04/1990 04/15/2002 02/19/2014
Volusia County Unincorporated Areas	11/23/1973	11/23/1973	07/01/1974	11/23/1973	07/01/1974 07/01/1977 04/04/1983 10/01/1983 06/04/1990 07/02/1992 02/02/1996 04/15/2002 02/19/2003 09/29/2011 02/19/2014

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 29 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 29: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Atlantic Ocean	*	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2015	City of Daytona Beach, City of Daytona Beach Shores, City of South Daytona, City of Edgewater, City of Holly Hill, City of New Smyrna Beach, City of Oak Hill, City of Ormond Beach, City of Port Orange, Town of Ponce Inlet, Volusia County Unincorporated Areas

Table 29: Summary of Contracted Studies Included in this FIS Report (continued)

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
B-19 Canal	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Daytona Beach, City of Port Orange
B-19 Canal Tributary No. 1	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Port Orange
B-19 Canal Tributary No. 2	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Port Orange
B-19 Canal Tributary No. 7	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Daytona Beach
B-27 Canal North	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Holly Hill, City of Ormond Beach, Volusia County Unincorporated Areas
B-27 Canal South	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Daytona Beach, City of Holly Hill
Bulow Creek	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	Volusia County Unincorporated Areas
Canal Between	6/4/1990	Camp, Dresser, & McKee, Inc.	*	March 1989	City of Daytona Beach
Crescent Lake	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	Volusia County Unincorporated Areas
E Canal	6/4/1990	*	*	August 1978	City of Edgewater
Eleventh Street Canal	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Daytona Beach
Groover Branch	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Ormond Beach, Volusia County Unincorporated Areas

Table 29: Summary of Contracted Studies Included in this FIS Report (continued)

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Halifax Canal	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Port Orange, Town of Ponce Inlet, Volusia County Unincorporated Areas
Laurel Creek	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Ormond Beach
Little Tomoka River	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Daytona Beach, City of Ormond Beach, Volusia County Unincorporated Areas
LPGA Canal	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Holly Hill
Misner Branch	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Ormond Beach
Nova Canal North Reach 1	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Holly Hill, Volusia County Unincorporated Areas
Nova Canal North Reach 2	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Daytona Beach, City of Holly Hill
Nova Canal South Reach 1	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Daytona Beach, City of South Daytona
Nova Canal South Reach 2	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Port Orange, City of South Daytona
Shooting Range Canal/Eleventh Street Canal Tributary No. 2/Eleventh Street Canal Tributary No. 2A	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Daytona Beach

Table 29: Summary of Contracted Studies Included in this FIS Report (continued)

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
South Canal	6/4/1990	*	*	August 1978	City of Edgewater
Spruce Creek	6/4/1990	Gee & Jenson Engineers-Architects-Planners, Inc.	EMW-C-0951	*	City of Port Orange, Volusia County Unincorporated Areas
Spruce Creek Tributary No. 1	6/4/1990	Gee & Jenson Engineers-Architects-Planners, Inc.	EMW-C-0951	*	Volusia County Unincorporated Areas
Spruce Creek Tributary No. 2	6/4/1990	Gee & Jenson Engineers-Architects-Planners, Inc.	EMW-C-0951	*	Volusia County Unincorporated Areas
Spruce Creek Tributary A	6/4/1990	Zev Cohen & Associates, Inc.	*	*	City of Port Orange, Volusia County Unincorporated Areas
St. Johns River	4/15/2002	*	*	*	City of Debary, Volusia County Unincorporated Areas
Thompson Creek	2/19/2014	Taylor Engineering, Inc.	HSFEHQ-09-D-0368	February 2013	City of Ormond Beach
Tomoka River	4/15/2002	Taylor Engineering, Inc.	EMW-95-C-4761	August 1996	City of Daytona Beach, City of Ormond Beach, Volusia County Unincorporated Areas
Wally Hoffmeyer Canal	6/4/1990	Camp, Dresser, & McKee, Inc.	*	March 1989	City of Daytona Beach

7.2 Community Meetings

The dates of the community meetings held for this Flood Risk Project and previous Flood Risk Projects are shown in Table 30. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 30: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
City of Daytona Beach	TBD	03/19/2014	Individual Community Meeting for Coastal Study	City of Daytona Beach and the study contractor
City of Daytona Beach Shores	TBD	03/21/2014	Individual Community Meeting for Coastal Study	City of Daytona Beach Shores and the study contractor
City of Edgewater	TBD	03/20/2014	Individual Community Meeting for Coastal Study	City of Edgewater and the study contractor
City of Flagler Beach	TBD	03/20/2014	Individual Community Meeting for Coastal Study	City of Flagler Beach and the study contractor
City of Holly Hill	TBD	03/19/2014	Individual Community Meeting for Coastal Study	City of Holly Hill and the study contractor
City of New Smyrna Beach	TBD	03/19/2014	Individual Community Meeting for Coastal Study	City of New Smyrna Beach and the study contractor
City of Ormond Beach	TBD	03/19/2014	Individual Community Meeting for Coastal Study	City of Ormond Beach and the study contractor

Table 30: Community Meetings (continued)

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Town of Ponce Inlet	TBD	03/19/2014	Individual Community Meeting for Coastal Study	Town of Ponce Inlet and the study contractor
City of Port Orange	TBD	03/21/2014	Individual Community Meeting for Coastal Study	City of Port Orange and the study contractor
City of South Daytona	TBD	03/20/2014	Individual Community Meeting for Coastal Study	City of South Daytona and the study contractor
Volusia County and Incorporated Areas	2/19/2014	08/10/2009	Initial CCO	City of Daytona Beach, City of DeBary, City of Deland, City of Deltona, City of Edgewater, City of Holly Hill, City of Lake Helen, City of New Smyrna Beach, City of Oak Hill, City of Orange City, City of Ormond Beach, City of Port Orange, City of South Daytona, Volusia County and the study contractor
		06/09/2011	Final CCO and Open House	FEMA, City of Daytona Beach, City of DeBary, City of Deland, City of Deltona, City of Edgewater, City of Holly Hill, City of Lake Helen, City of New Smyrna Beach, City of Oak Hill, City of Orange City, City of Ormond Beach, City of Port Orange, City of South Daytona, Volusia County and the study contractor
	TBD	12/12/2012	Northeast Florida Coastal Study Technical Update Meeting	City of Daytona Beach, City of DeBary, City of Deland, City of Deltona, City of New Smyrna Beach, City of Ormond Beach, City of Port Orange, City of South Daytona, Volusia County and the study contractor

Table 30: Community Meetings (continued)

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Volusia County Unincorporated Areas (continued)	TBD	03/24/2014	Coastal Study Update Meeting: Overland Wave Analysis	FEMA, City of Daytona Beach, City of Edgewater, City of Flagler Beach, City of Holly Hill, City of New Smyrna Beach, Volusia County and the study contractor
	TBD	09/24/2015	Flood Risk Review Meeting	City of Daytona Beach, City of Edgewater, City of New Smyrna Beach, City of Ormond Beach, City of Port Orange, Volusia County and the study contractor
	TBD	03/20/2014	Individual Community Meeting for Coastal Study	Volusia County and the study contractor

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see http://www.fema.gov.

Table 31 is a list of the locations where FIRMs for Volusia County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 31: Map Repositories

Community	Address	City	State	Zip Code
City of Daytona Beach	Daytona Beach City Hall 301 South Ridgewood Avenue	Daytona Beach	FL	32114
City of Daytona Beach Shores	Daytona Beach Shores City Hall 2990 South Atlantic Avenue	Daytona Beach Shores	FL	32118
City of Debary	Debary City Hall 16 Colomba Road	Debary	FL	32713
City of Deland	Deland Public Works Department 1102 South Garfield Avenue	Deland	FL	32724
City of Deltona	City of Deltona Department of Development Services 2345 Providence Boulevard	Deltona	FL	32725
City of Edgewater	City of Edgewater Building and Planning Department 104 North Riverside Drive	Edgewater	FL	32132
City of Flagler Beach	Flagler Beach City Hall 105 South 2nd Street	Flagler Beach	FL	32136
City of Holly Hill	Holly Hill City Hall City Planner's Office 1066 Ridgewood Avenue	Holly Hill	FL	32117
City of Lake Helen	Lake Helen City Hall 327 South Lakeview Drive	Lake Helen	FL	32744
City of New Smyrna Beach	New Smyrna Beach City Hall 210 Sams Avenue	New Smyrna Beach	FL	32168
City of Oak Hill	Oak Hill City Hall 234 South U.S. Highway 1	Oak Hill	FL	32759

Table 31: Map Repositories (continued)

Community	Address	City	State	Zip Code
City of Orange City	Orange City Planning Department 205 East Graves Avenue	Orange City	FL	32763
City of Ormond Beach	Ormond Beach City Hall City Manager's Office 22 South Beach Street	Ormond Beach	FL	32174
City of Port Orange	Port Orange City Hall 1000 City Center Circle	Port Orange	FL	32129
City of South Daytona	South Daytona City Hall 1672 South Ridgewood Avenue	South Daytona	FL	32119
Town of Pierson	Pierson Town Hall 106 North Center Street	Pierson	FL	32180
Town of Ponce Inlet	Ponce Inlet Town Hall 4300 South Atlantic Avenue	Ponce Inlet	FL	32127
Volusia County Unincorporated Areas	Volusia County Office of Growth Management 123 West Indiana Avenue	Deland	FL	32720

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM databases and LOMCs. Together they create a GIS data layer for a State or Territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 32.

Table 32 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the State NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of State or territorial government to coordinate that State's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of State and local GIS data in their state.

Table 32: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	https://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/engineering-library
NFIP website	http://www.fema.gov/national-flood-insurance-program
NFHL Dataset	http://msc.fema.gov
FEMA Region IV	FEMA-R4 (Hollins Building), 3003 Chamblee-Tucker Road, Atlanta, GA 30341 (770) 220-3174
Other Federal Agencies	
USGS website	http://www.usgs.gov
Hydraulic Engineering Center website	http://www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Steven Martin, CFM, State Floodplain Manager Florida Division of Emergency Management 2555 Shumard Oak Boulevard Tallahassee, FL 32399-2100 (850) 922-5269 steve.martin@em.myflorida.com
State GIS Coordinator	Richard Butgereit, GIS Administrator Florida Division of Emergency Management 2555 Shumard Oak Boulevard Tallahassee, FL 32399-2100 (850) 413-9907 richard.butgereit@em.myflorida.com

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 33 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 33: Bibliography and References

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	Abrams Aerial Survey Corporation	*Aerial Photography with Contours, Scale 1:2,400, Contour Interval 1 Foot: City of Ormond Beach and City of Daytona Beach, Florida*		St. Petersburg, Florida, and Lansing, Michigan	January 1983	
	Abrams Aerial Survey Corporation	*Aerial Photography with Contours, Scale 1:2,400, Contour Interval 1 Foot: City of Port Orange, Florida*		St. Petersburg, Florida, and Lansing, Michigan	March 1981	
	Aeromap, U.S., Inc.	*Topographic Map of Ormond Beach, Florida, Scale 1:200, Contour Interval 1 Foot: City of Ormond Beach, Florida*		Ormond Beach, Florida	1995	
	Applied Technology & Management, Inc.	*Turnbull Creek Watershed Management Plan*		Gainesville, Florida	July 1994	
	Bellemead Development Corp.	*Topographical Maps, Surveyed Section Lines and Aerial Photography, Bulow Creek Area, Volusia County*		Daytona Beach, Florida		
	Camp Dresser & McKee, Inc.	*Deep Creek Basin Stormwater Master Plan*			July 2009	
	Camp Dresser & McKee, Inc.	*East Volusia Regional Water Authority Nova Canal Flood Control and Integrated Water Resource Program Final Report*			July 2010	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	Camp Dresser & McKee, Inc.	*EXTRAN User's Manual and Program Documentation*	L.A. Roesner, et al.	Annandale, Virginia	October 1988	
	Camp Dresser & McKee, Inc.	*Runoff User's Manual and Documentation*		Annandale, Virginia	October 1988	
	Camp Dresser & McKee, Inc.	*Tomoka River and B-19 Canal 100-year Flood Results for the City of Daytona Beach*			November 1988, revised March 1989	
	Camp Dresser & McKee, Inc.	*Turnbull Creek Watershed for the County of Volusia*		West Palm Beach, Florida	1988	
	Camp Dresser & McKee, Inc.	*Turnbull Creek Watershed Study (Exhibit B): Structure Identification and Floodplain Delineations, Photogramatic survey of Turnbull Creek, Volusia County project #1564-28*		West Palm Beach, Florida	July 1987	
	Camp Dresser & McKee, Inc.	*Volusia County Halifax River Watershed Management Plan: Stormwater Control, Conservation, and Aquifer Recharge Program*		West Palm Beach, Florida	July 1994	
	City of Daytona Beach, Florida	*Aerial Topography with Contours, Scale 1:12,000, Contour Interval 2 feet*		Daytona Beach, Florida	January 1983	
	City of Deltona, Florida	*Stormwater Management Plan*			1999	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	Environmental Consulting and Technology, Inc.	*B-21 Watershed Management Plan*			August 2009	
	Federal Emergency Management Agency	*Coastal Flood Storm Surge Model, SURGE*		Washington, D.C.	1988	
	Federal Emergency Management Agency	*Flood Insurance Study Supplement - Wave Height Analysis, Volusia County, Unincorporated Areas, Florida*		Washington, D.C.	April 1983	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, Brevard County, Florida and Incorporated Areas*		Washington, D.C.	Flood Insurance Rate Map, August 1992; Flood Insurance Study, November 1997	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, City of New Smyrna Beach, Volusia County, Florida*		Washington, D.C.	June 1992	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, Flagler County, Florida (Unincorporated Areas)*		Washington, D.C.	July 1992	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, Lake County, Florida (Unincorporated Areas)*		Washington, D.C.	April 1982	FEMA Map Service Center http://msc.fema.gov

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	Federal Emergency Management Agency	*Flood Insurance Study, Putnam County, Florida (Unincorporated Areas)*		Washington, D.C.	August 1994	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, Seminole County, Florida (Unincorporated Areas)*		Washington, D.C.	April 1995	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, Volusia County, Florida (Unincorporated Areas)*		Washington, D.C.	February 1996	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Flood Insurance Study, Volusia County, Florida and Incorporated Areas*		Washington, D.C.	April 2002	FEMA Map Service Center http://msc.fema.gov
	Federal Emergency Management Agency	*Guidelines and Specifications for Study Contractors*		Washington, D.C.	January 1995	
Runup 2.0 (1990)	Federal Emergency Management Agency	*RUNUP Computer Program, Version 2.0*		Washington, D.C.	1990	http://www.fema.gov/media-library-data/20130726-1636-20490-5850/runup_v2_readme.pdf
	Federal Emergency Management Agency	*User's Manual for Wave Height Analysis*		Washington, D.C.	revised February 1981	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
WHAFIS (2007)	Federal Emergency Management Agency	*Wave Height Analysis for Flood Insurance Studies (WHAFIS), Version 4.0*		Washington, D.C.	August 2007	http://www.fema.gov/media-library-data/20130726-1615-20490-8504/whafis4_readme.txt
	Federal Emergency Management Agency	*Wave Height Analysis for Flood Insurance Studies Computer Program, Version 3.0*		Washington, D.C.	September 1988	
	Federal Emergency Management Agency, Federal Insurance Administration	*Guidelines and Specifications for Wave Elevation Determination and V Zone Mapping*		Washington, D.C.	March 1995	
	Florida Department of Environmental Protection	*Personal Communication*	Doug Thompson		November 1996	
	Florida Department of Environmental Protection, State Topographic Office, Florida Department of Transportation	*Coastal construction control line Aerial Photographs with Contours, 1:1,200 scale, 2 feet contours*		Tallahassee, Florida	August 1978	
	Florida Department of Transportation	*Aerial Photographs, Flagler and Volusia Counties*		Tallahassee, Florida	1992 and 1993	
	Florida Department of Transportation	*Drainage Manual (Volume 2-A)*		Tallahassee, Florida	1987	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	Geographic Information Services	*Computer files of selected GIS coverages*		Volusia County, Florida	1991-1995	
	Marshall, McCully & Associates	*Indian River Lagoon/Mosquito Lagoon Watershed Management Plan: Volusia County Stormwater Control, Conservation, and Aquifer Recharge Program*			July 1994	
	Marshall, Provost & Associates	*Nova Canal System Watershed Management Plan: Volusia County Stormwater Control, Conservation, and Aquifer Recharge Program.*		New Smyrna Beach, Florida	March 1995	
	Marshall, Provost & Associates	*Spruce Creek and Rose Bay OFW Watershed Management Plan: Volusia County Stormwater Control, Conservation, and Aquifer Recharge Program*		New Smyrna Beach, Florida	July 1995	
	McGraw-Hill	*Open-Channel Hydraulics*	Ven Te Chow	New York	1959	
	McKim & Creed	*B-19 Canal Watershed Management Plan*		Ormond Beach, Florida	April 1995	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	Merrick and Company	*City of Deltona Survey and Map Report*	Doyle G. Abramson		February 4, 2005, 1 foot Orthophotography Deliverable, Collected February 2004-May 2004	
	Municipal Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency	*Storm Water Management Model User's Manual Version III*	W.C. Huber, et al.	Cincinnati, Ohio	November 1981, Second Printing May 1982	
	Natural Resources Conservation Service, United States Department of Agriculture	*Soil Survey Geographic (SSURGO) Database for Volusia County, FL*				http://soildatamart.nrcs.usda.gov
	Obtained by Florida Engineering Associates, Inc.	*Ground and Bathymetric Surveys*		Panama City, Florida	1984	
	P.B. Bedient and W.C. Huber	*Hydrology and Flood Plain Analysis*		New York: Addison-Wesley	1988	
	Research Planning Institute, Inc.	*Storm Surge Levels Near Halifax Plantation, Northeast Volusia County, Florida*		Columbia, South Carolina		

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	St. Johns River Water Management District	*24-Hour Rainfall Distributions for Surface Water Basins within the St. Johns River Water Management District, Northeast Florida, Technical Publication SJ 91-3*		Palatka, Florida	1991	
	St. Johns River Water Management District	*Digital Orthophoto Quadrangles, Quads 3909, 3910, 3911, 4009, 4010, 4011*		Palatka, Florida	Collected December 2003-January 2004	
	St. Johns River Water Management District	*Digital Orthophoto Quadrangles, Quads 3909, 3910, 3911, 4009, 4010, 4011*		Palatka, Florida	Collected December 2003-January 2004	
	St. Johns River Water Management District	*Rainfall Analysis for Northeast Florida, Part IV: 24-Hour to 96-Hour Maximum Rainfall for Return Periods 10 Years, 25 Years, and 100 Years, Technical Publication SJ 88-3*		Palatka, Florida	1988	
	Streamline Technologies, Inc.	*Advanced Interconnected Channel and Pond Routing model, v. 3.02*			April 2007	
	U.S. Army Corps of Engineers, Coastal Engineering Research Center, Waterways Experiment Station	*Shore Protection Manual*		Vicksburg, Mississippi	1984	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*River Analysis System (RAS), Version 4.1.0*		Davis, California	January 2010	
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*HEC-2 Water Surface Profiles, Generalized Computer Program*		Davis, California	May 1991	
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*HEC-2 Water Surface Profiles: User's Manual*		Davis, California	September 1990	
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*HEC-l Flood Hydrograph Package, (Version 4.0.1 E)*		Davis, California	May 1991	
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*Infiltration and Soil Moisture Redistribution in HEC-l (Technical Paper No. 95)*		Davis, California	1984	
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*Introduction and Application of Kinematic Wave Routing Techniques Using HEC-1 (Training Document No. 10)*		Davis, California	1979	
	U.S. Army Corps of Engineers, Hydrologic Engineering Center	*Hydrologic Modeling System (HMS), Version 3.4*		Davis, California	August 2009	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Department of Agriculture, Natural Resources Conservation Service	*National Engineering Handbook, Section 4 – Hydrology*	Kent, K. M.		August 1972	
	U.S. Department of Agriculture, Natural Resources Conservation Service	*Technical Release 55: Urban Hydrology for Small Watersheds*			June 1986	
	U.S. Department of Agriculture, Soil Conservation Service	*Technical Release No. 61, WSP-2 Computer Program*			May 1976	
	U.S. Department of Agriculture, Soil Conservation Service	*Tomoka River Floodplain Management Study - Tributaries to the Tomoka River*			1986	
	U.S. Department of Agriculture, Soil Conservation Service	*Tomoka River Floodplain Management Study (Part II) B-19 Canal*			1986	
	U.S. Department of Commerce	*Technical Paper No. 40: Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years*		Washington, D.C.	May 1961	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Department of Commerce, Environmental Science Services Administration	*Technical Memorandum, WBTM, Hydro 11, Joint Probability Method of Tide Frequency Analysis*	V.A. Myers		April 1970	
	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service	*Technical Report NWS-15, Some Climatological Characteristics of Hurricanes and Tropical Storms, Gulf and East Coasts of the United States*		F.P. Ho, R.W. Schwerdt and H.V. Goodyear	May 1975	
	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service	*Technical Report NWS-23, Meteorological Criteria for Standard Project Hurricanes and Probable Maximum Hurricane Windfields, Gulf and East Coasts of the United States*		F.P. Ho, R.W. Schwerdt and R.R. Watkins	1979	
	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service	*Tropical Cyclones of the North Atlantic Ocean, 1871-1977*			June 1978	
	U.S. Department of Interior, Geological Survey	*Downstream-Upstream Reservoir Routing*	M. Jennings, Bay	St. Louis, Mississippi	1977	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Department of Interior, Geological Survey	*Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains (Water-Supply Paper 2339)*		Washington, D.C.	1989	
	U.S. Department of Interior, Geological Survey	*Guidelines for Determining Flood Flow Frequency*			September 1981, revised March 1982	
	U.S. Department of Interior, Geological Survey	*Program A-526, Automatic Computation of Stage-Discharge Relations at Culverts*	Matthai, Stull, and Davidian			
	U.S. Department of Interior, Geological Survey	*Water Supply Paper 1543-A, Flood Frequency Analysis*			1960	
	U.S. Department of the Interior, Geological Survey	*7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 5 Feet*			Flagler Beach West, Florida, 1956, photo revised 1970; Flagler Beach East, Florida, 1956, photo revised 1970; Ormond Beach, Florida, 1956, photo revised 1970; Daytona Beach, Florida, 1952, photo revised 1970	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Department of the Interior, Geological Survey	*7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 5 Feet*			Port Orange, Florida, 1956, photo revised 1970; New Smyrna Beach, Florida, 1956, photo revised 1970; Edgewater, Florida, 1950, photo revised 1970; Aerial, Florida, 1950, photo revised 1970; Oak Hill, Florida, 1949, photo revised 1970; Pardon Island, Florida, 1949, photo revised 1970	

Table 33: Bibliography and References (continued)

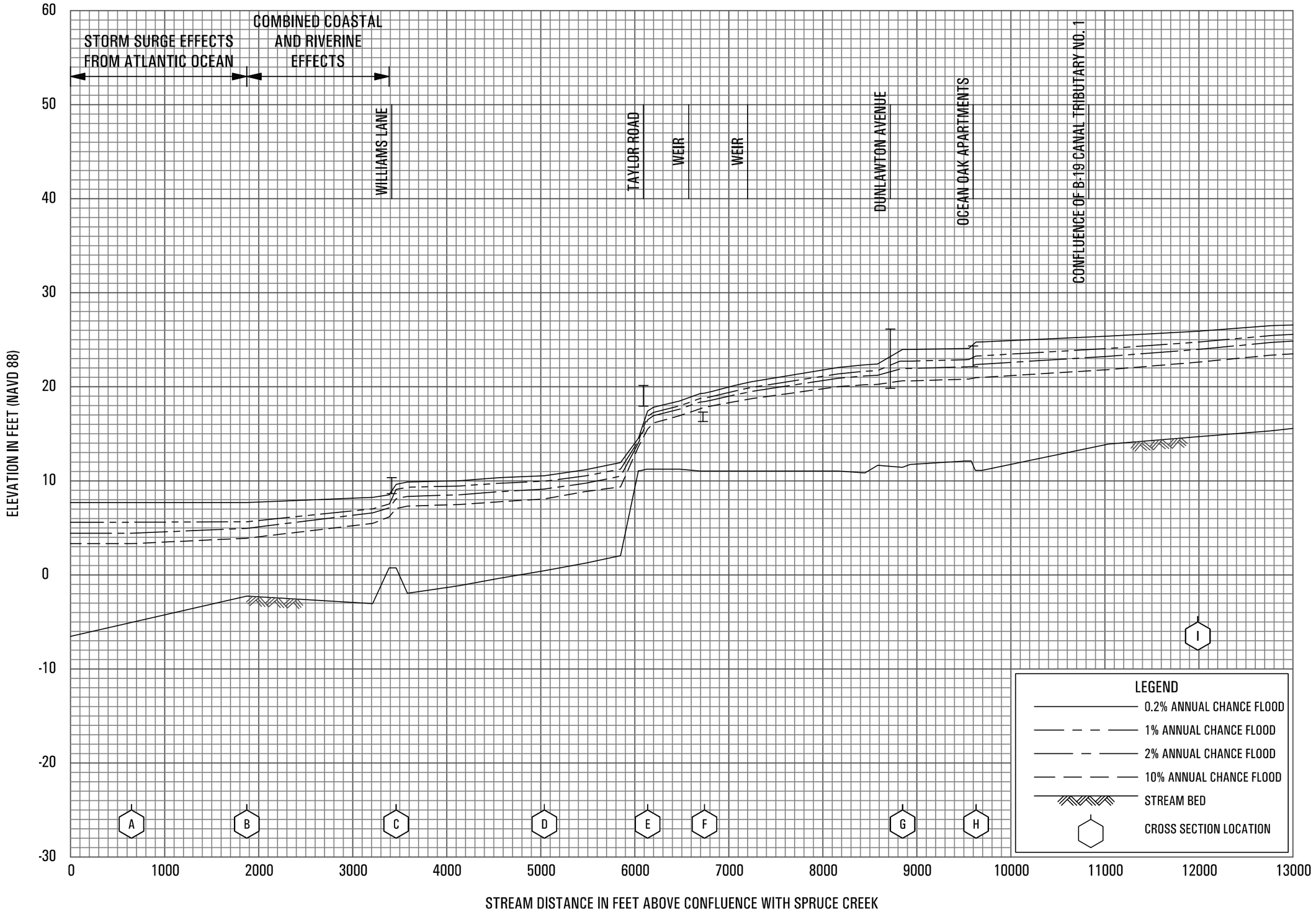
Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Department of the Interior, Geological Survey	*7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 5 Feet*			Lake Ashby, Florida, 1988; Lake Helen, Florida, 1966, photo revised 1980; Orange City, Florida, 1964, photo revised 1980; Osceola, Florida, 1988; Osteen, Florida, 1980; Sanford, Florida, 1988	
	U.S. Department of the Interior, Geological Survey	*Open-File Report 76-499, Computer Applications for Step-Backwater and Floodway Analyses*			1976	
	U.S. Department of the Interior, U.S. Geologic Survey, in cooperation with the Florida Department of Transportation	*Water Resources Investigations 82-4012, Technique for Estimating Magnitude and Frequency of Floods on Natural Flow Streams in Florida*			1982	
	U.S. Environmental Protection Agency	*SWMM Computer Program, Version 4.3*			May 1994	
	U.S. Environmental Protection Agency	*SWMM Computer Program, Version 5.0.021*			September 2010	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	U.S. Geological Survey (USGS)	*Topographic Maps. Scale 1:100,000 metric, contour interval 5 meters*			Daytona Beach, FL, 1978; New Smyrna Beach, FL, 1978; Orlando, FL, 1979; Titusville, FL, 1979	
	U.S. Soil Conservation Service	*Urban Hydrology for Small Watersheds (Technical Release No. 55)*		Littleton, Colorado	1986	
	U.S. Weather Bureau	*Rainfall Frequency Atlas of the United States, U.S. Weather Bureau, Technical Paper No. 40*	D.M. Hershfield	Washington, D.C.	1961	
	Upham, Inc.	*Plan/Profile -Station 53+00 to 59+00*		Ormond Beach, Florida	December 1994	
	Water Resources Council	*Guidelines for Determining Flood Flow Frequency, Bulletin 17A*		Washington, D.C.	June 1977	
	Woolpert, Inc.	*2006/2007 Volusia County LiDAR DTM Project, 1"=100', Contour Interval 1 foot*		Orlando, Florida	2007	
	Zev Cohen & Associates, Inc.	*Spruce Creek Fly-In Report*			February 1986	
ADCIRC (2003)		*Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC)*	R.A. Luettich, Jr., and J.J. Westerink, 1994 - 2012		2003	

Table 33: Bibliography and References (continued)

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
		Volusia County Tomoka River Watershed Management Plan: Stormwater Control Conservation, and Aquifer Recharge Program		West Palm Beach, Florida	April 1995	



FLOOD PROFILES

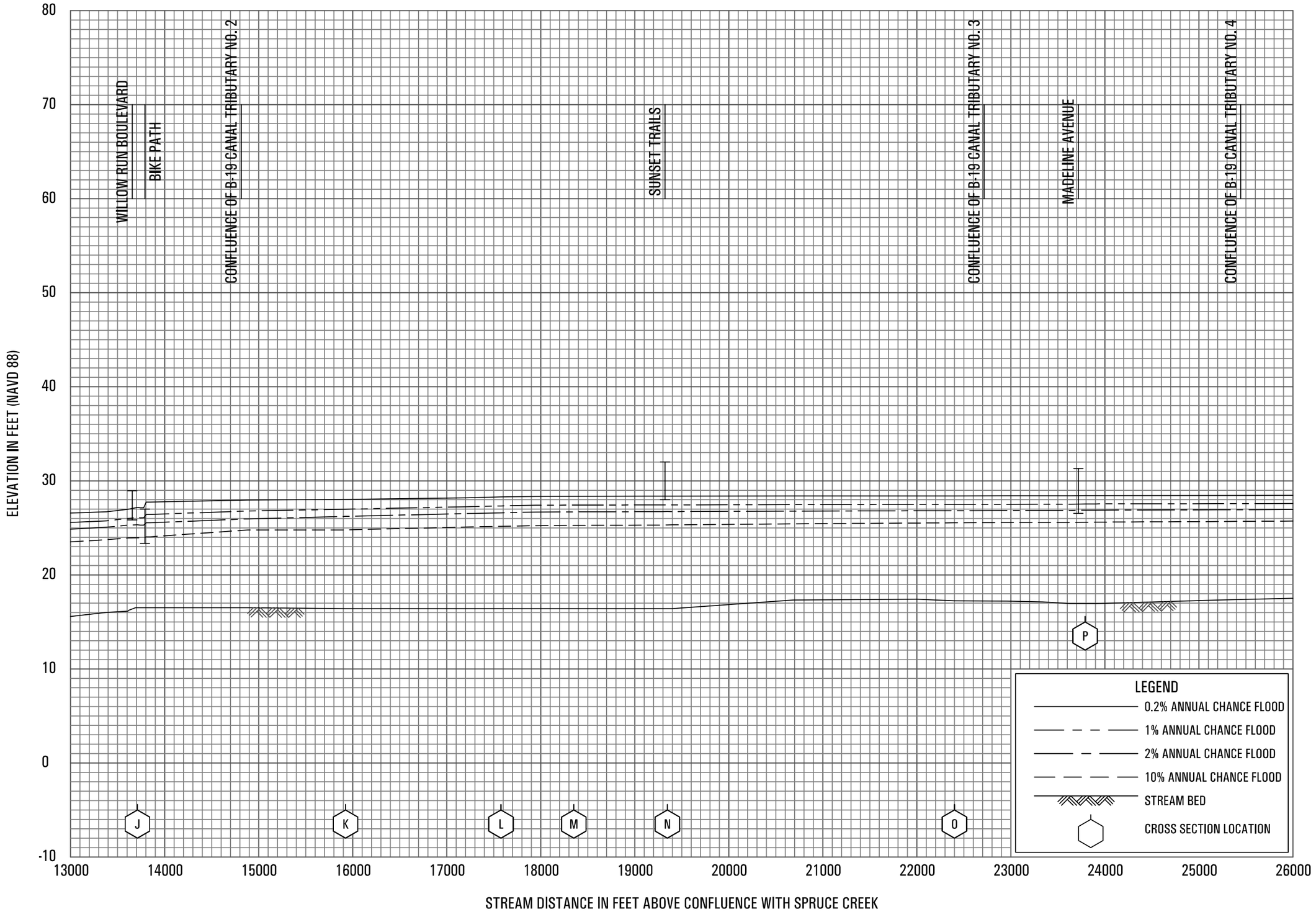
B-19 CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

01P



FLOOD PROFILES

B-19 CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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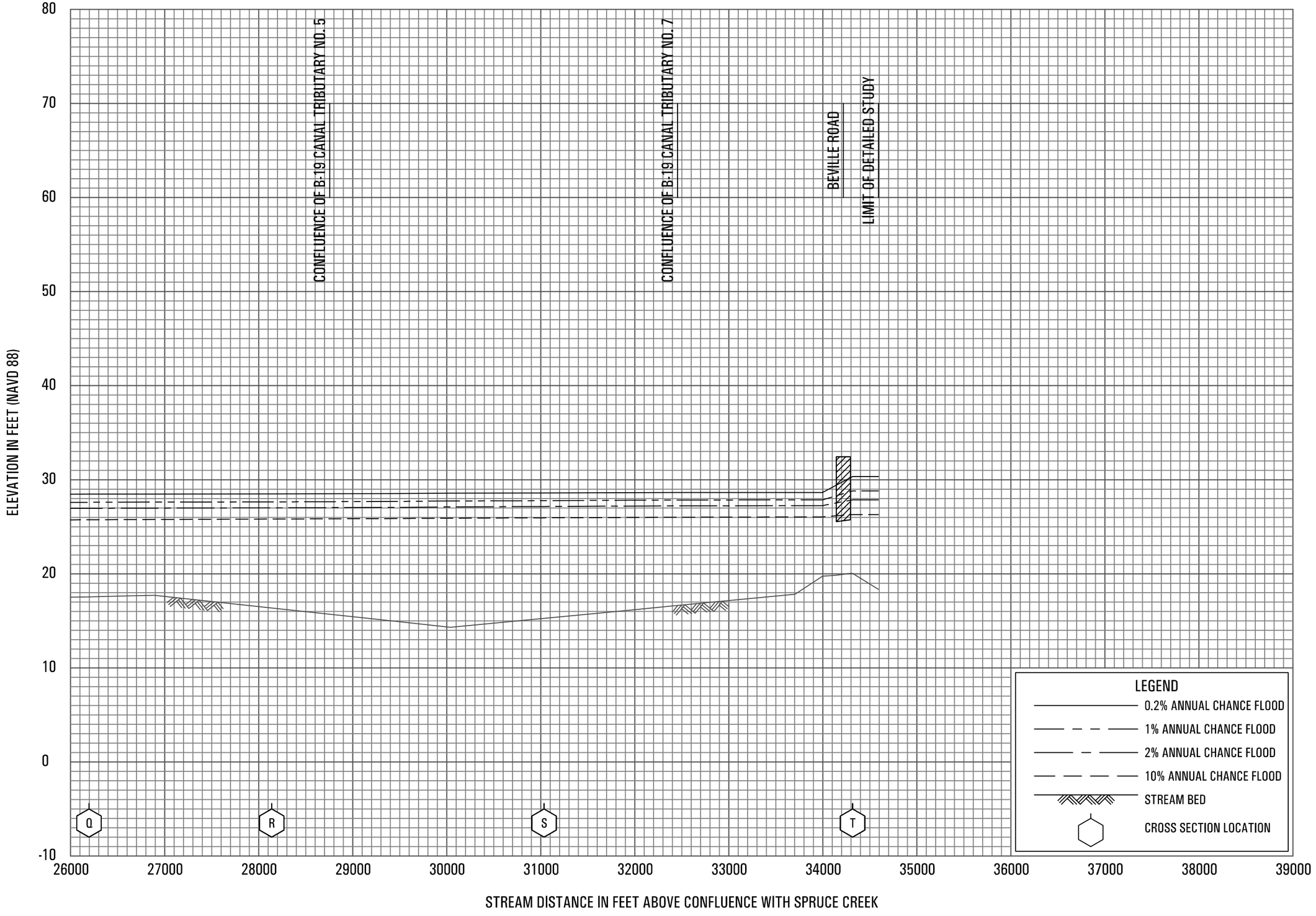

FLOOD PROFILES

B-19 CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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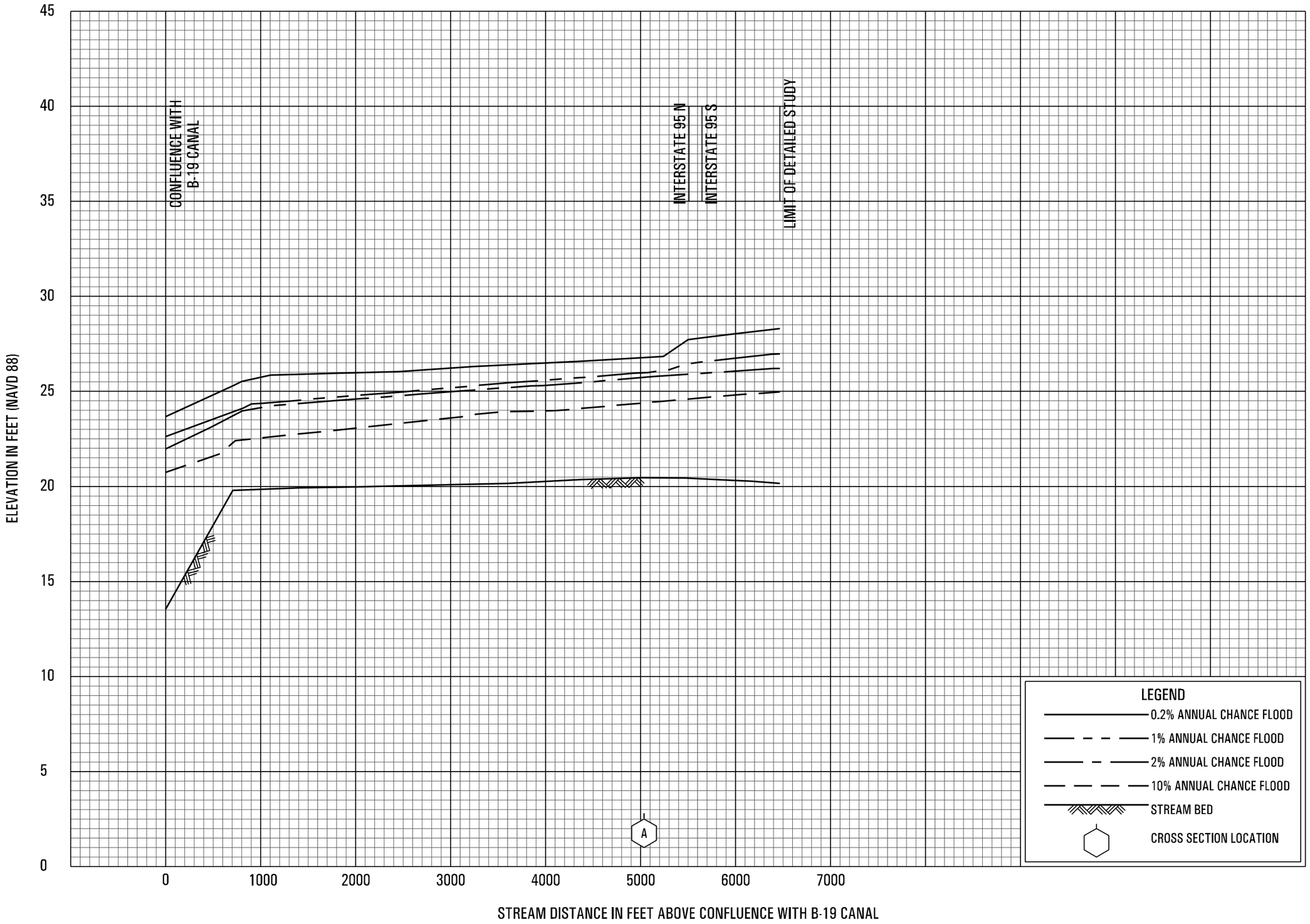

FLOOD PROFILES

B-19 CANAL TRIBUTARY NO. 1

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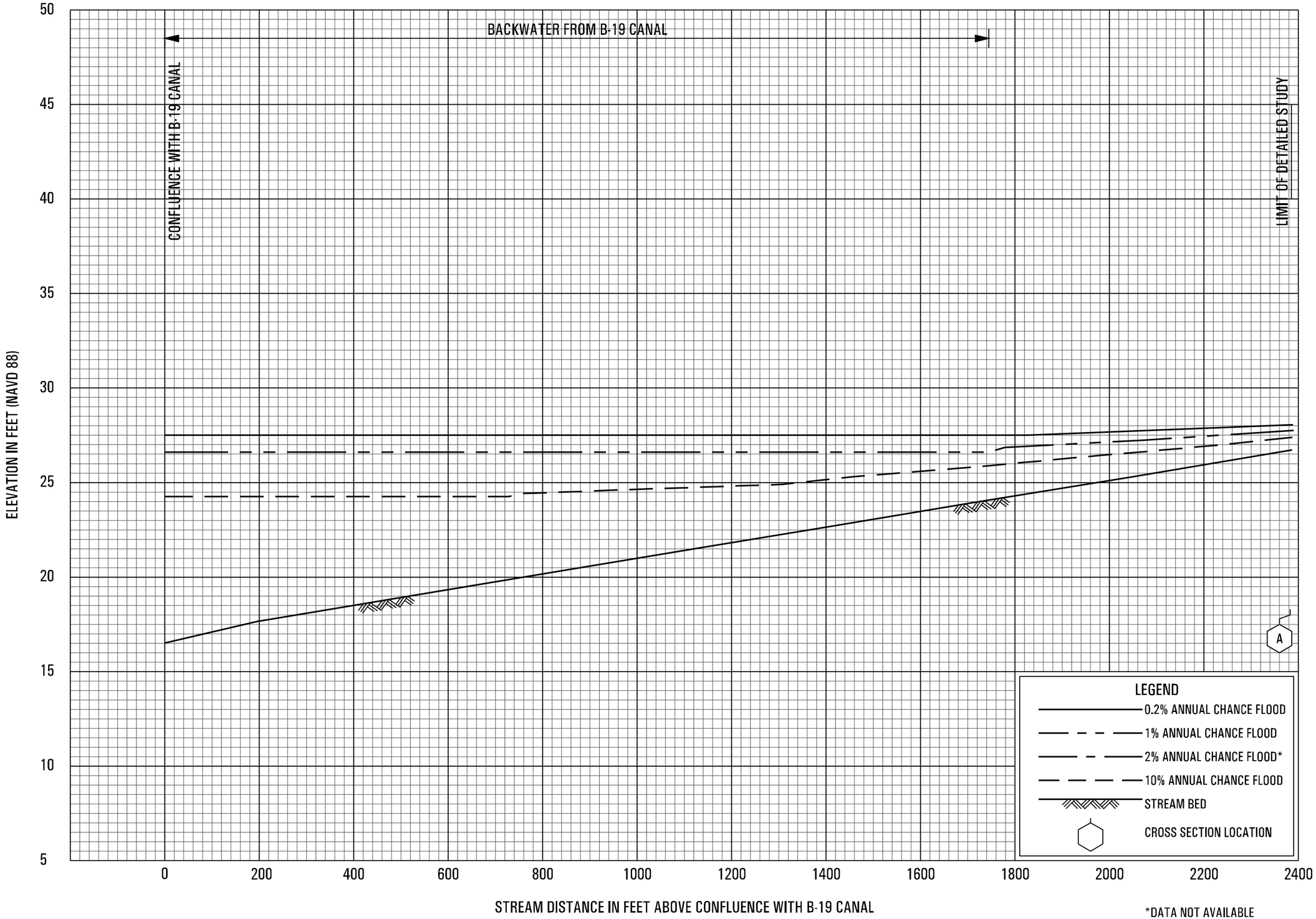
VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



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VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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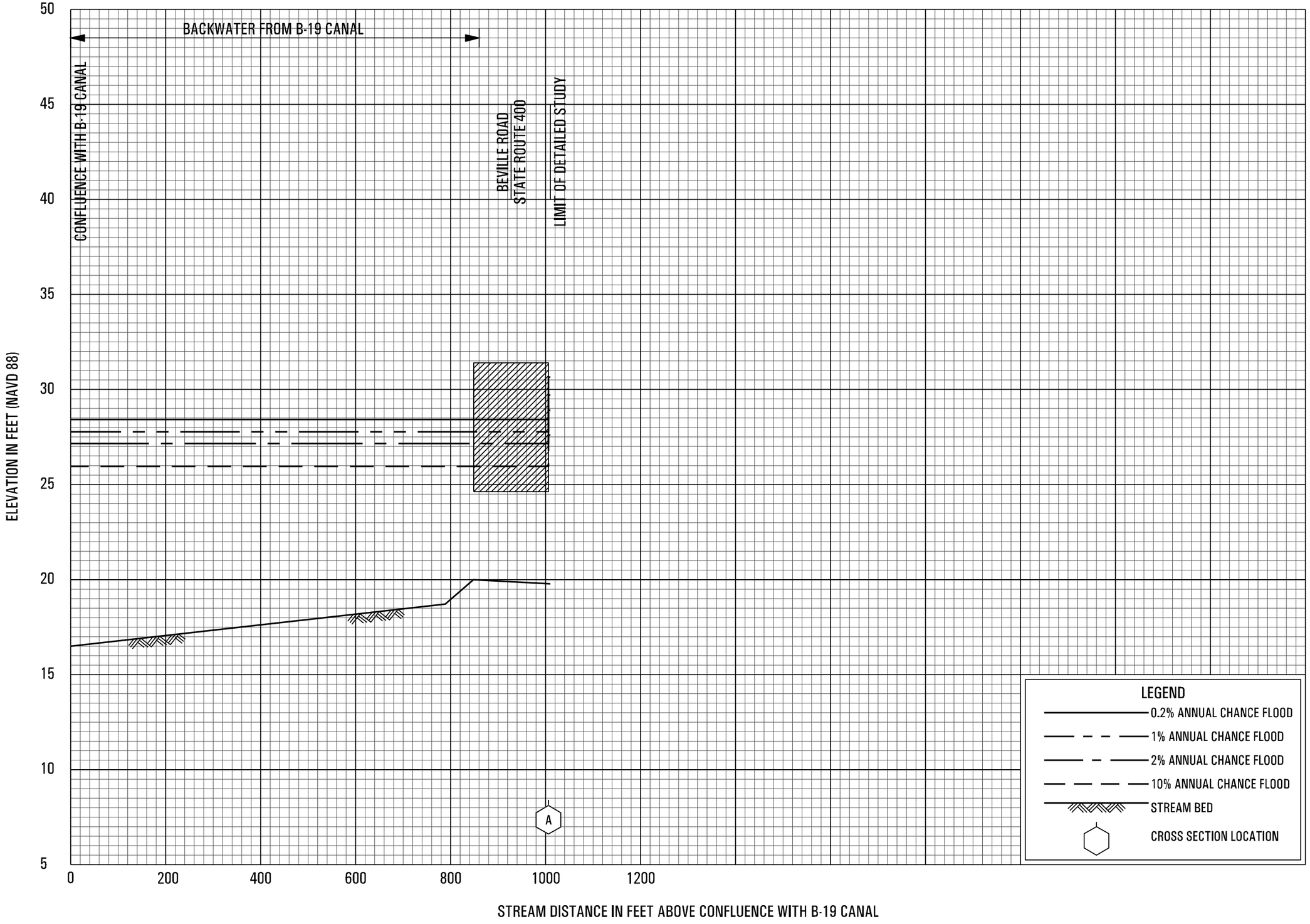

FLOOD PROFILES

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VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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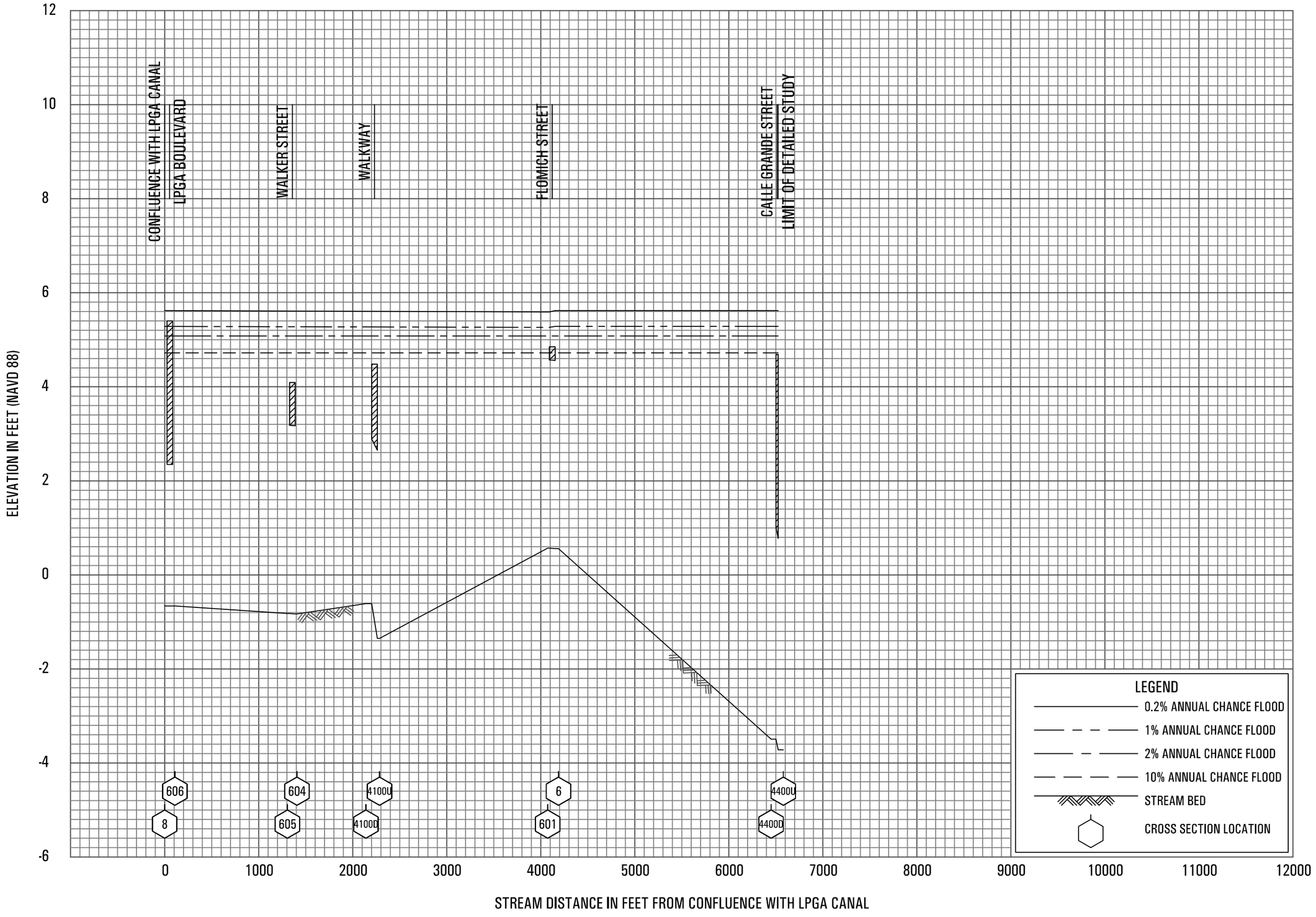

FLOOD PROFILES

B-27 CANAL NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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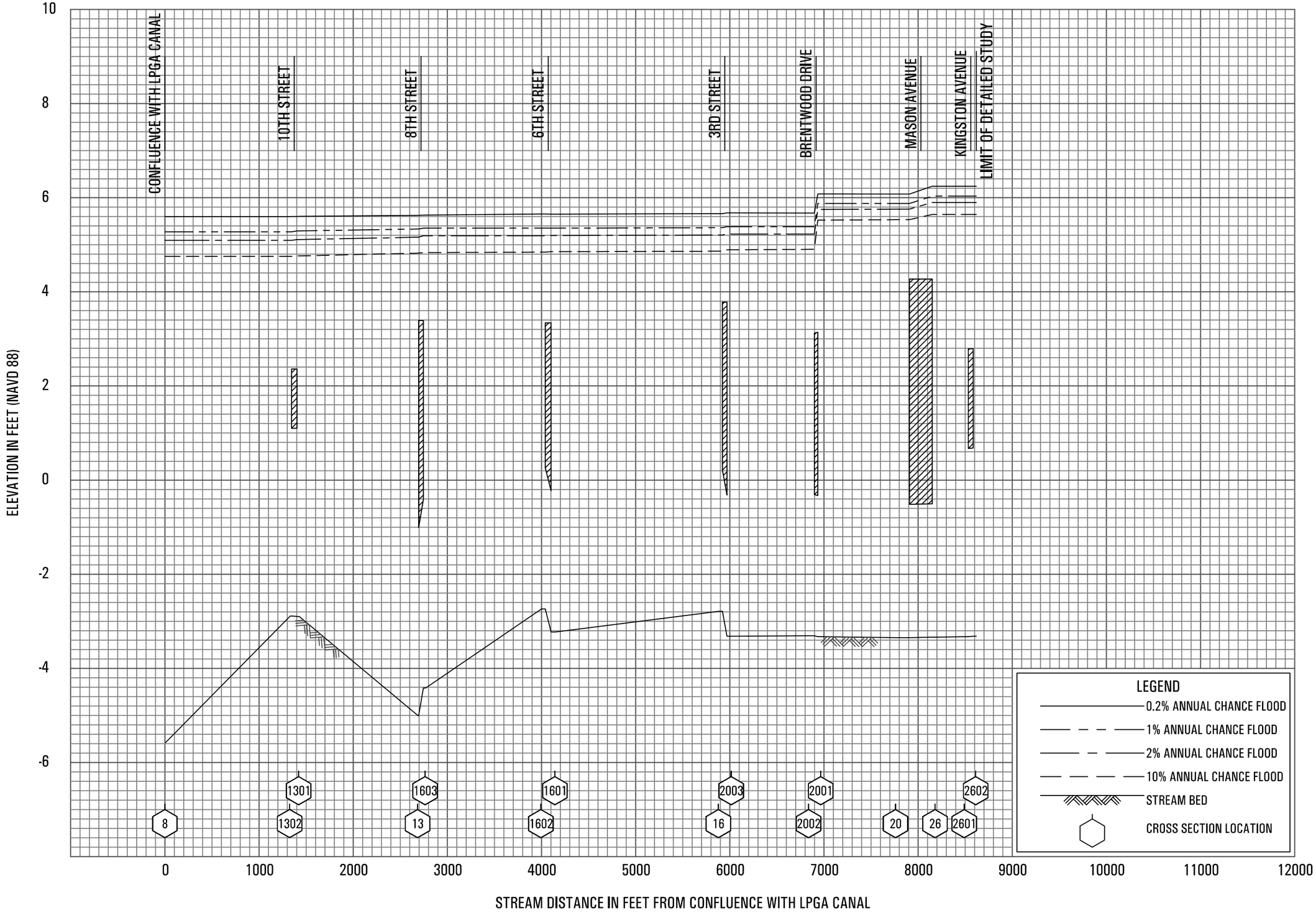

FLOOD PROFILES

B-27 CANAL SOUTH

FEDERAL EMERGENCY MANAGEMENT AGENCY
VOLUSIA COUNTY, FL
AND INCORPORATED AREAS

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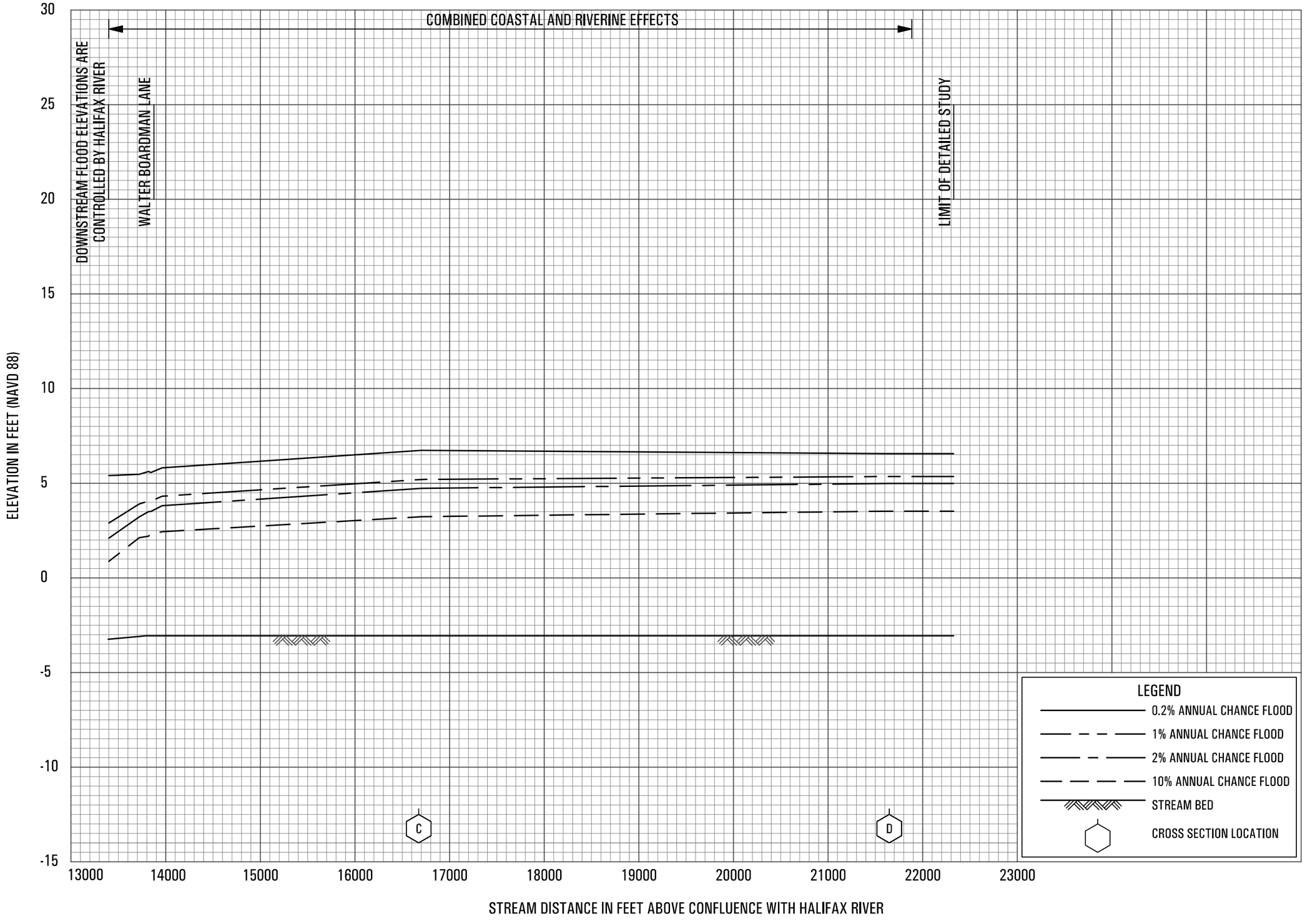

FLOOD PROFILES

BULOW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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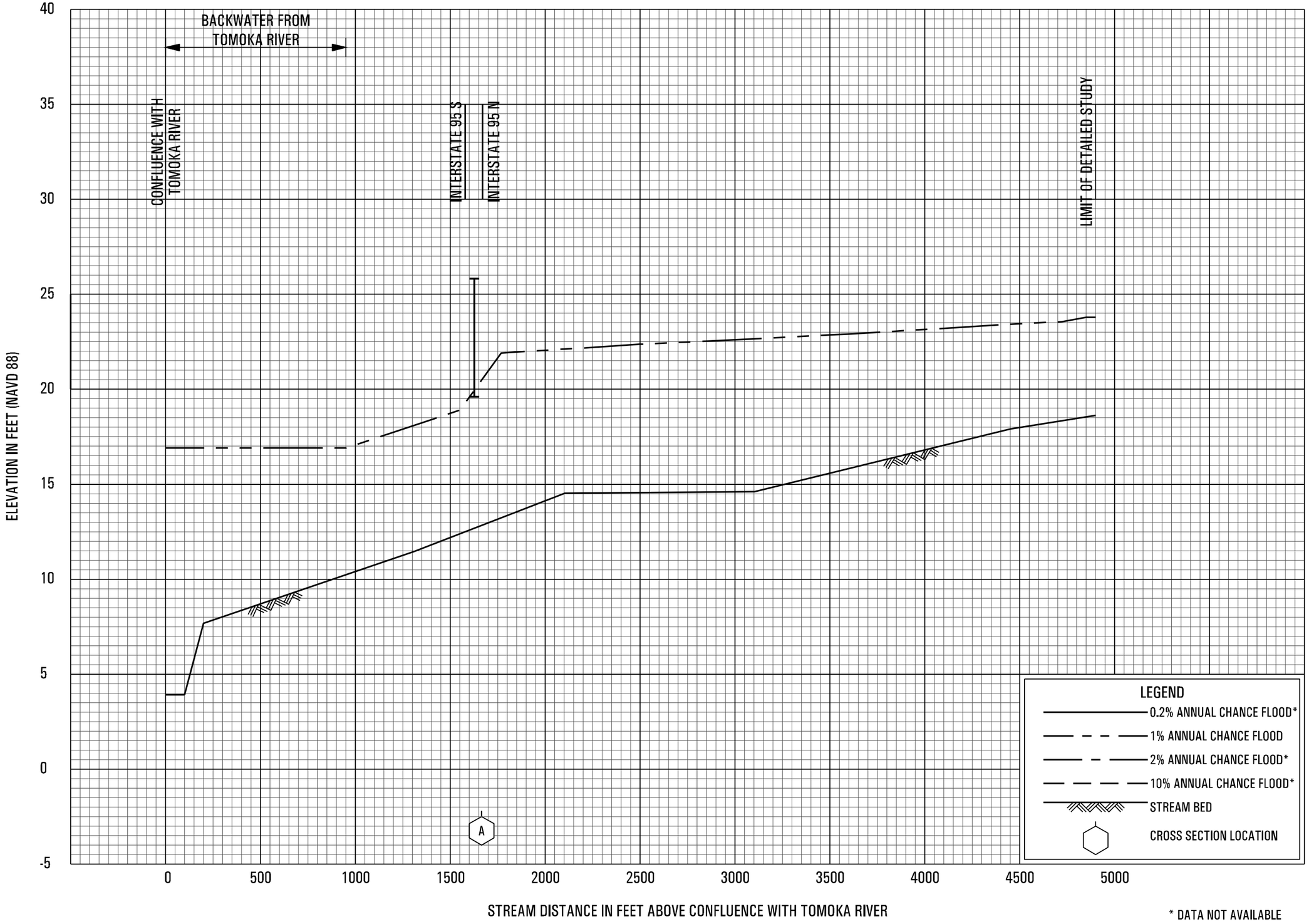

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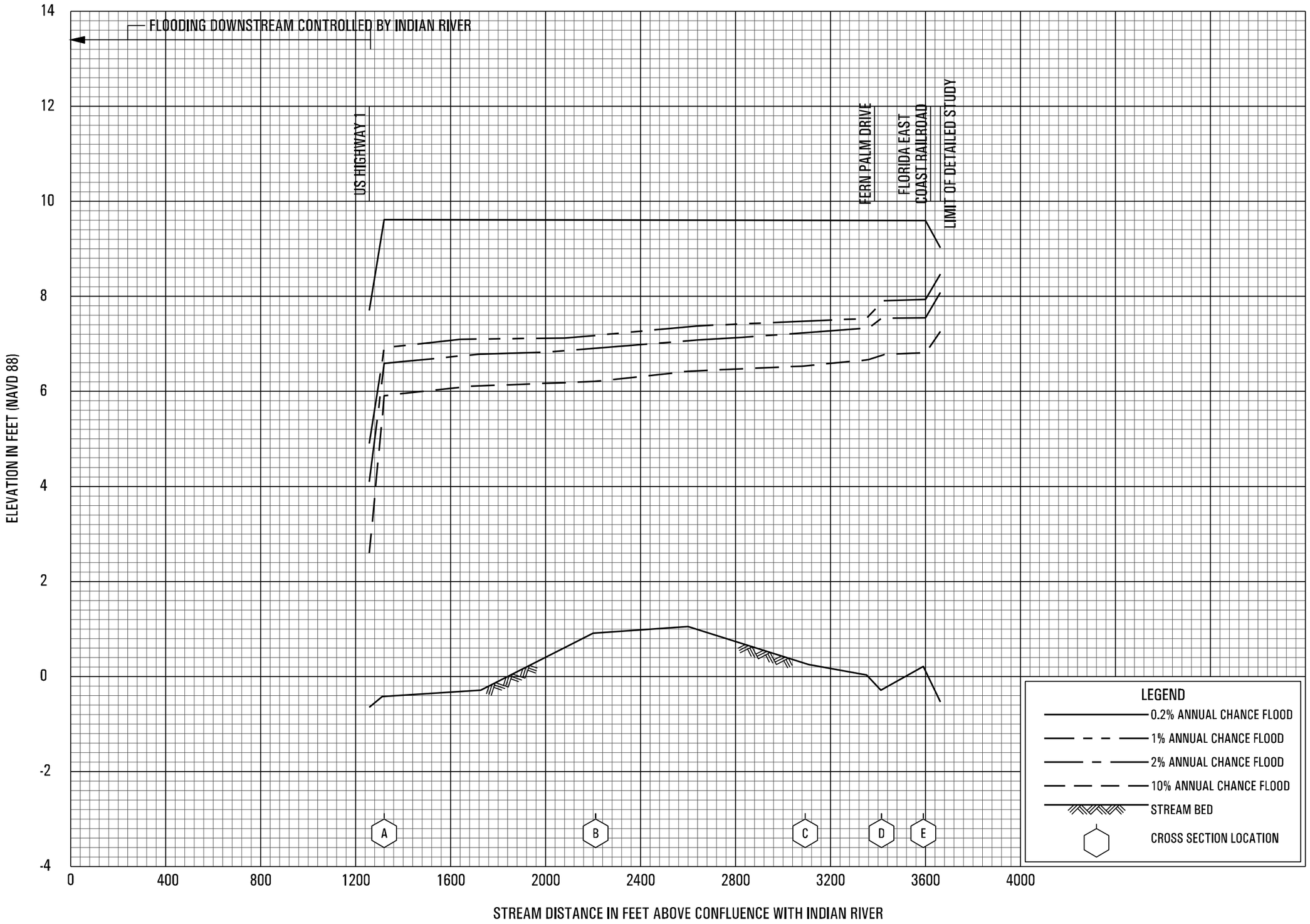
VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



FLOOD PROFILES

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VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

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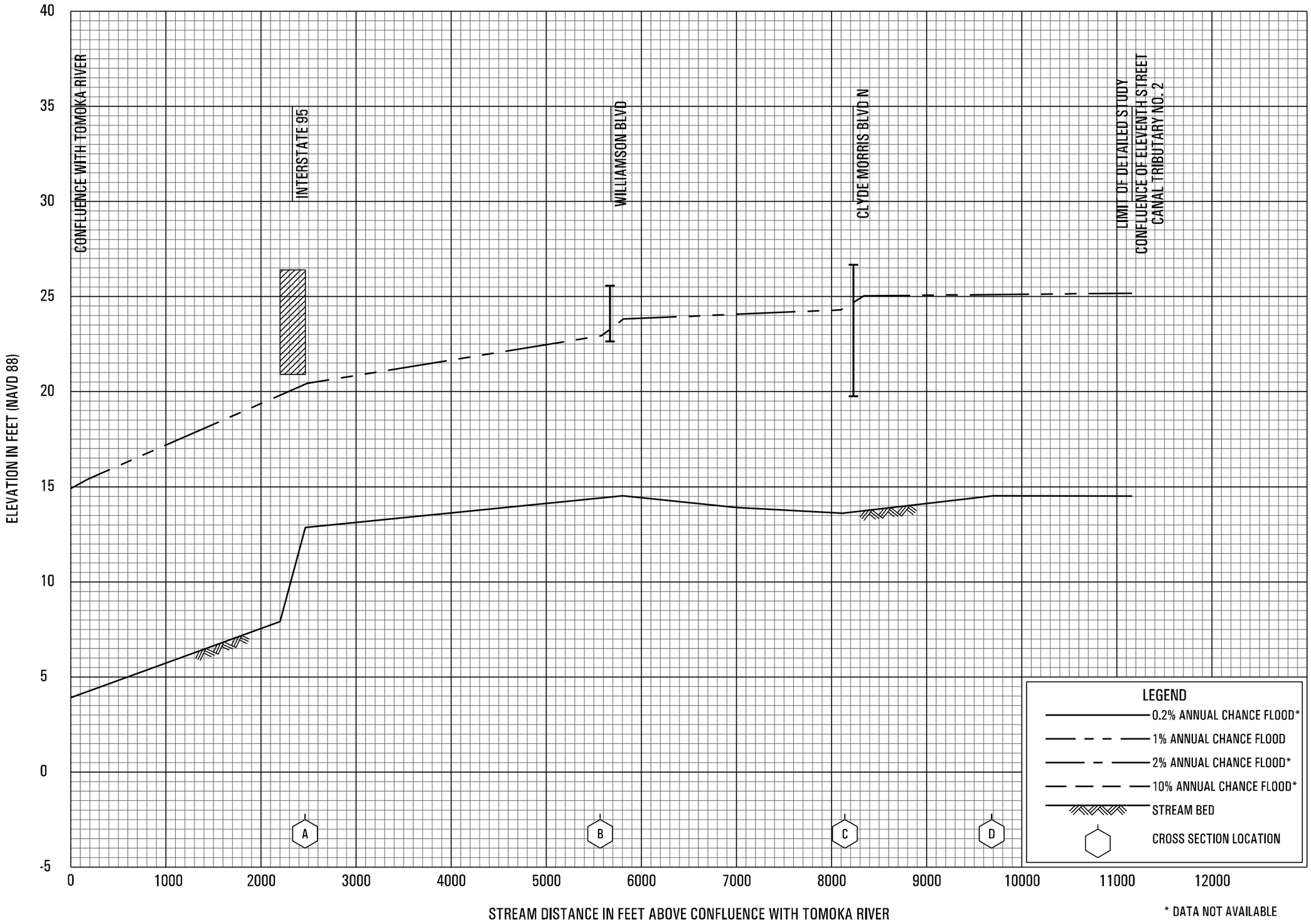

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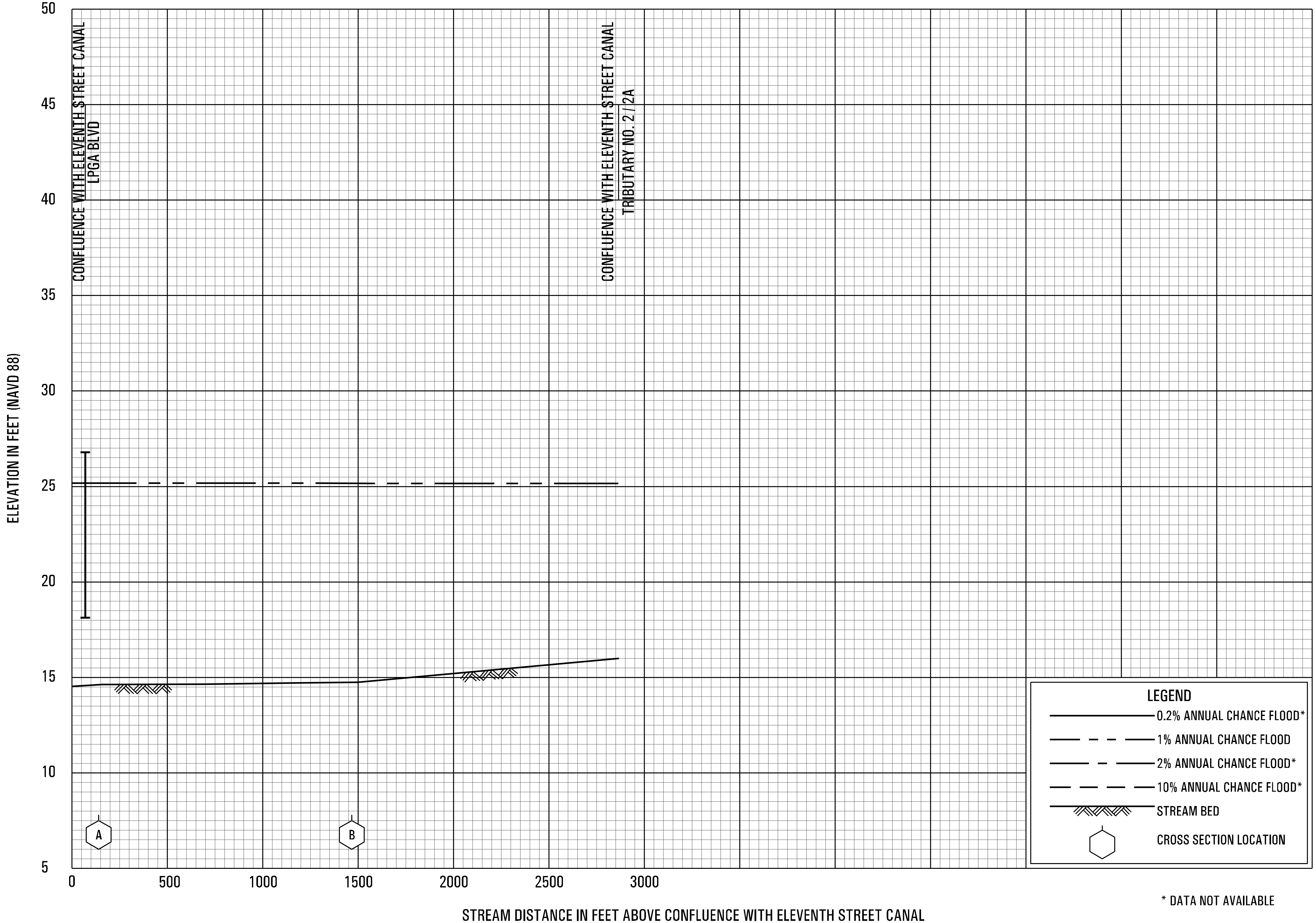
FLOOD PROFILES

ELEVENTH STREET CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



FLOOD PROFILES

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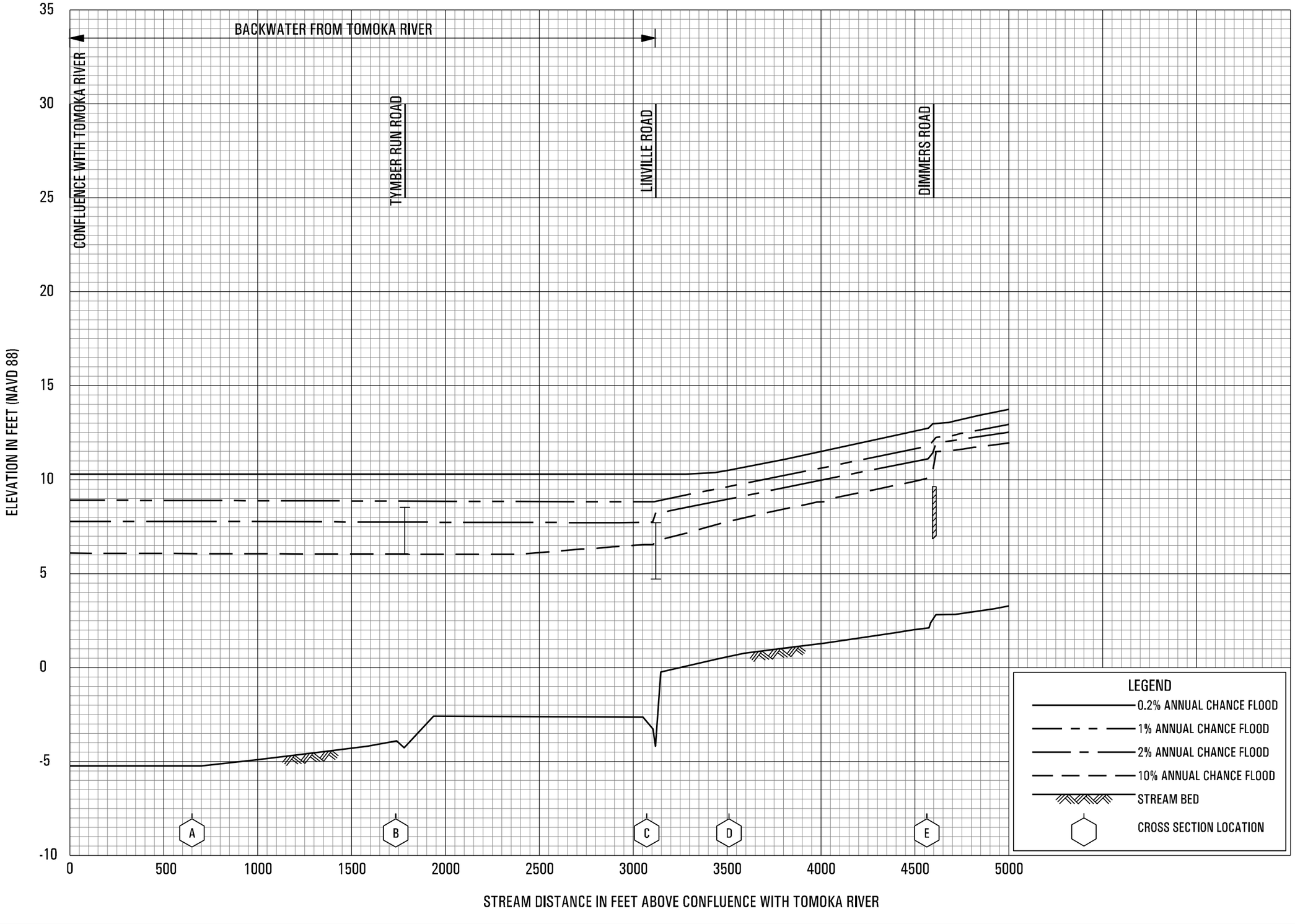
VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



FLOOD PROFILES

GROOVER BRANCH

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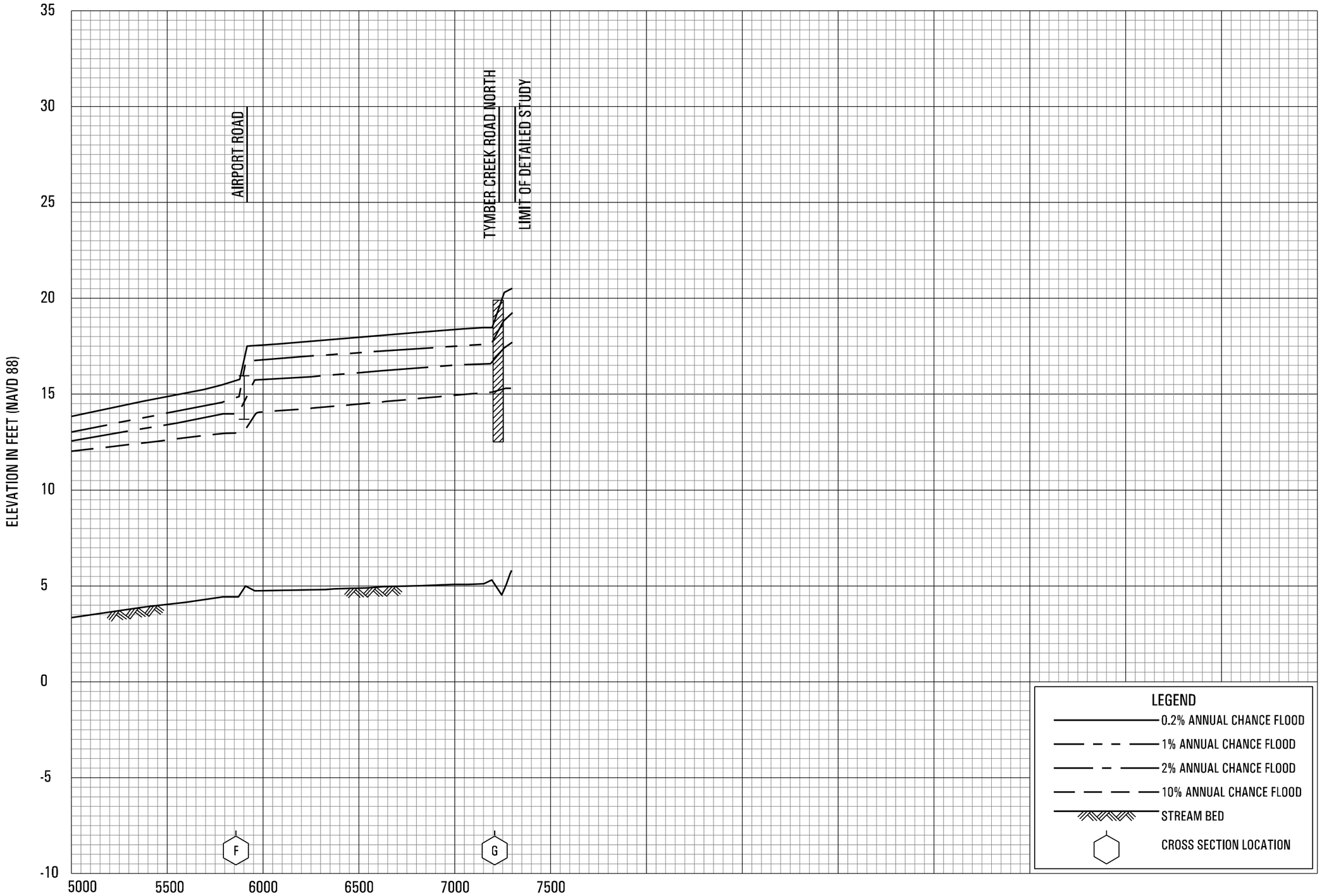
VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH TOMOKA RIVER

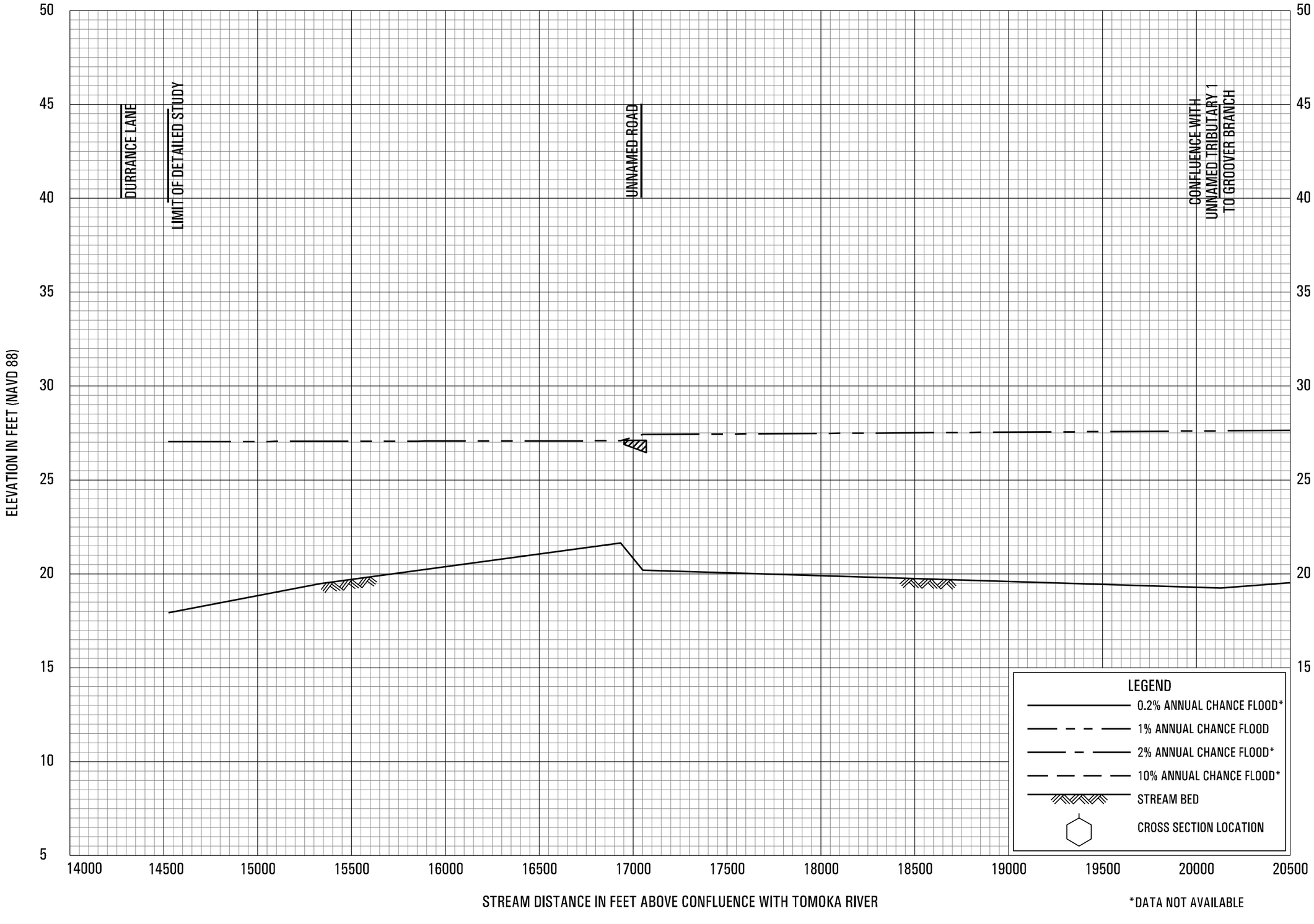
FLOOD PROFILES

GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



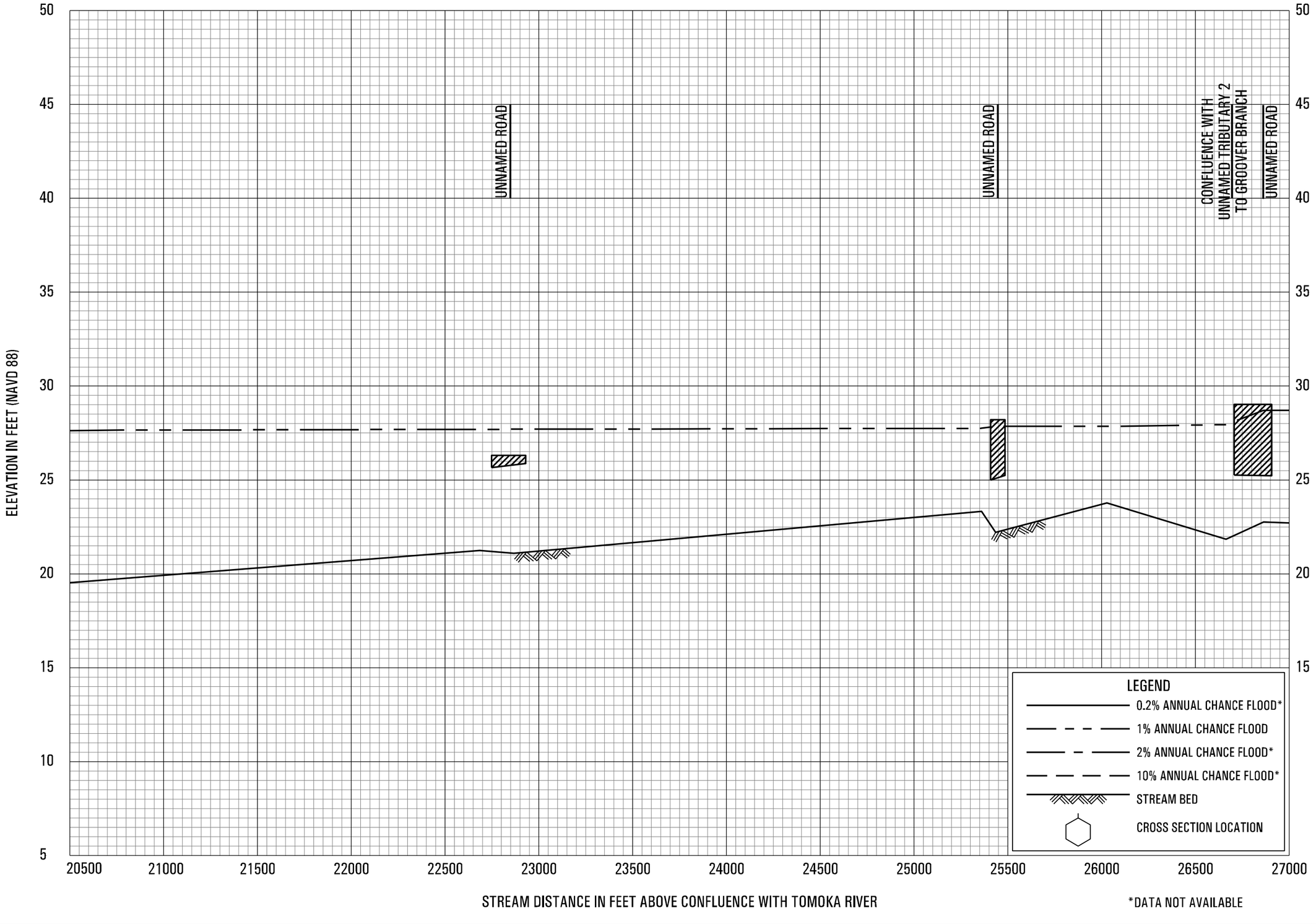
FLOOD PROFILES

GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



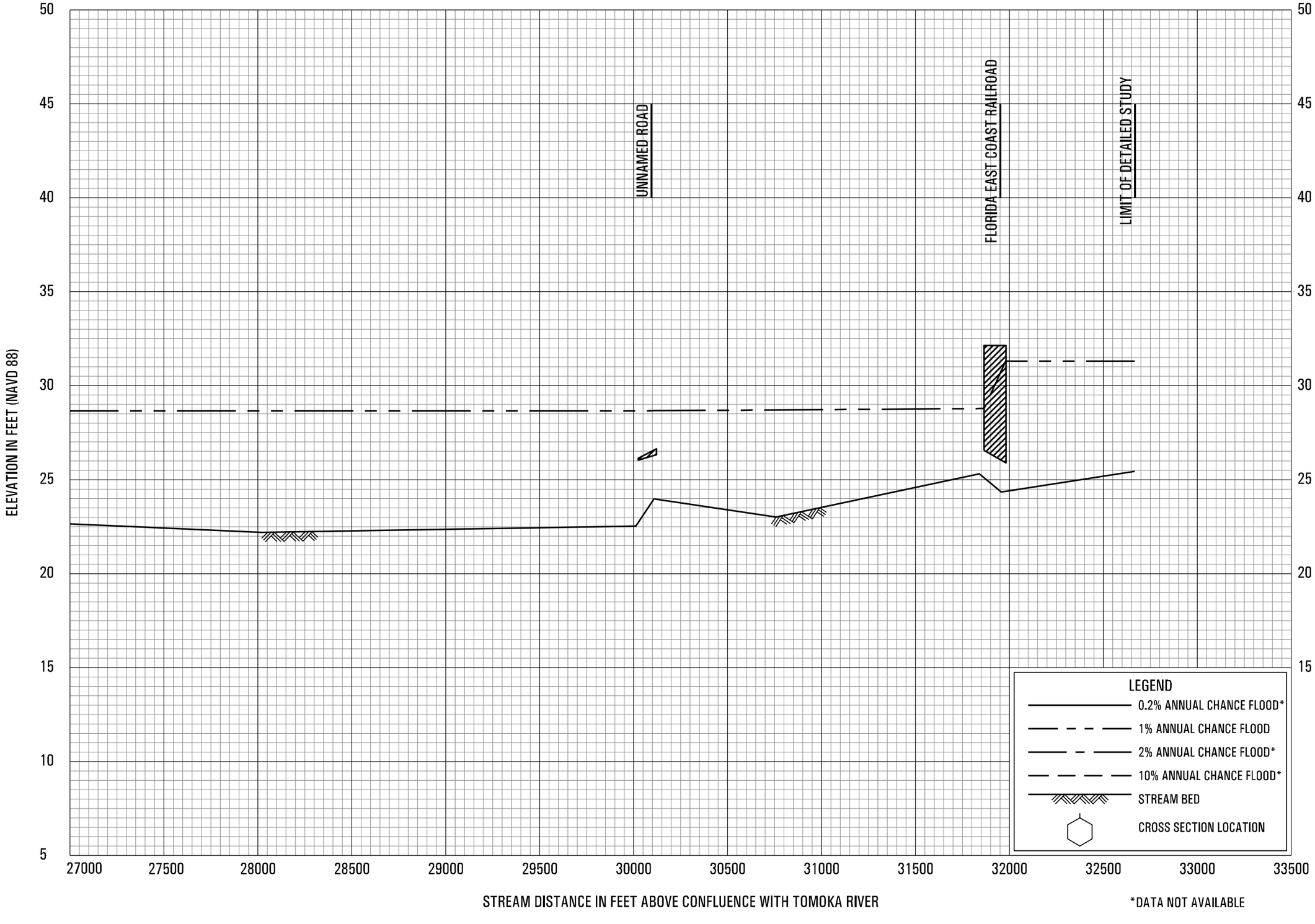
FLOOD PROFILES

GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



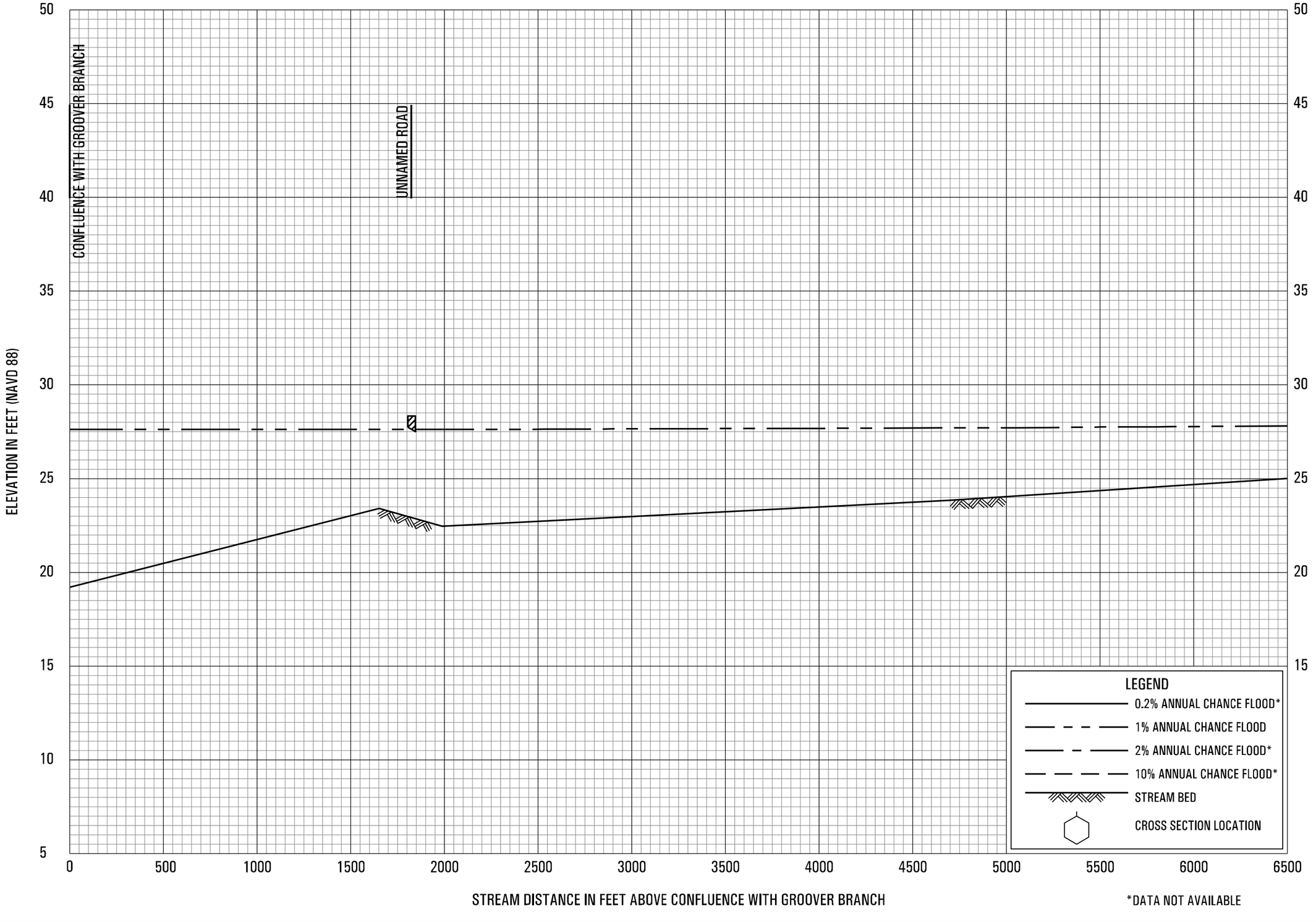
FLOOD PROFILES

GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



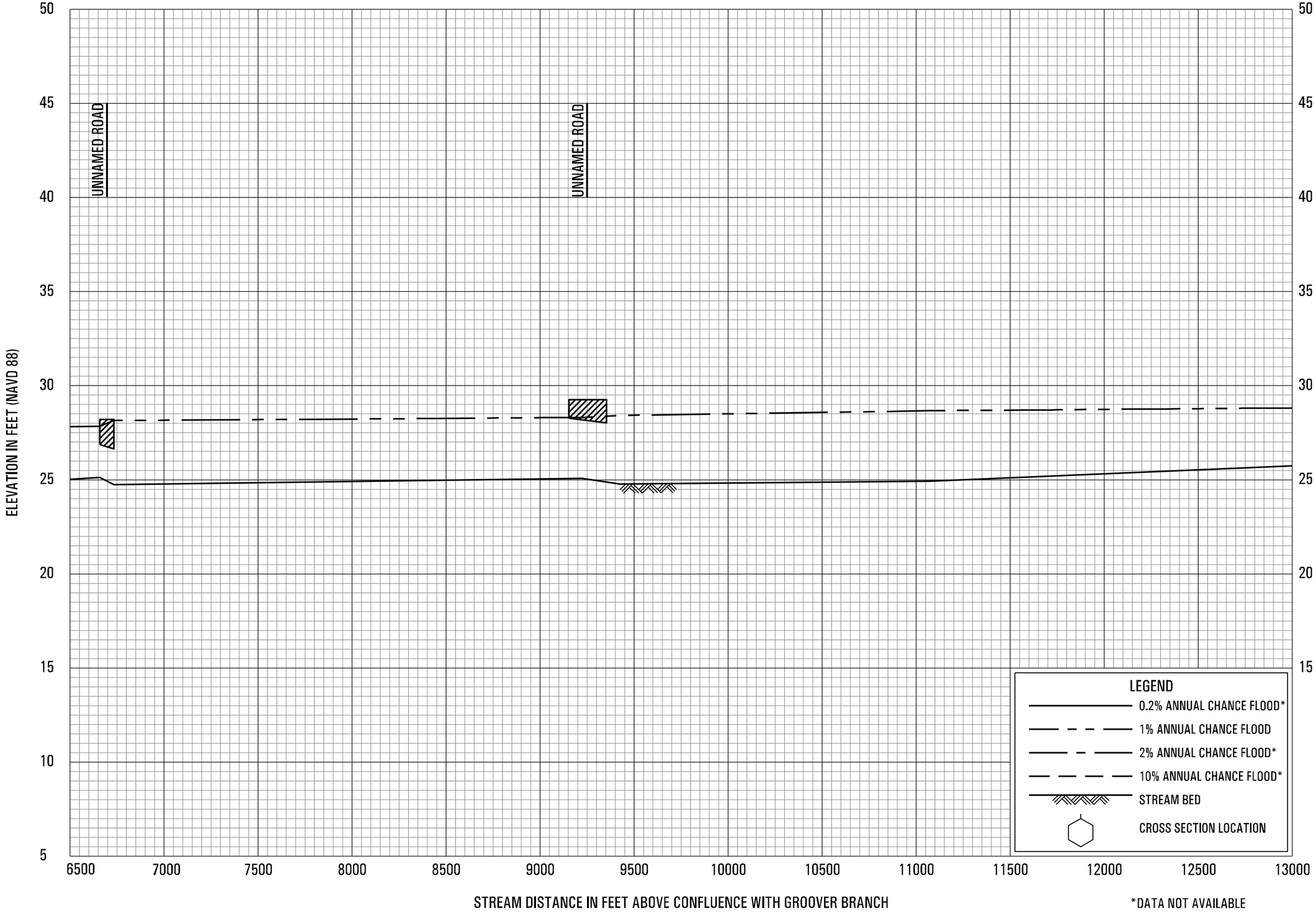
FLOOD PROFILES

UNNAMED TRIBUTARY 1 TO GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



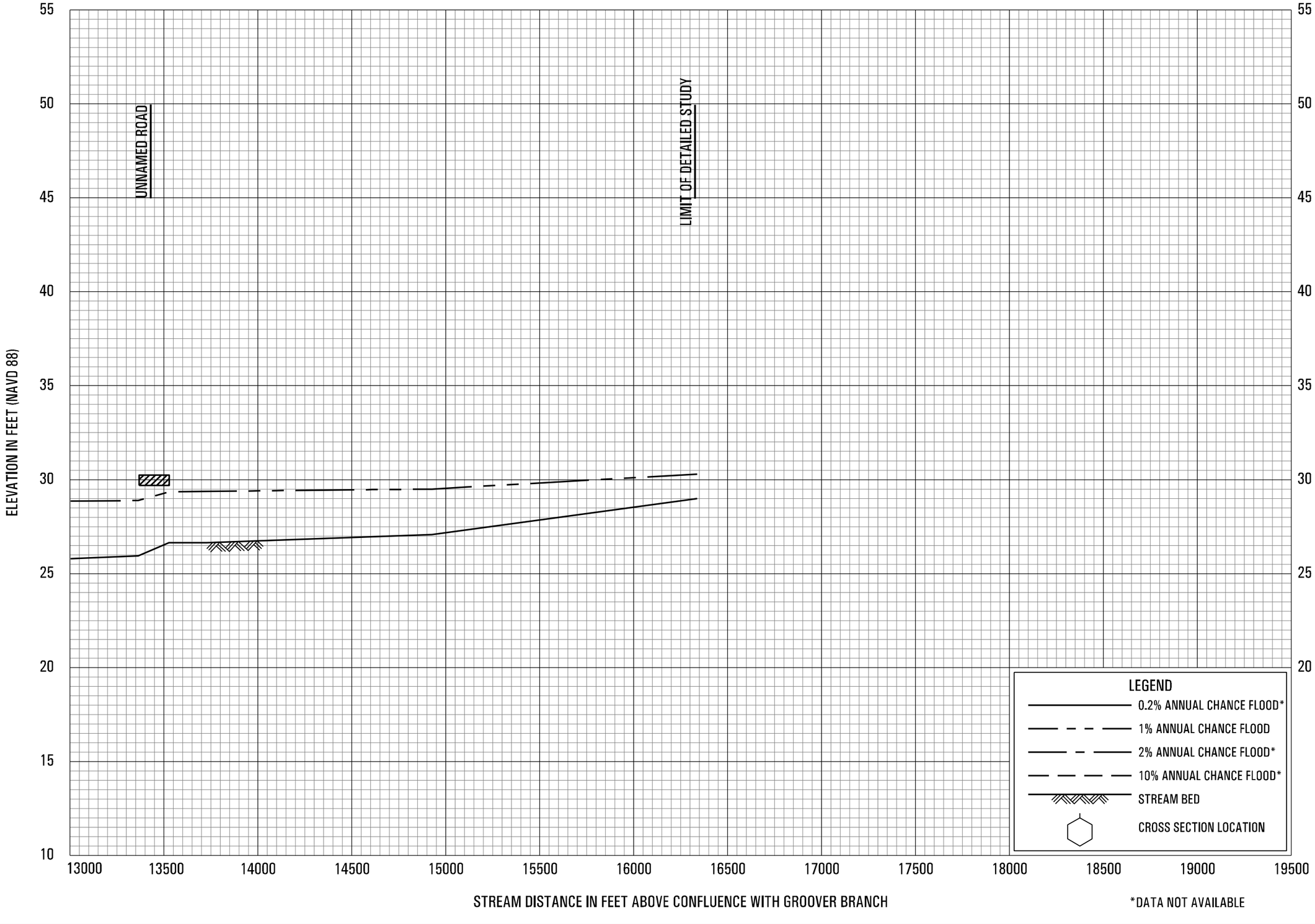
FLOOD PROFILES

UNNAMED TRIBUTARY 1 TO GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



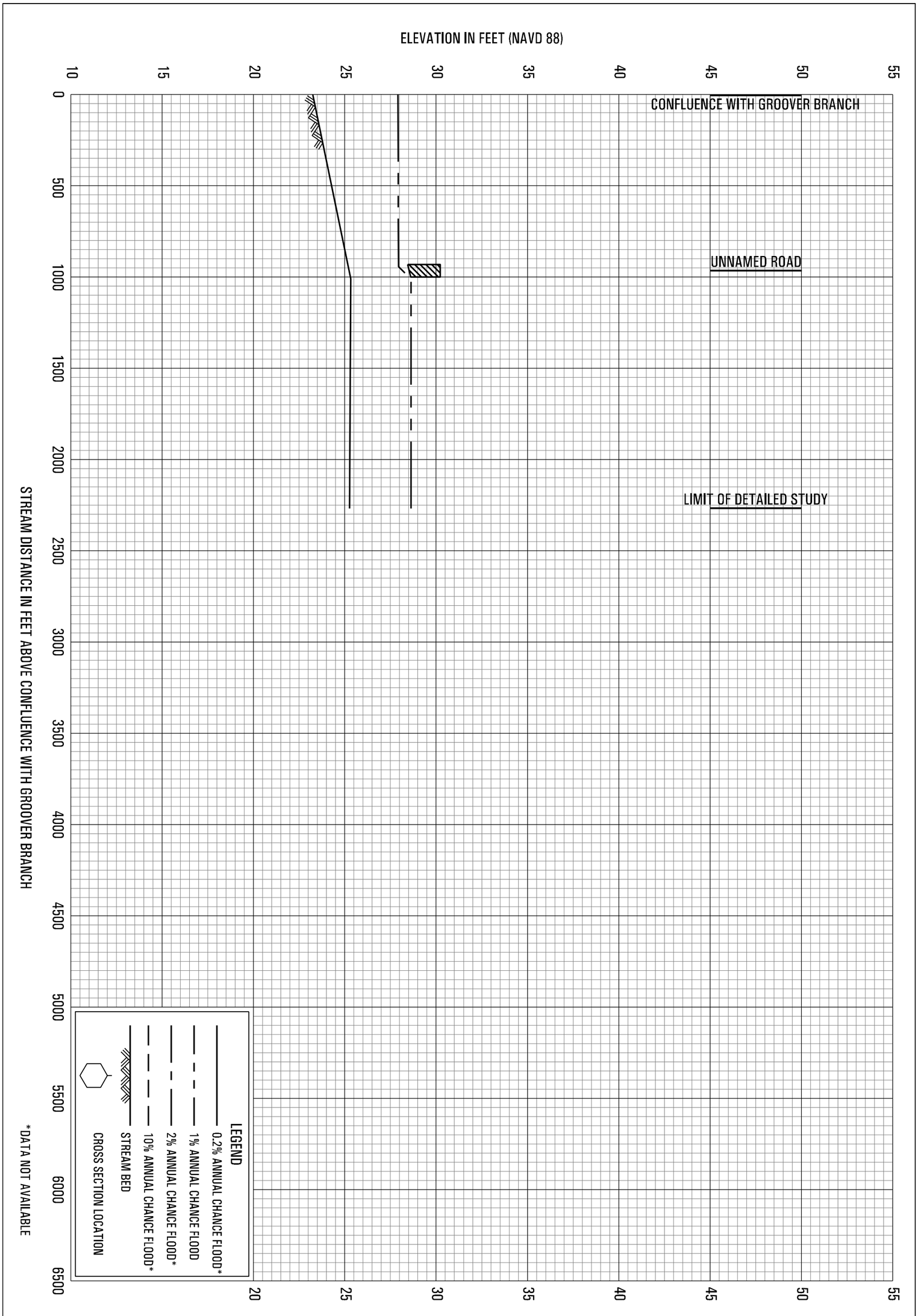
FLOOD PROFILES

UNNAMED TRIBUTARY 1 TO GROOVER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



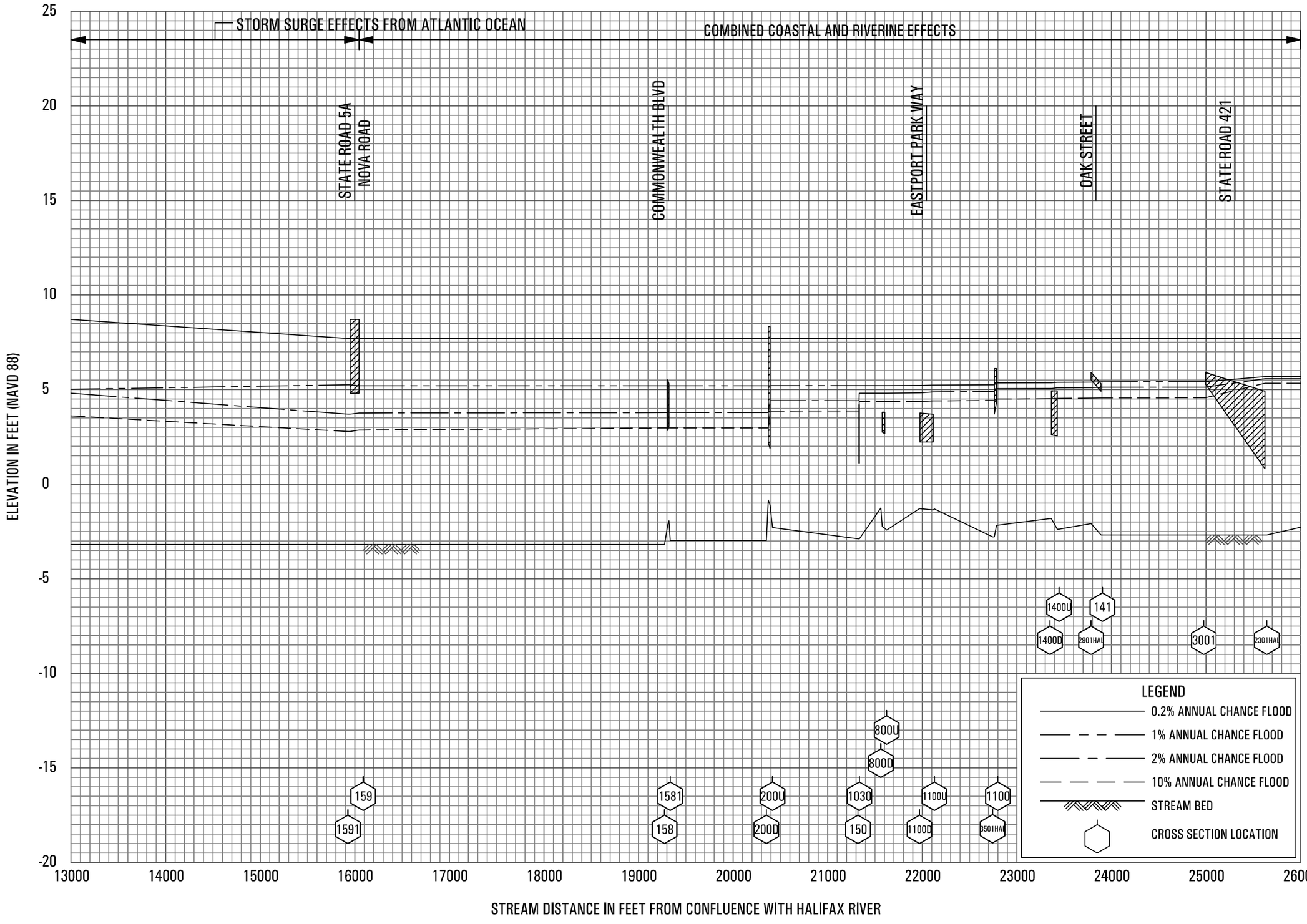
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

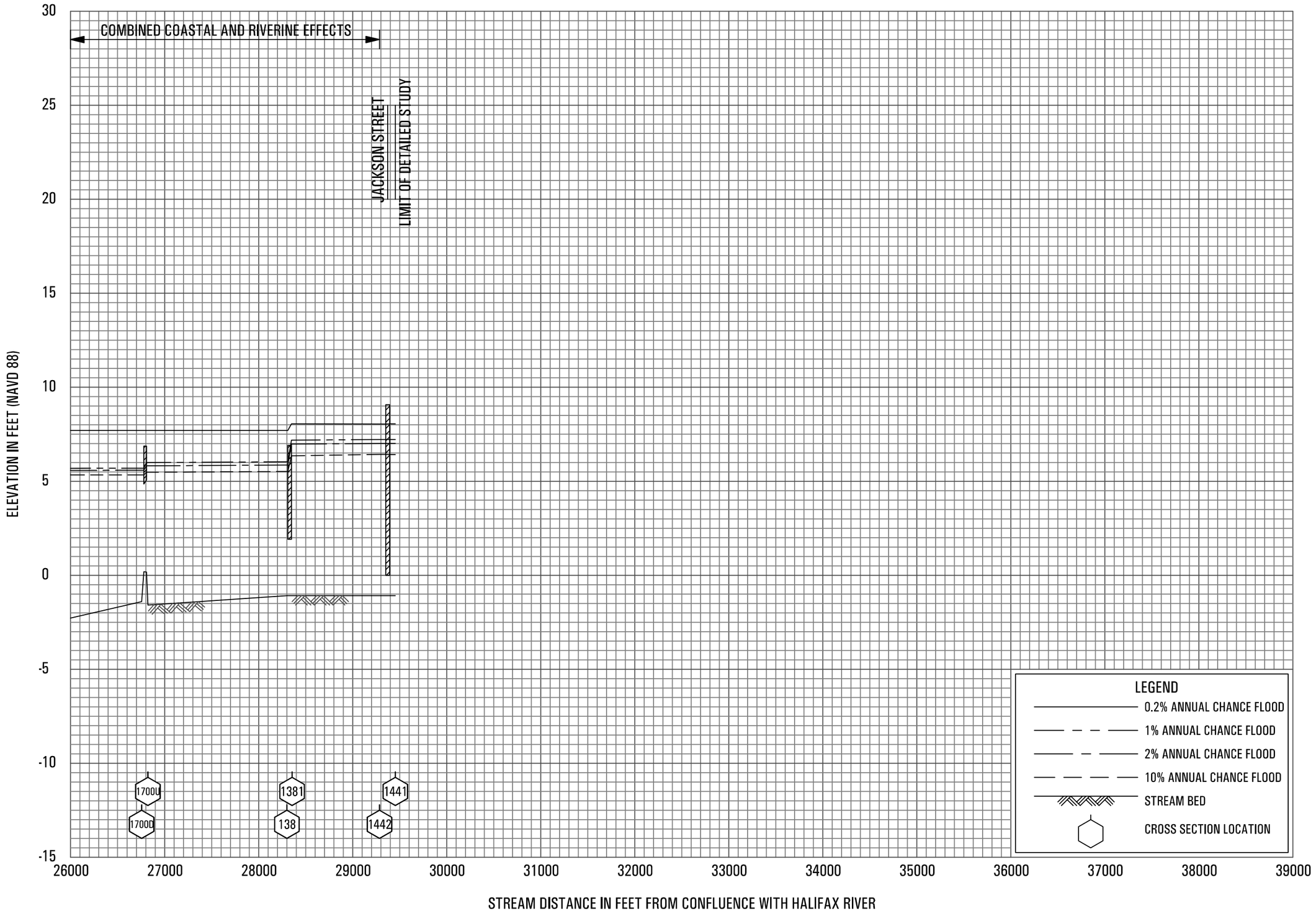
UNNAMED TRIBUTARY 2 TO GROOVER BRANCH



FLOOD PROFILES

HALIFAX CANAL

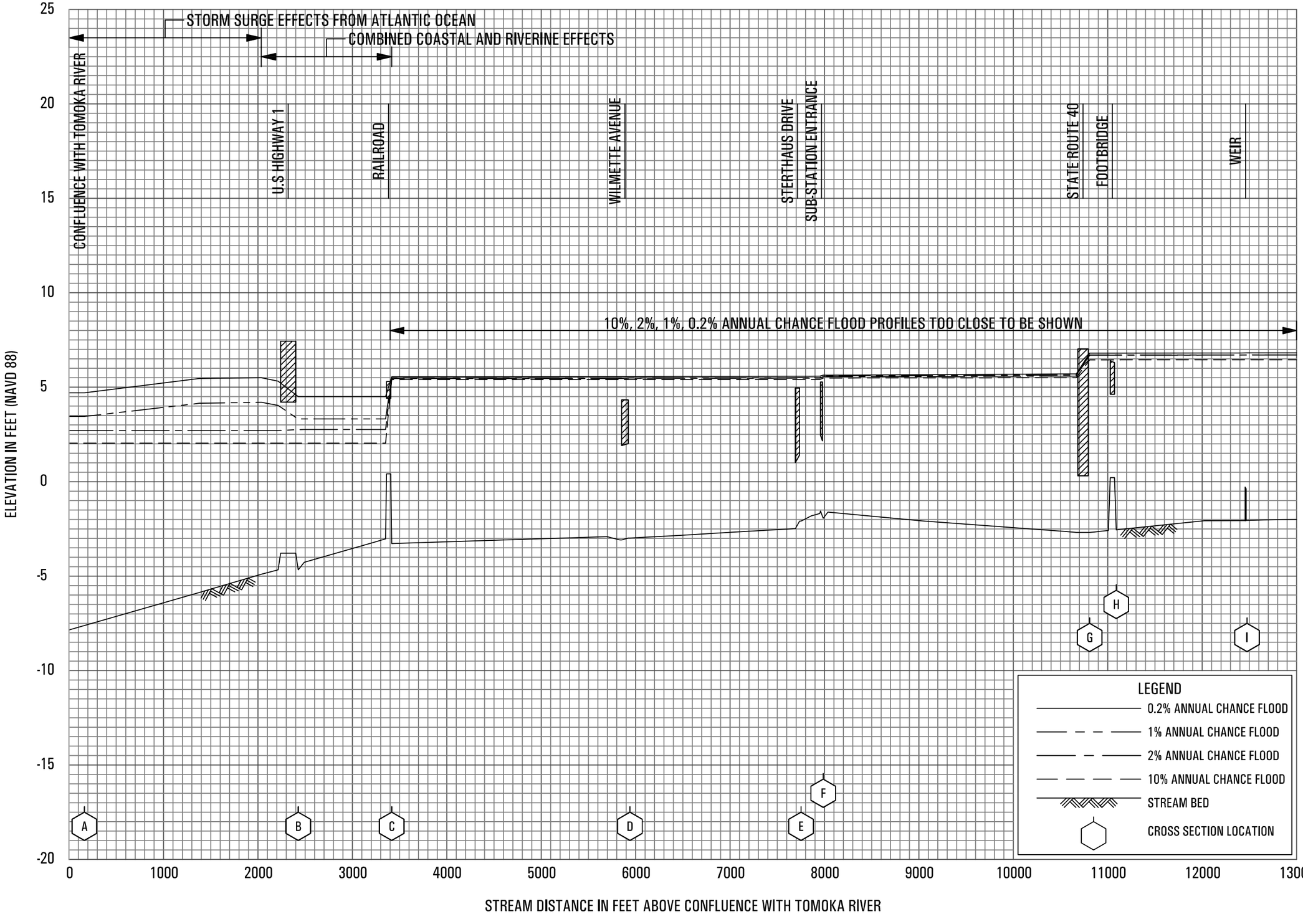
FEDERAL EMERGENCY MANAGEMENT AGENCY
VOLUSIA COUNTY, FL
AND INCORPORATED AREAS



FLOOD PROFILES

HALIFAX CANAL

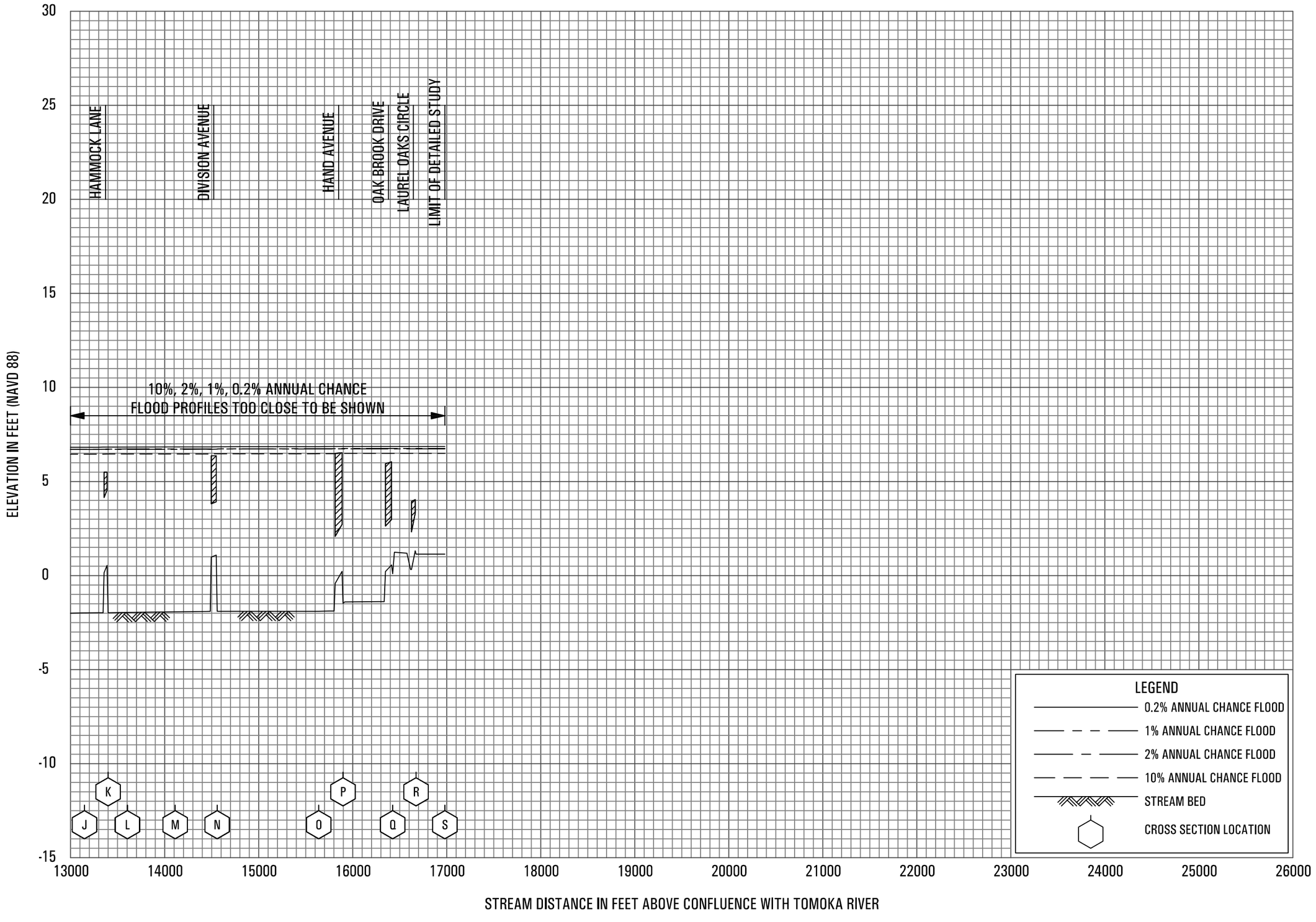
FEDERAL EMERGENCY MANAGEMENT AGENCY
VOLUSIA COUNTY, FL
AND INCORPORATED AREAS



FLOOD PROFILES

LAUREL CREEK

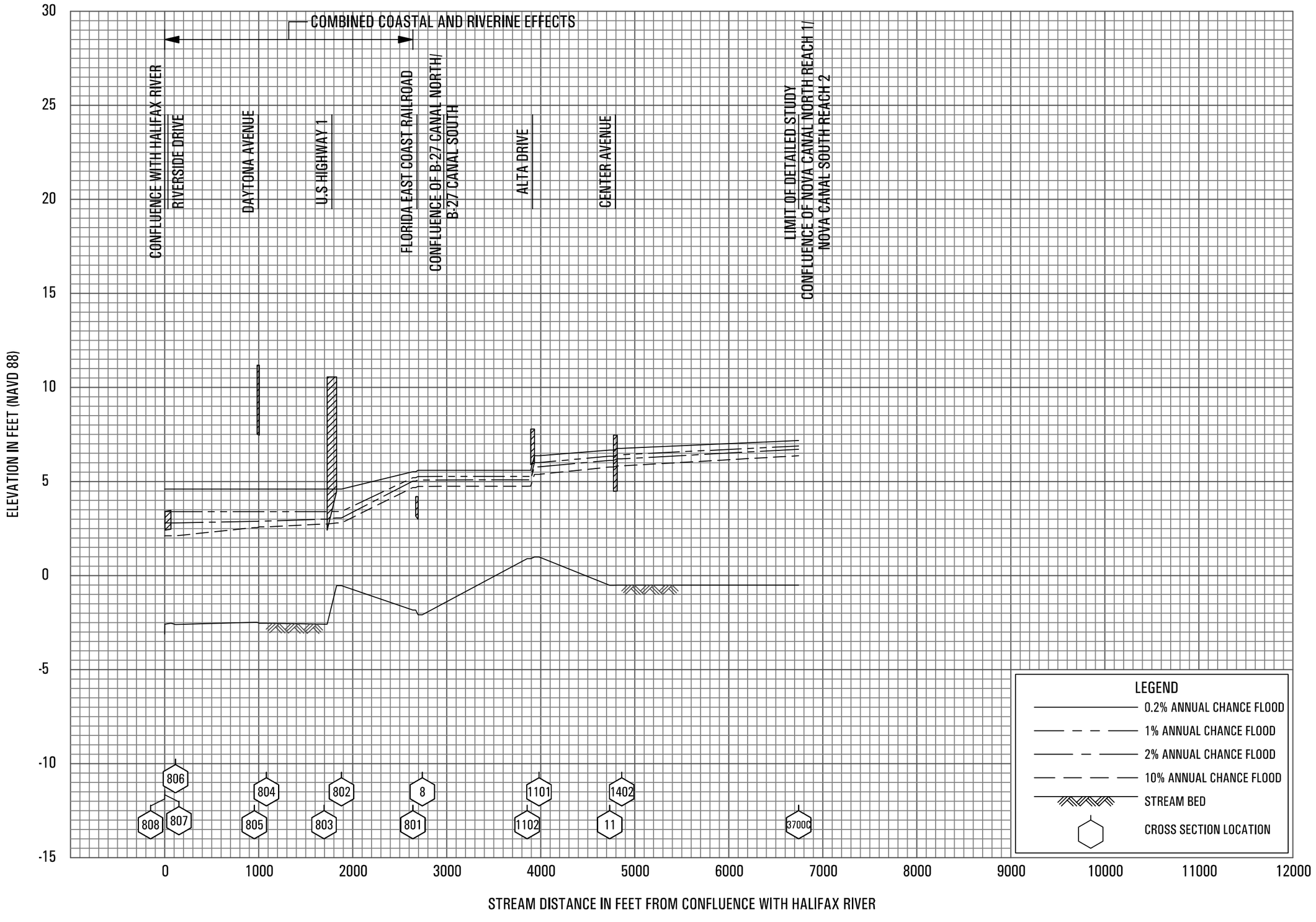
FEDERAL EMERGENCY MANAGEMENT AGENCY
VOLUSIA COUNTY, FL
AND INCORPORATED AREAS



FLOOD PROFILES

LAUREL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
VOLUSIA COUNTY, FL
AND INCORPORATED AREAS



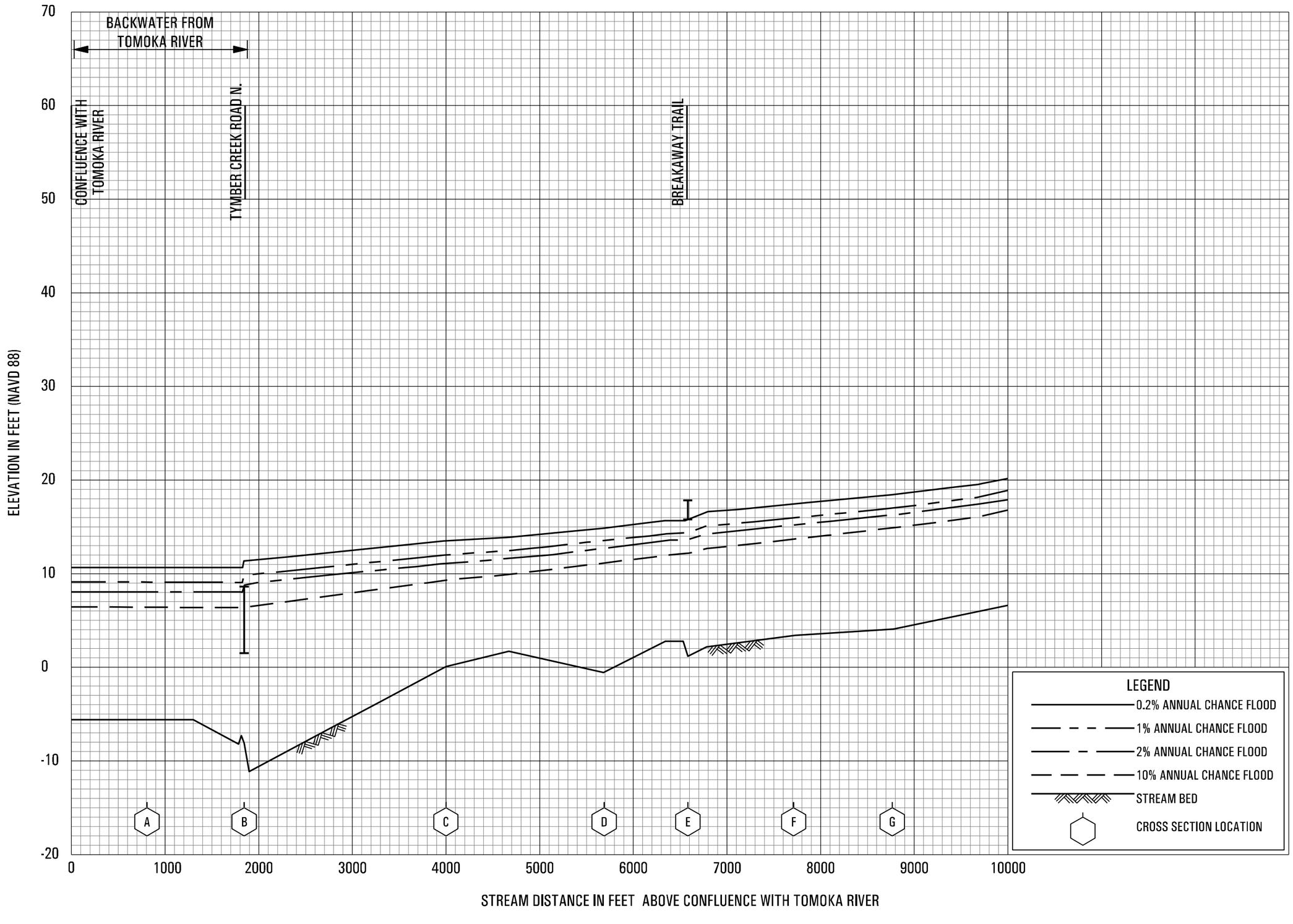
FLOOD PROFILES

LPGA CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



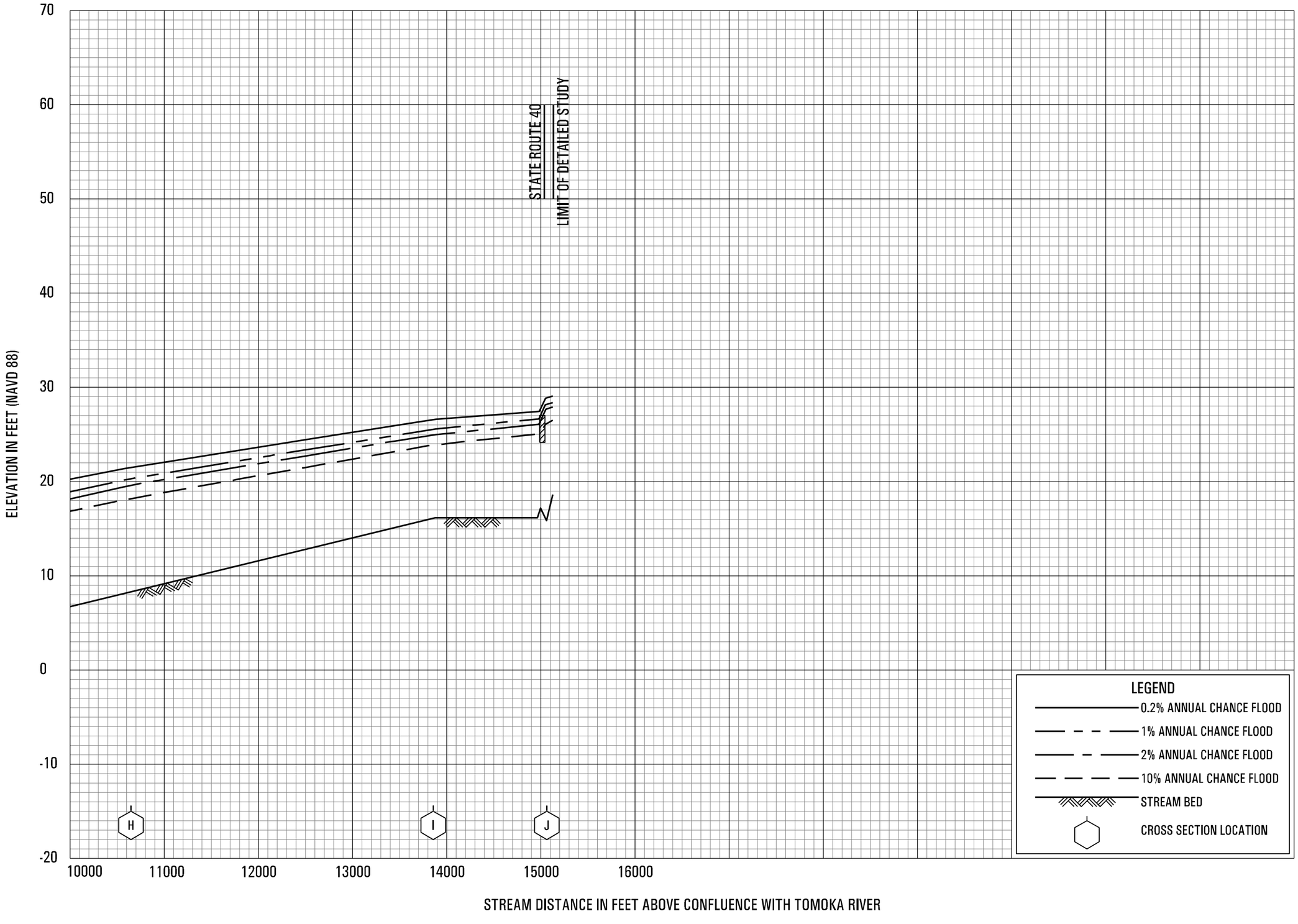
FLOOD PROFILES

LITTLE TOMOKA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



FLOOD PROFILES

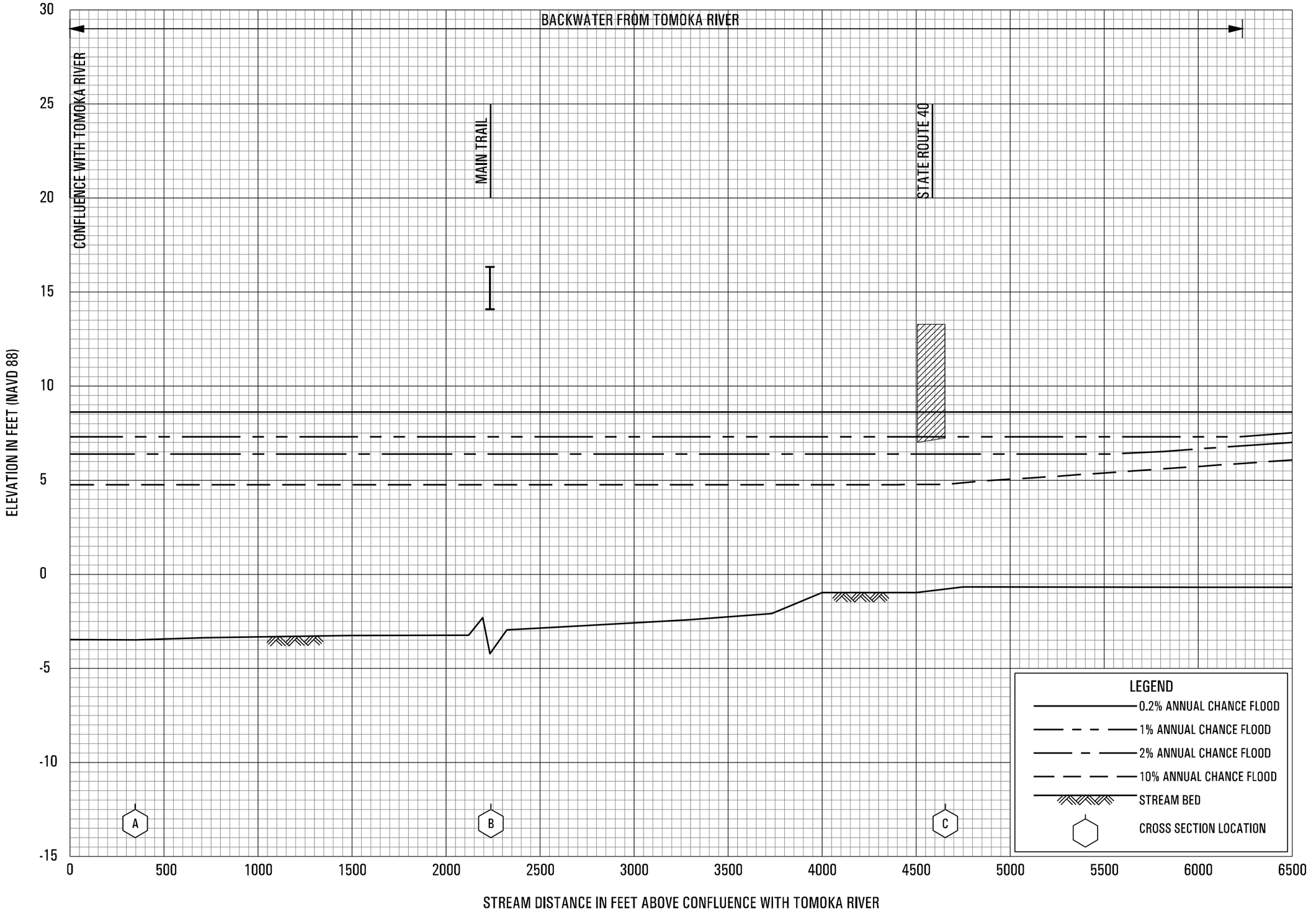
LITTLE TOMOKA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

29P



FLOOD PROFILES

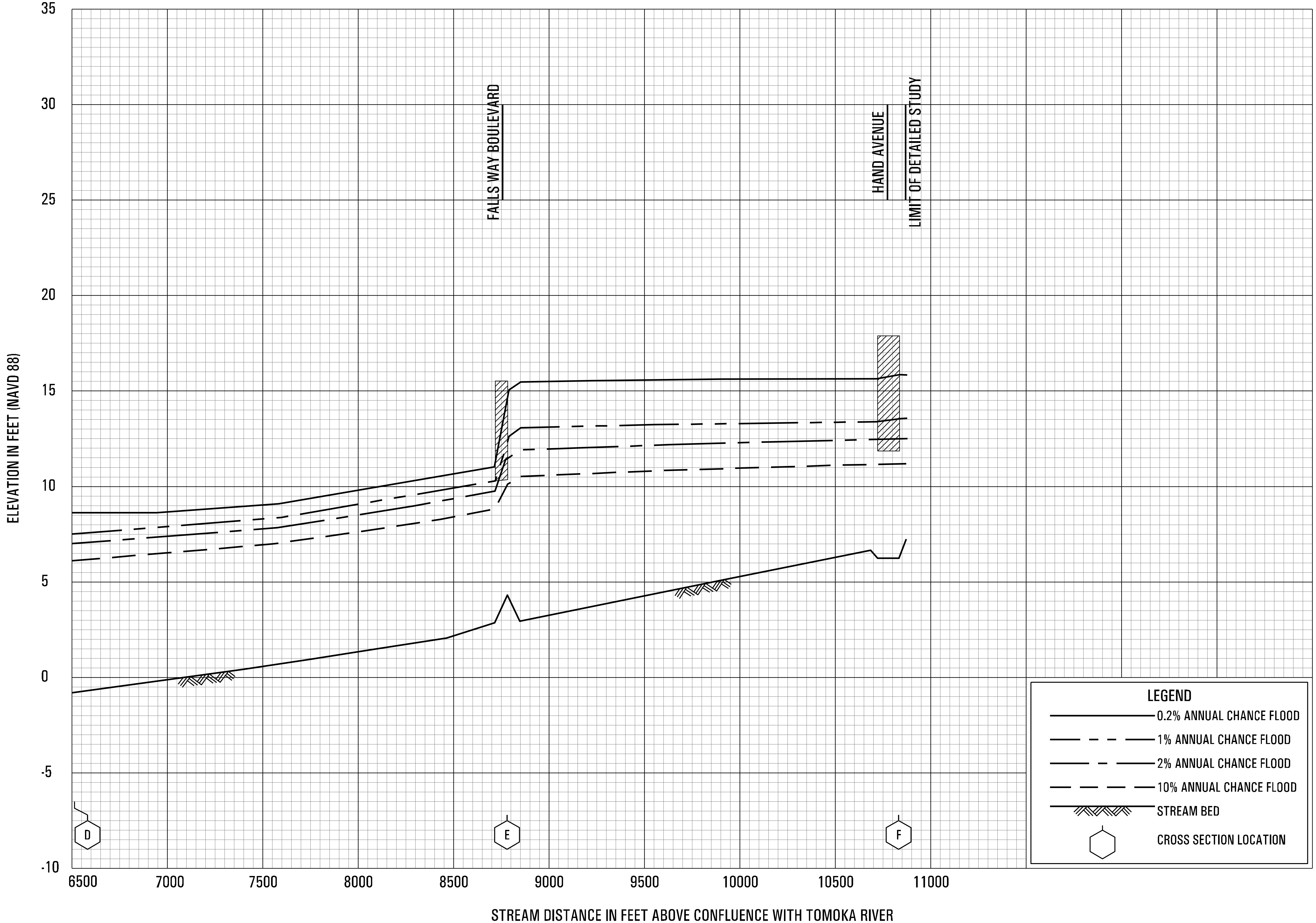
MISNER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

30P



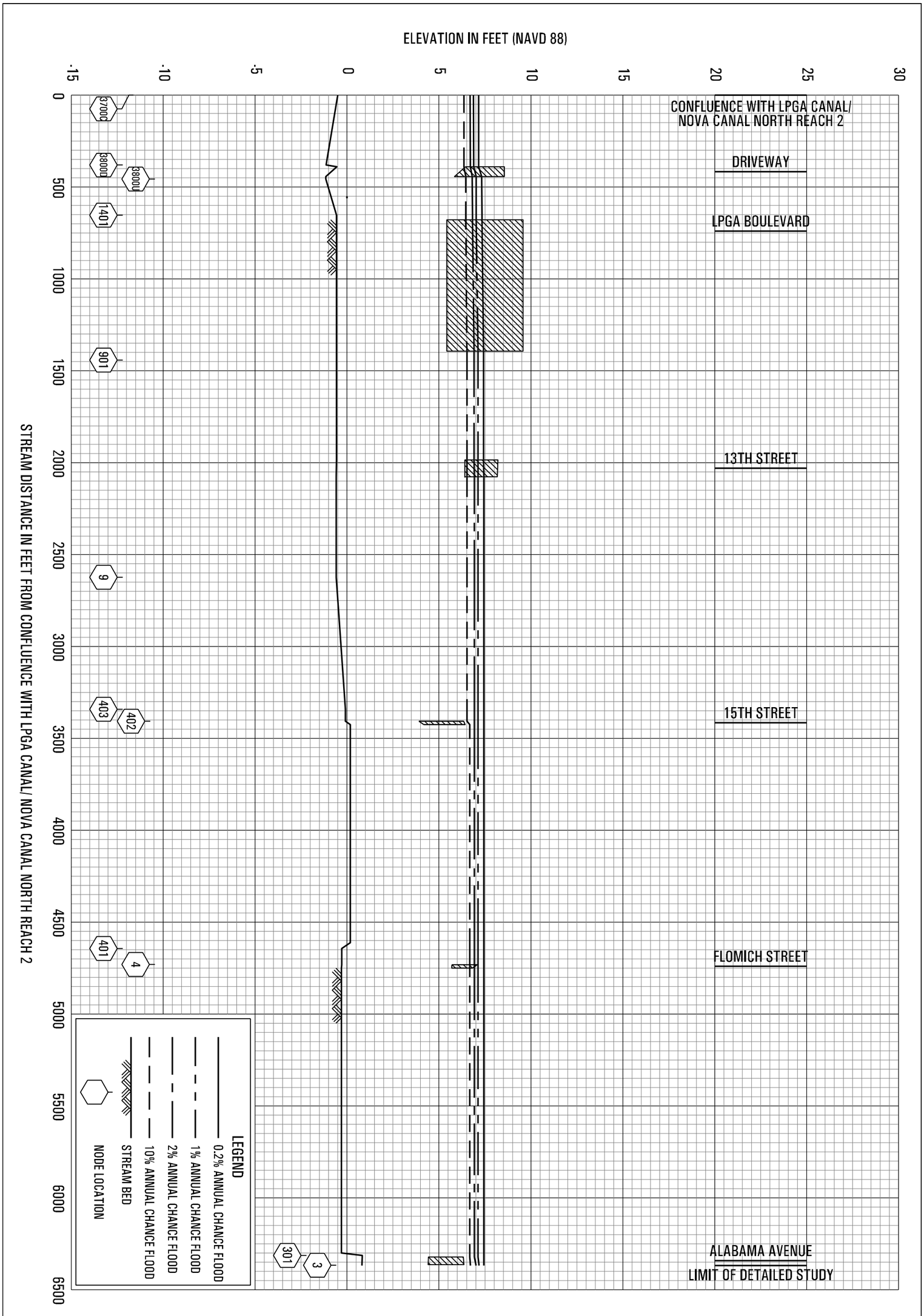
FLOOD PROFILES

MISNER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



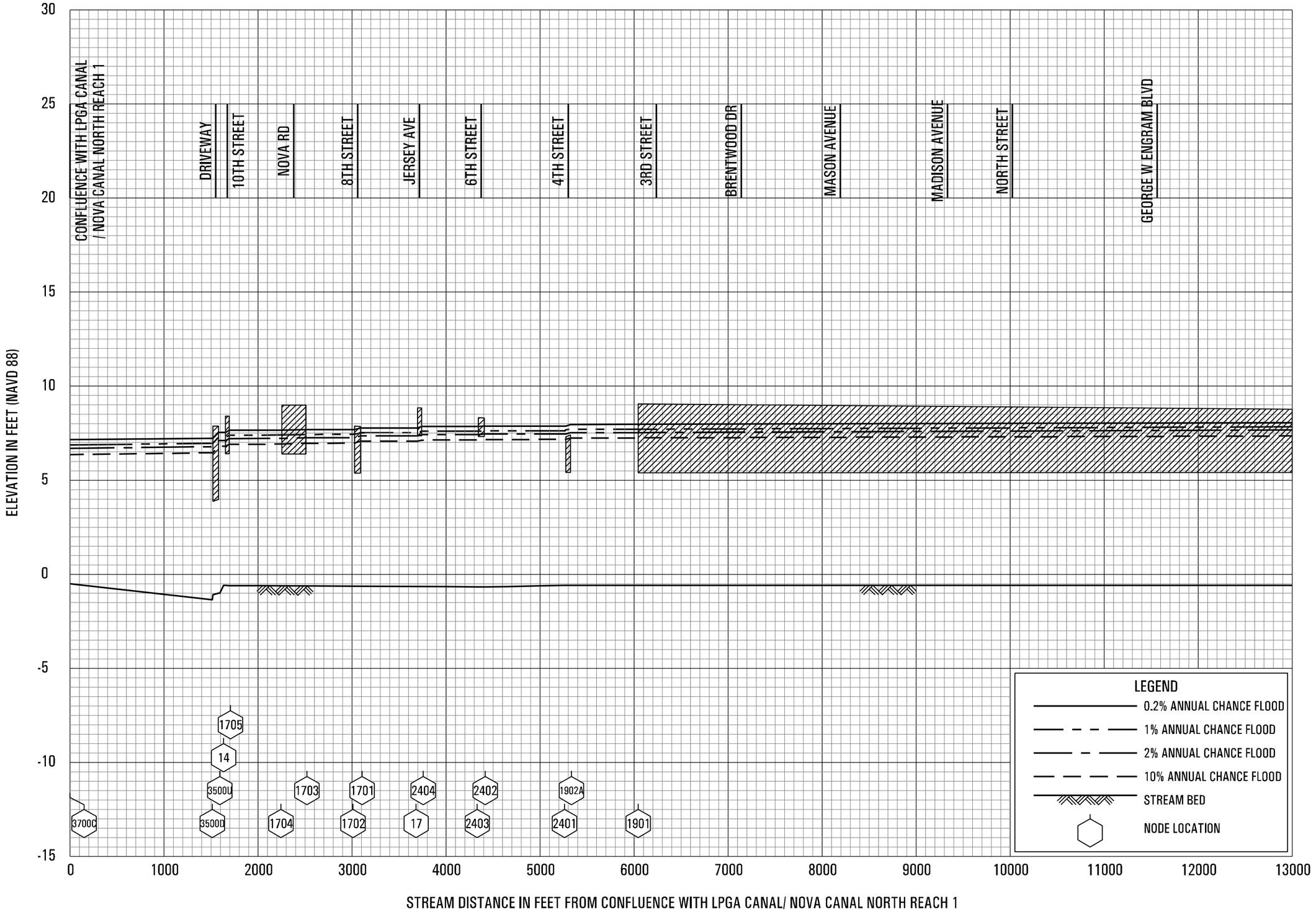
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

NOVA CANAL NORTH REACH 1



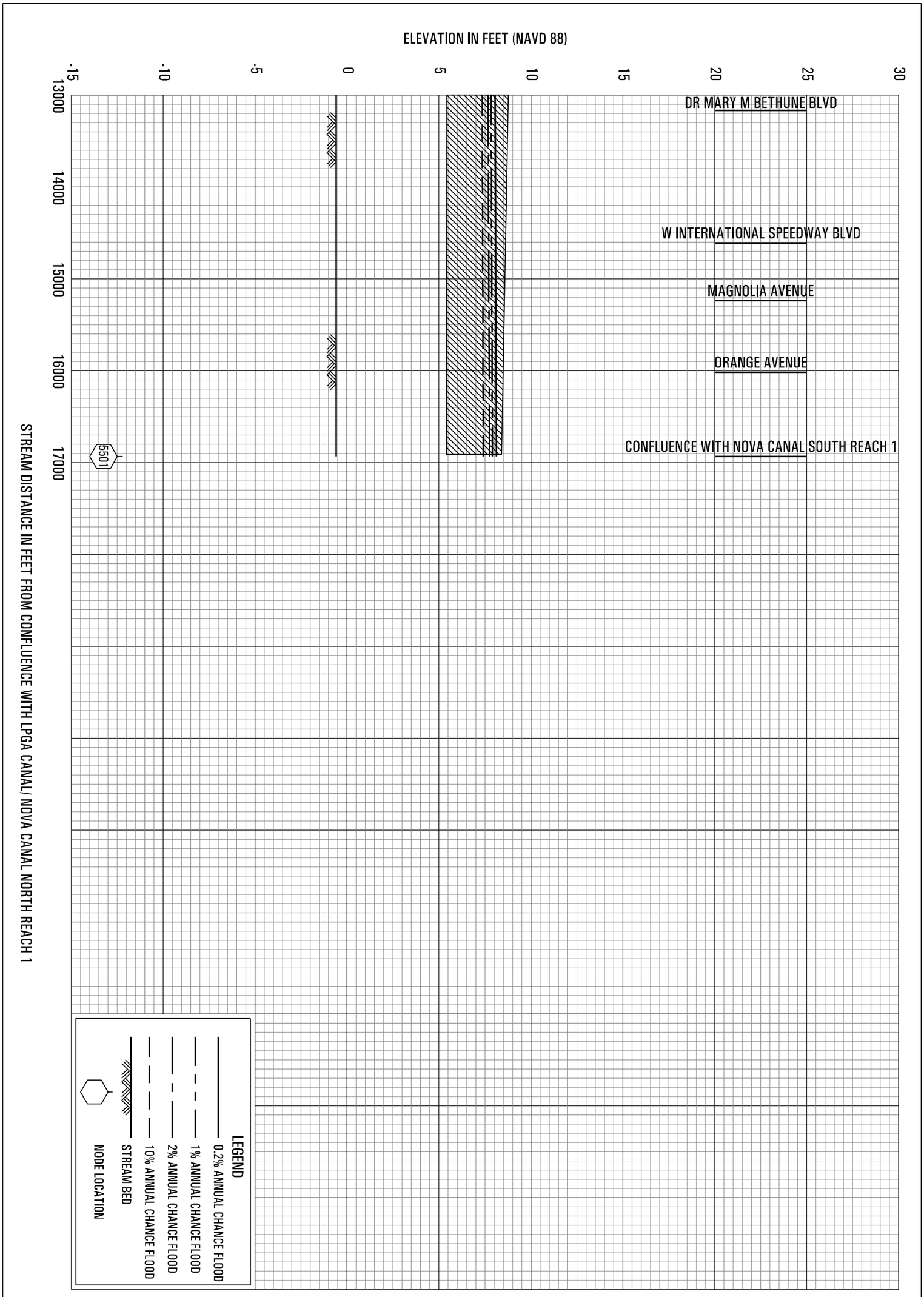
FLOOD PROFILES

NOVA CANAL NORTH REACH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



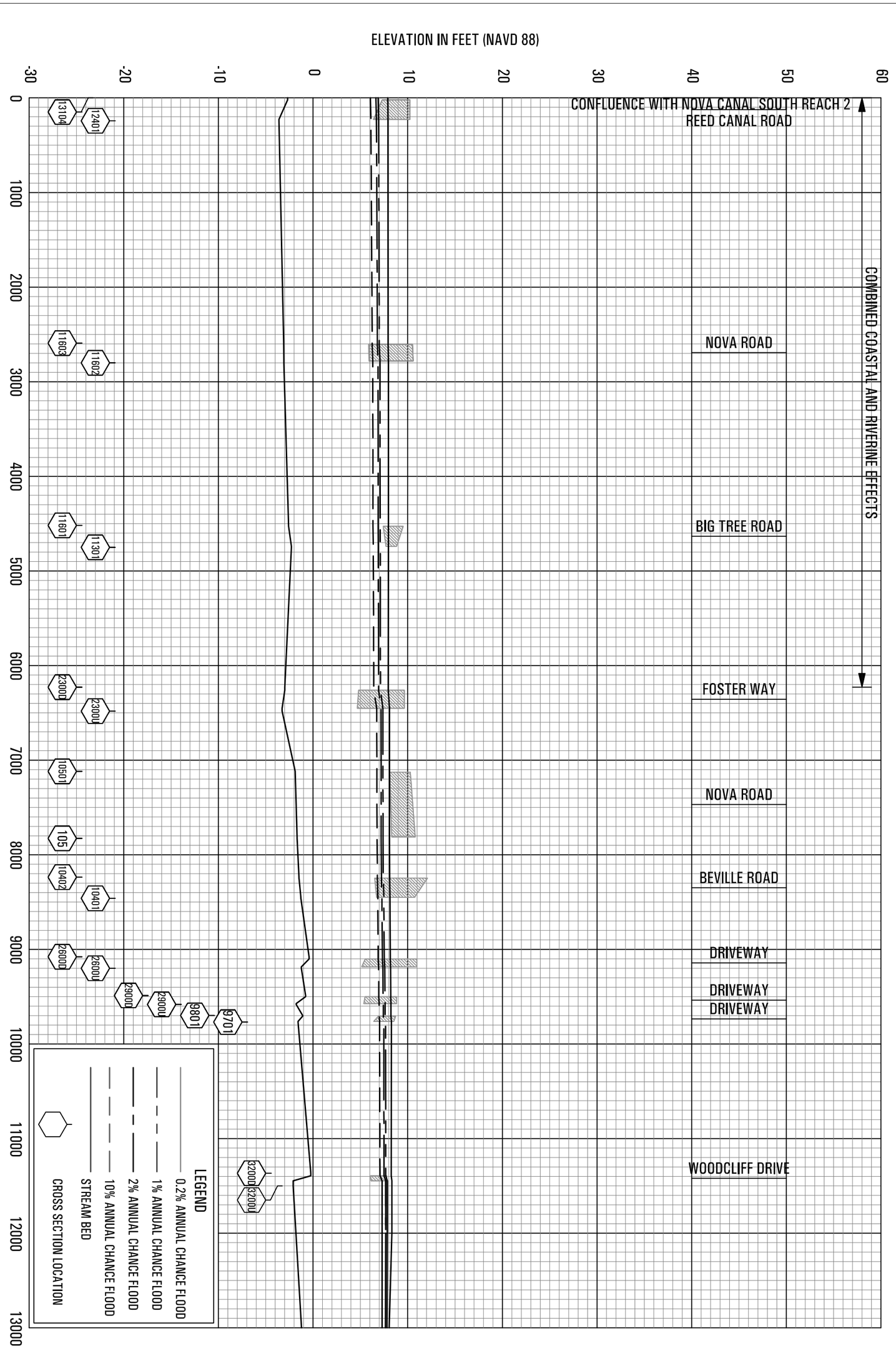
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

NOVA CANAL NORTH REACH 2



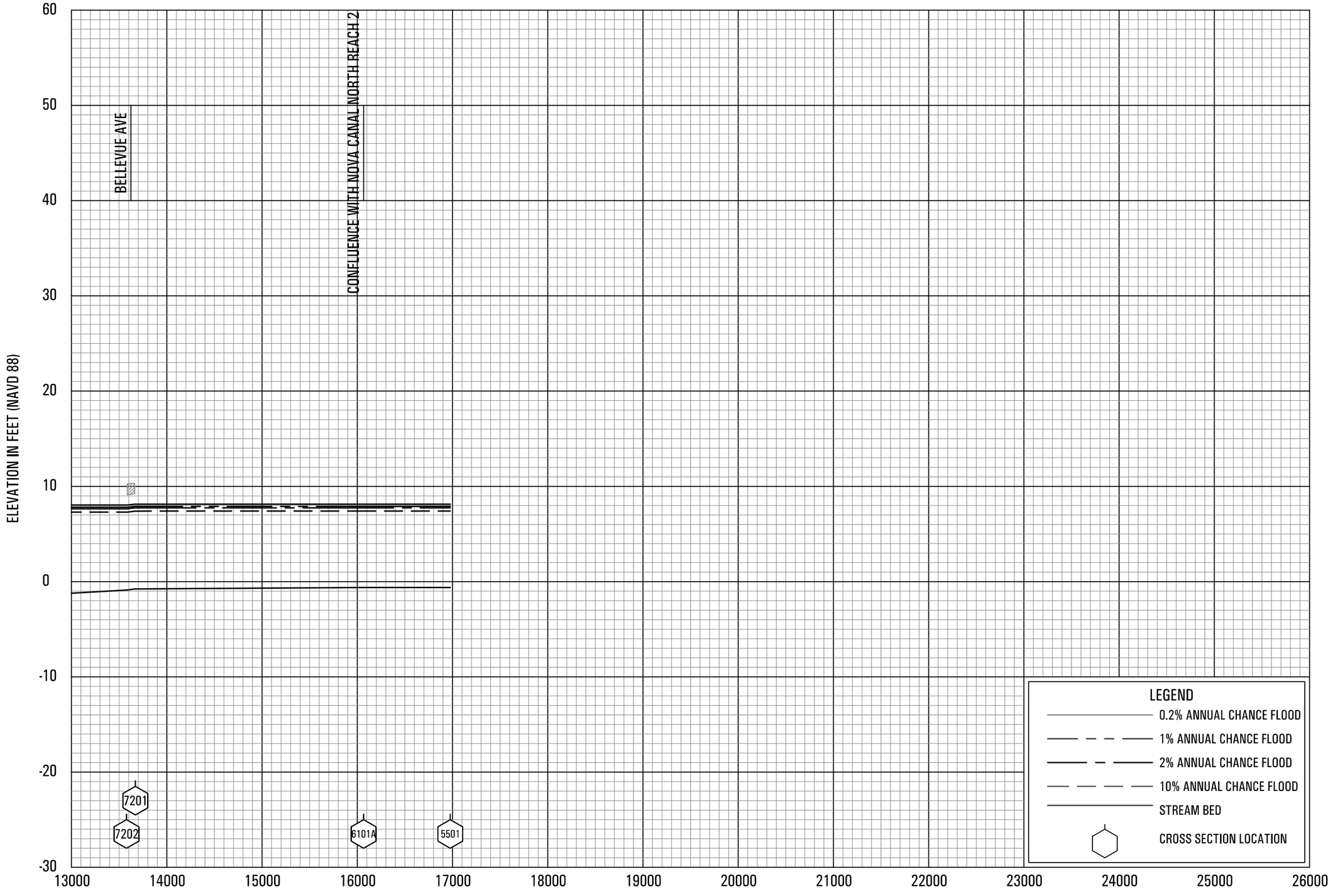
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

NOVA CANAL SOUTH REACH 1



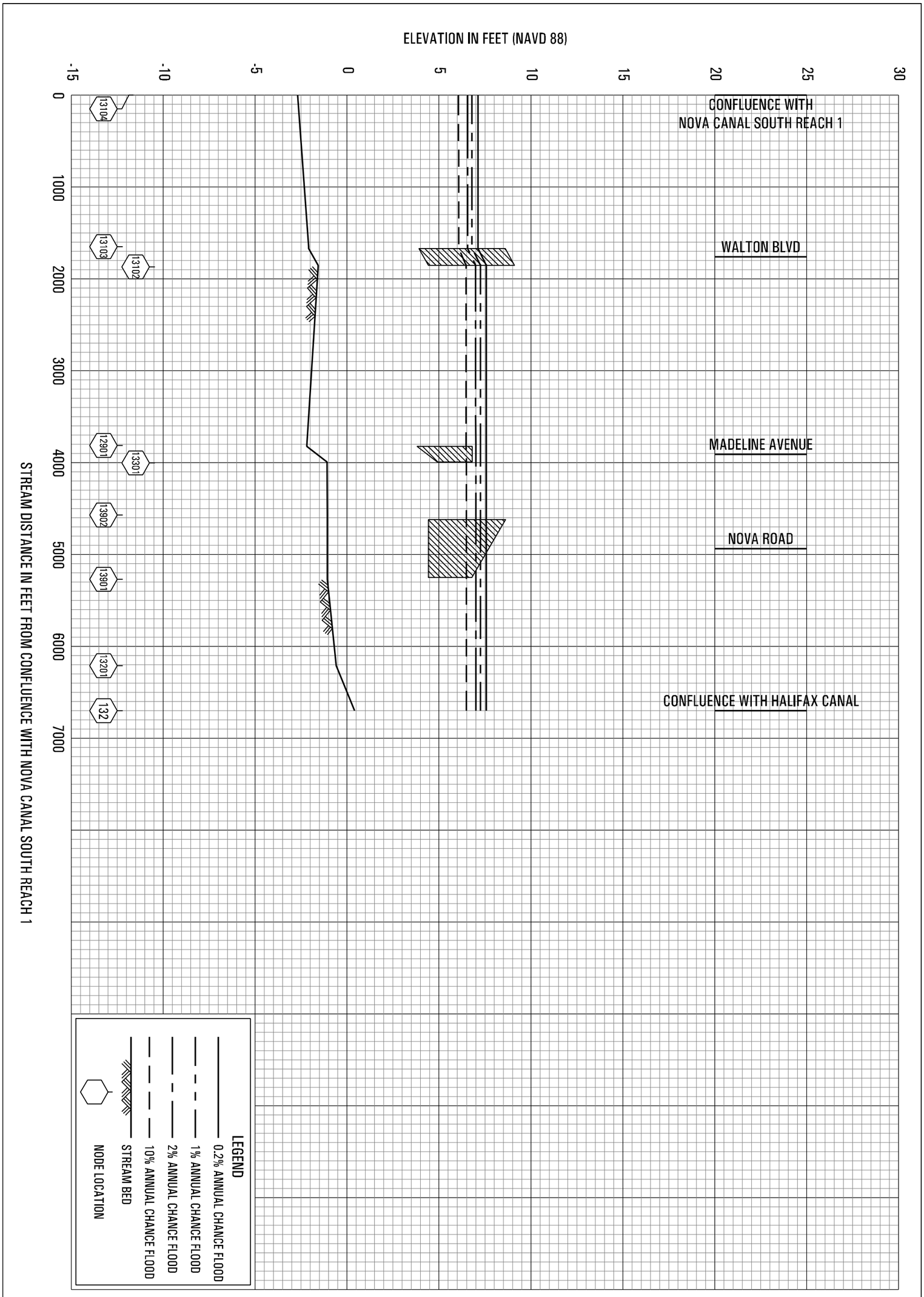
FLOOD PROFILES

NOVA CANAL SOUTH REACH 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



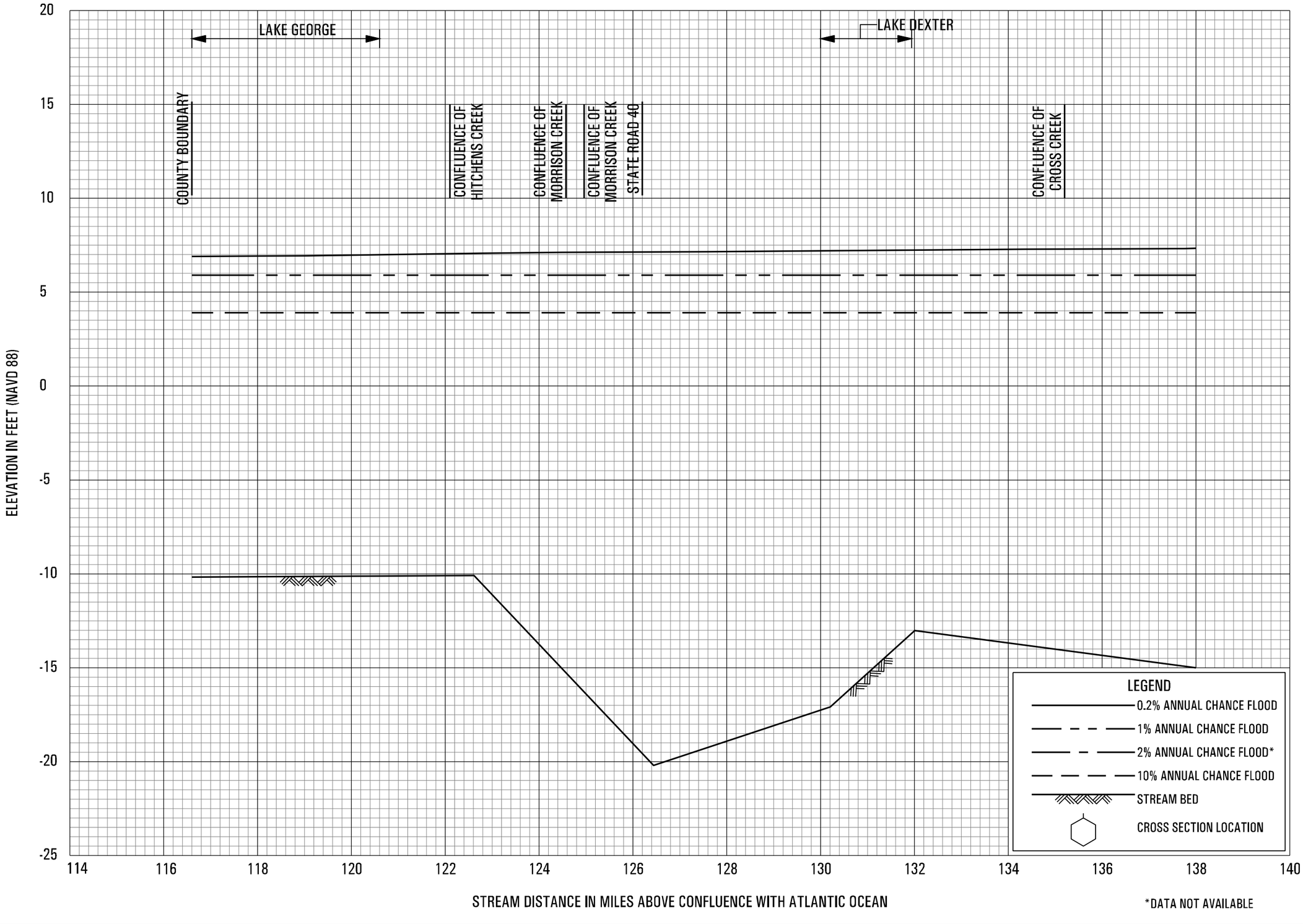
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

NOVA CANAL SOUTH REACH 2



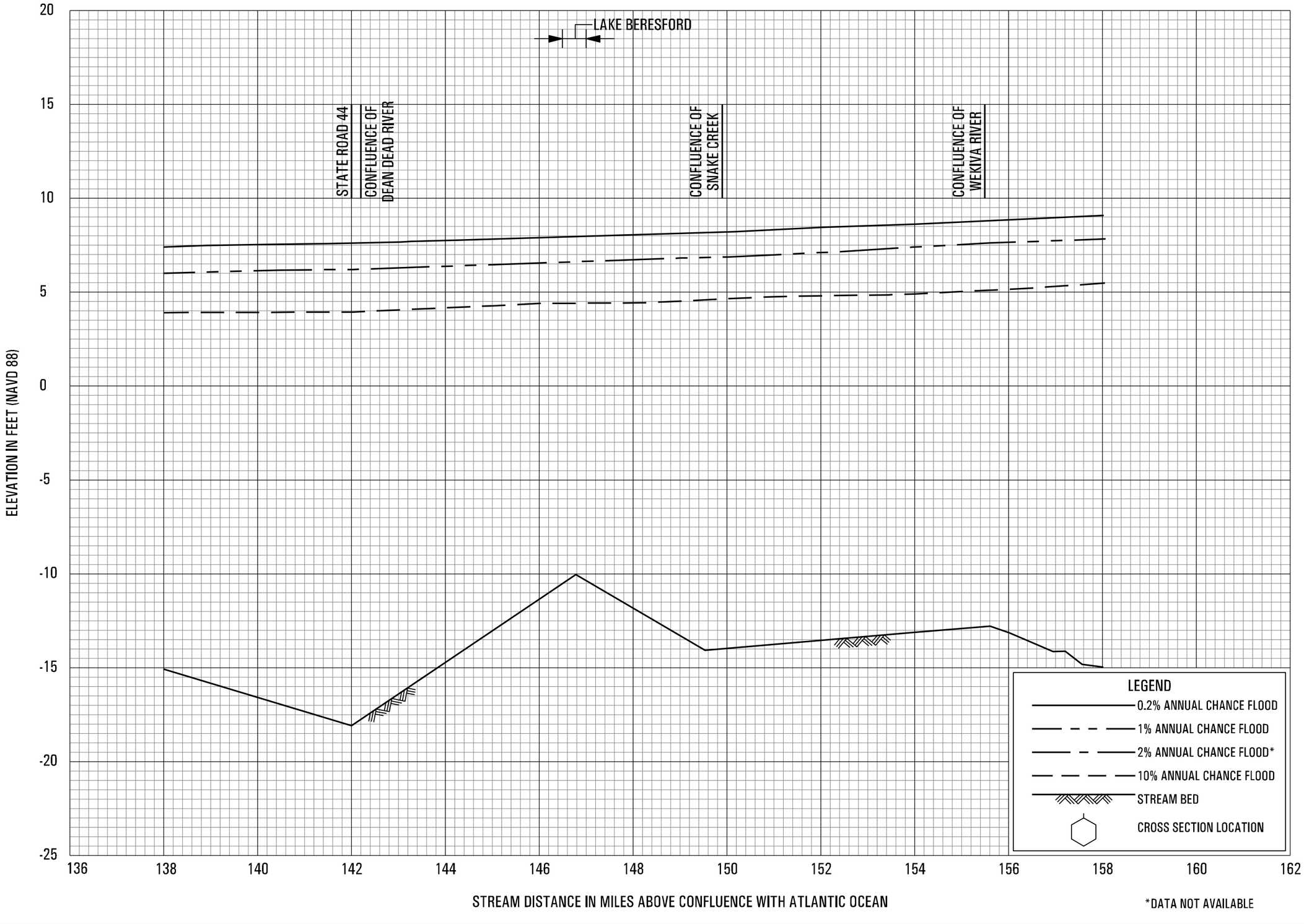
FLOOD PROFILES

ST. JOHNS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



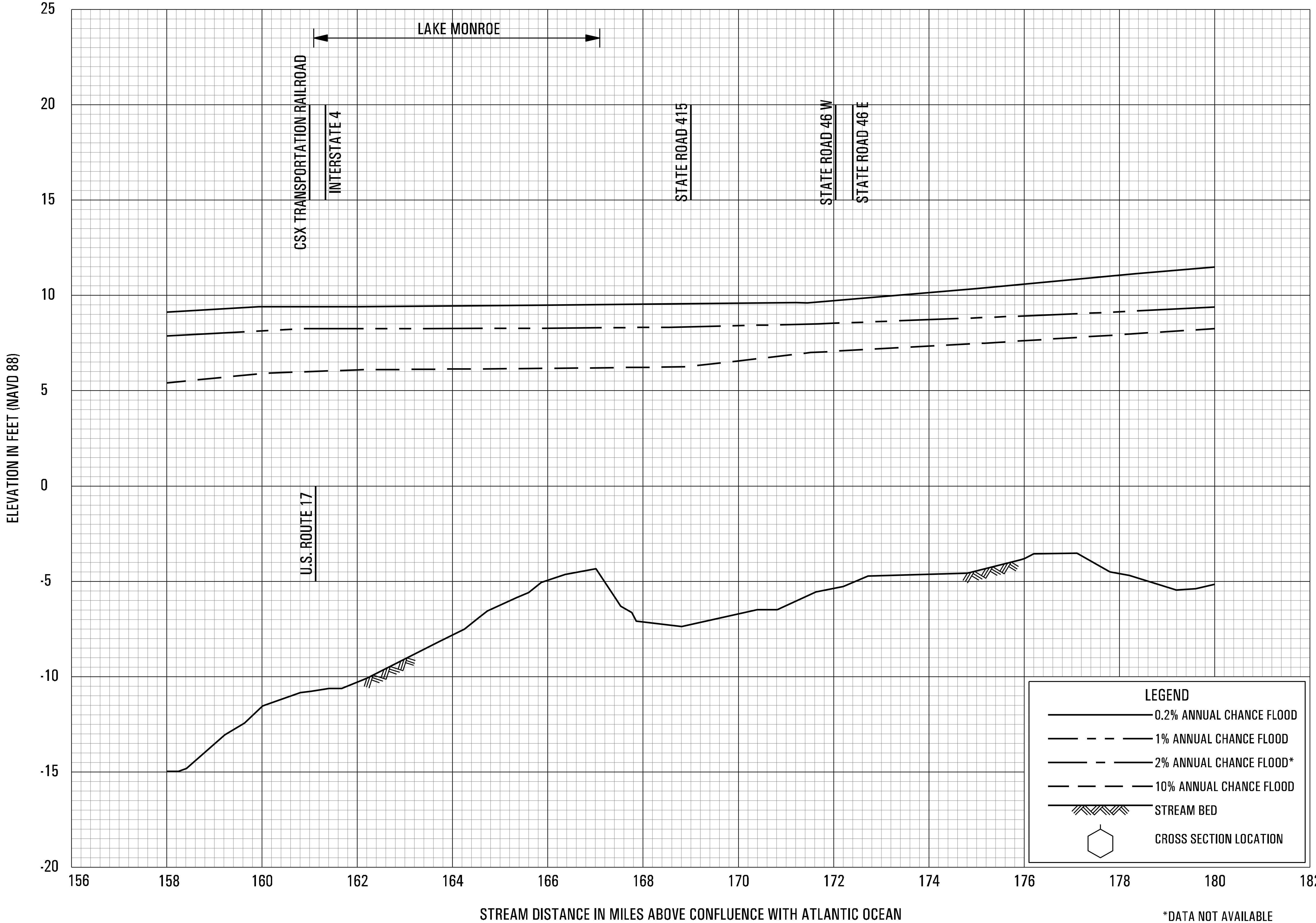
FLOOD PROFILES

ST. JOHNS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



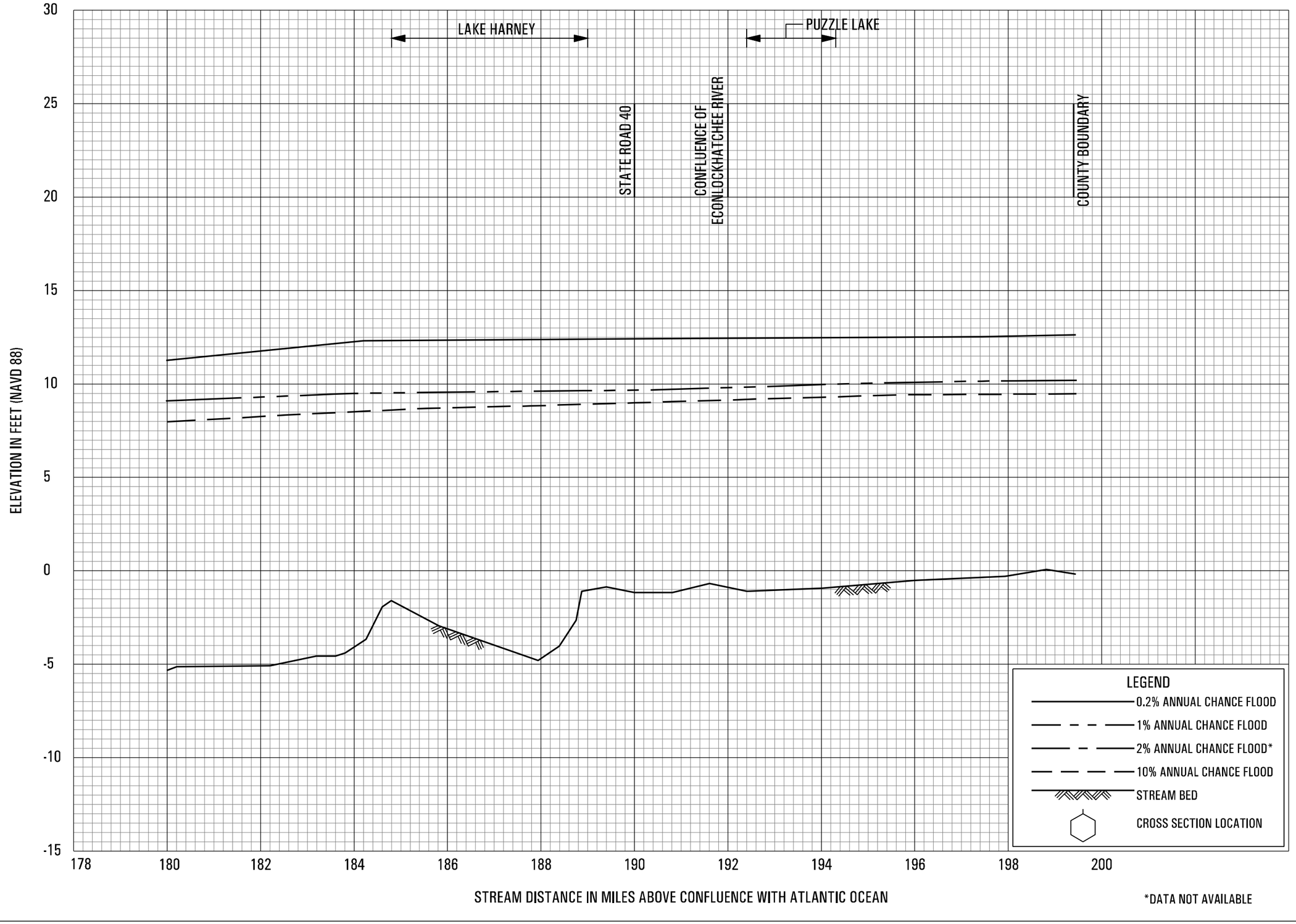
FLOOD PROFILES

ST. JOHNS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



*DATA NOT AVAILABLE

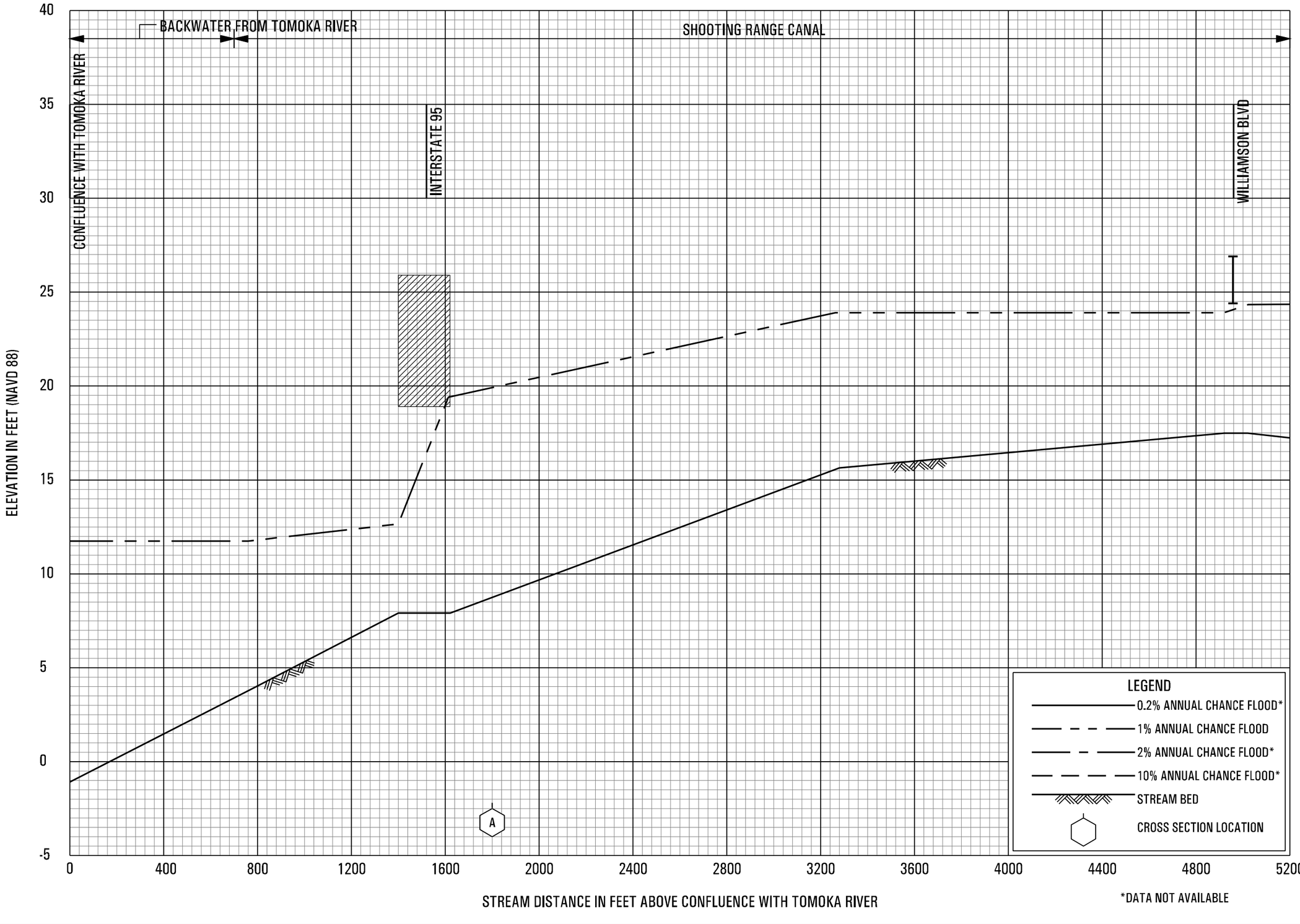
FLOOD PROFILES

ST. JOHNS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



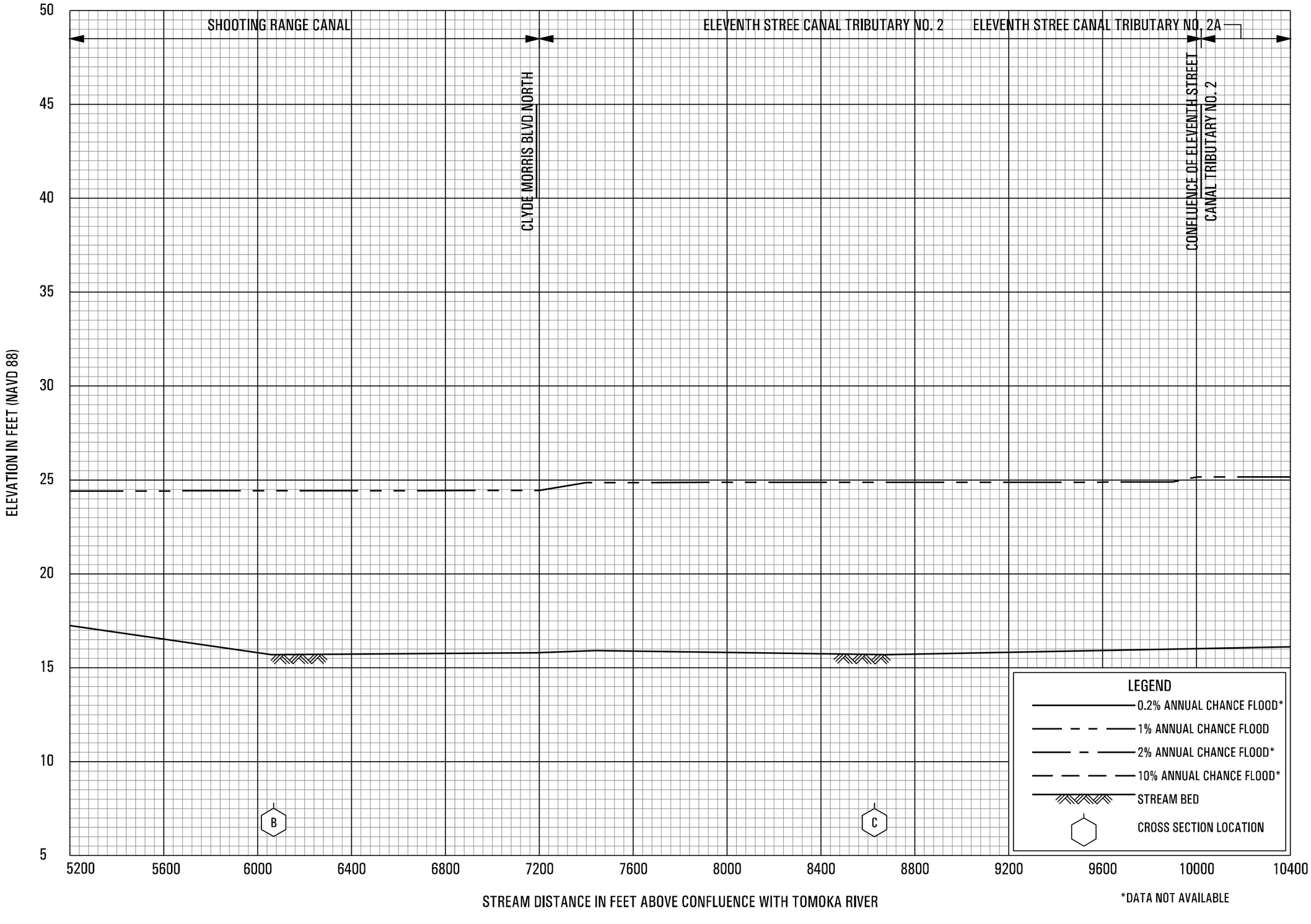
FLOOD PROFILES

SHOOTING RANGE CANAL/ ELEVENTH STREET CANAL TRIBUTARY NO. 2/2A

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



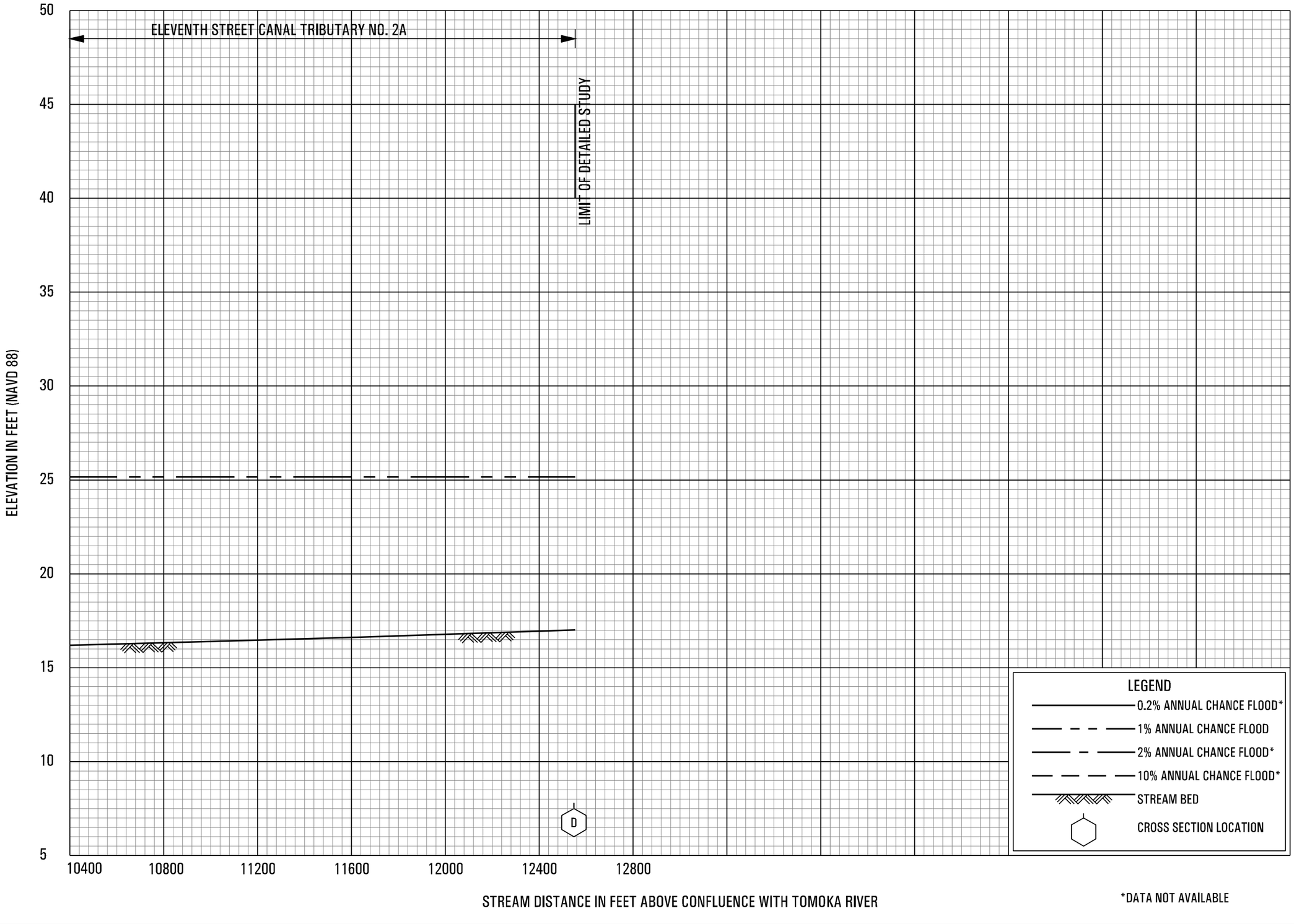
FLOOD PROFILES

SHOOTING RANGE CANAL/ ELEVENTH STREET CANAL TRIBUTARY NO. 2/2A

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



*DATA NOT AVAILABLE

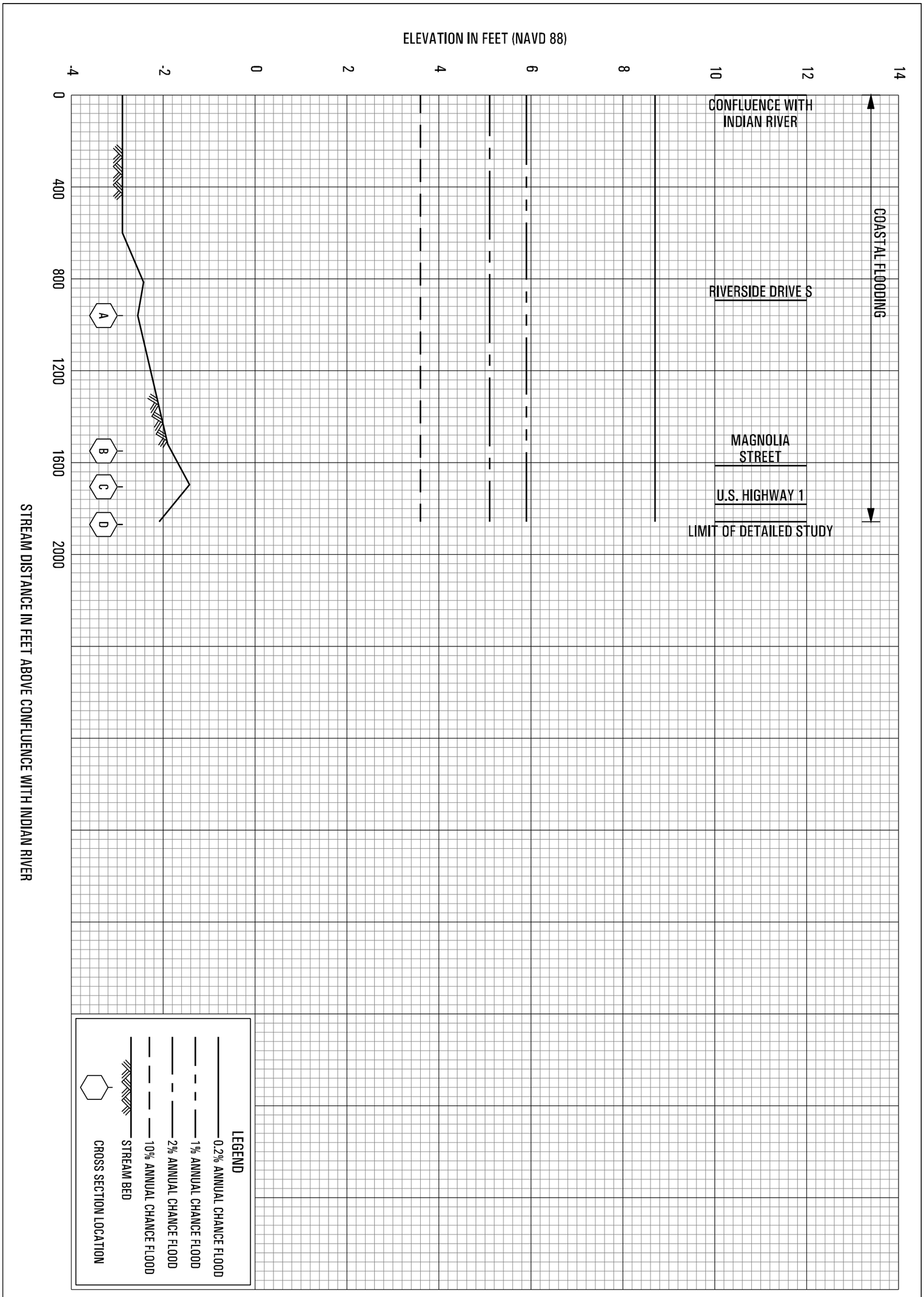
FLOOD PROFILES

SHOOTING RANGE CANAL/ ELEVENTH STREET CANAL TRIBUTARY NO. 2/2A

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



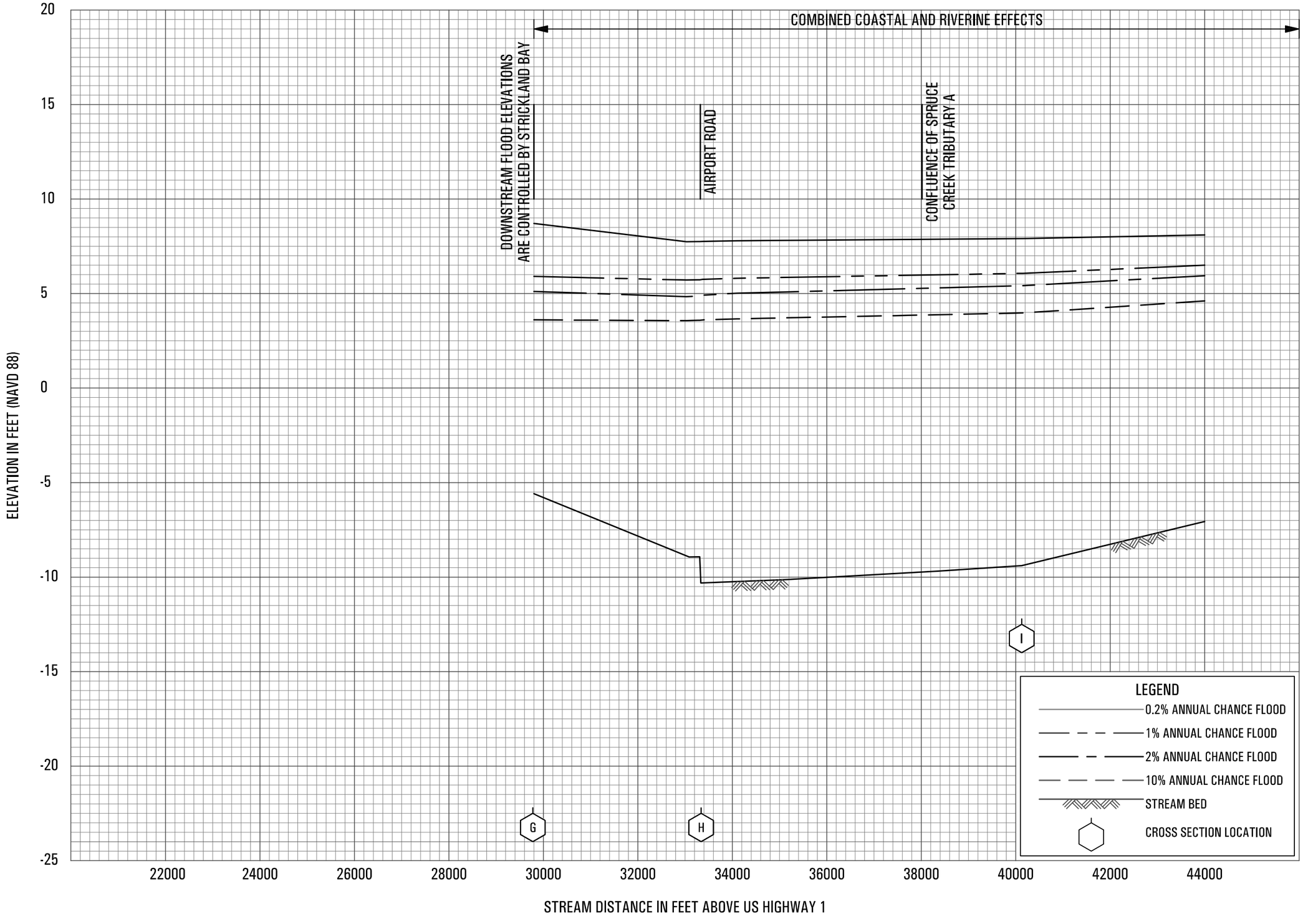
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

SOUTH CANAL



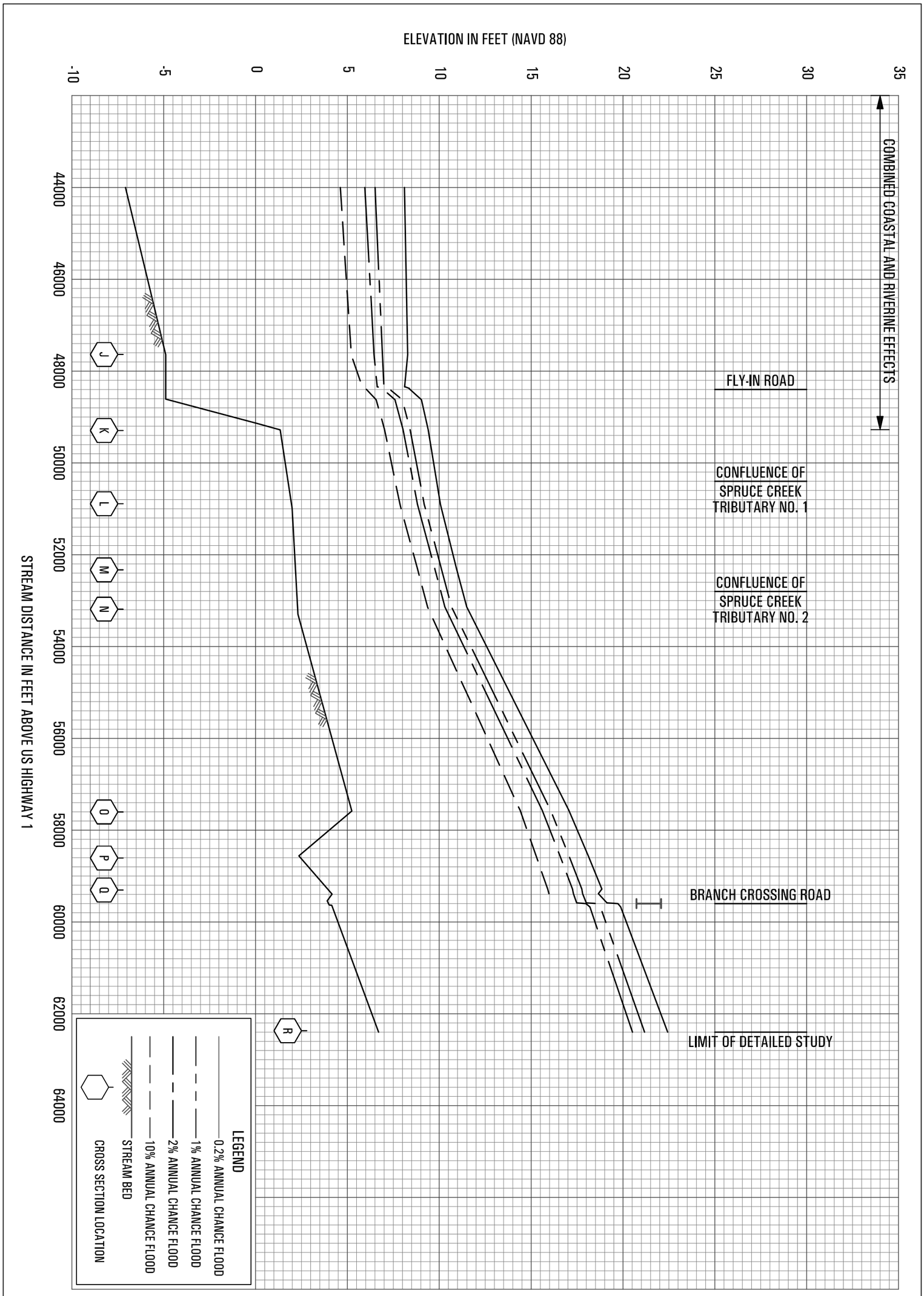
FLOOD PROFILES

SPRUCE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



47P

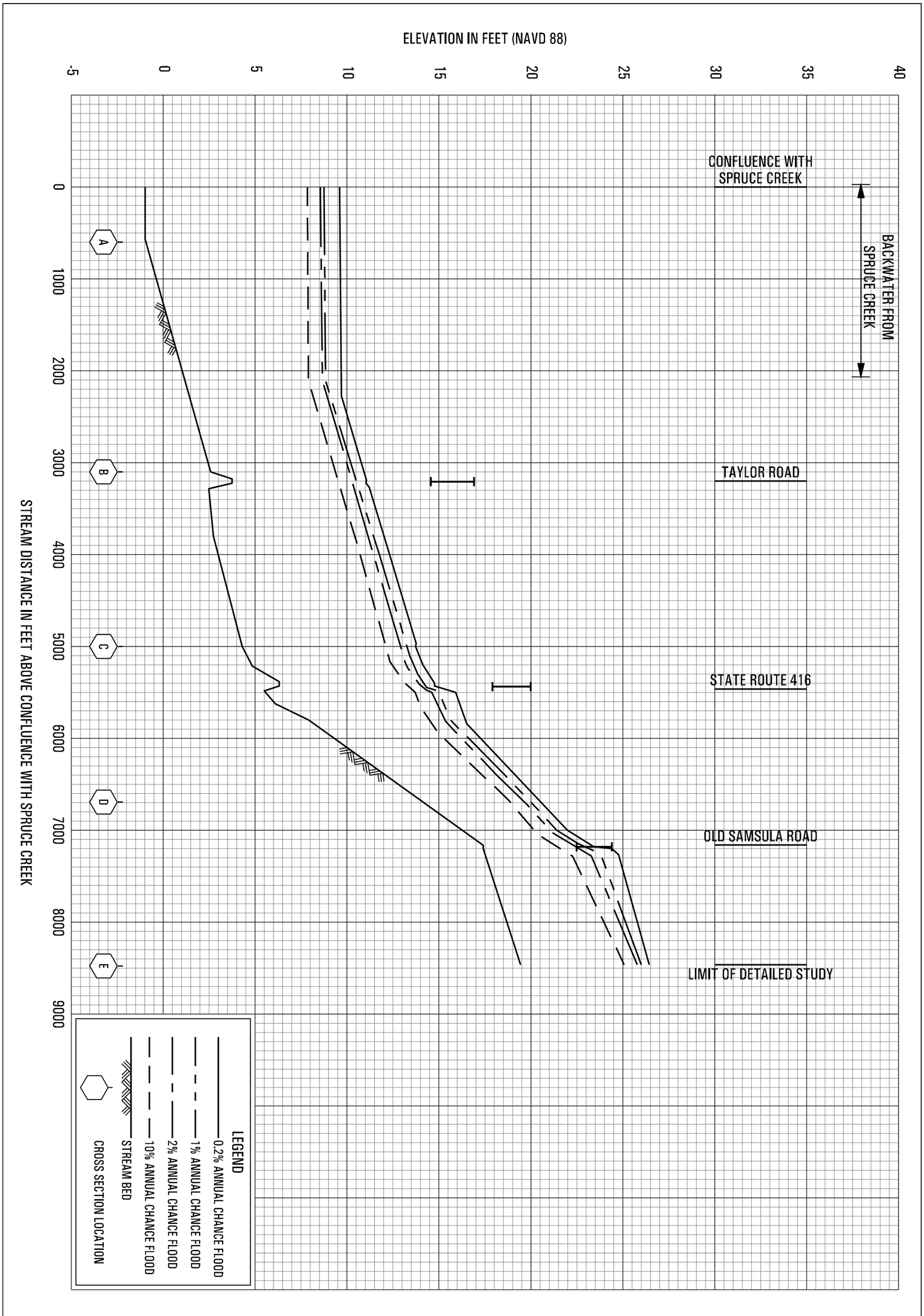
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

SPRUCE CREEK



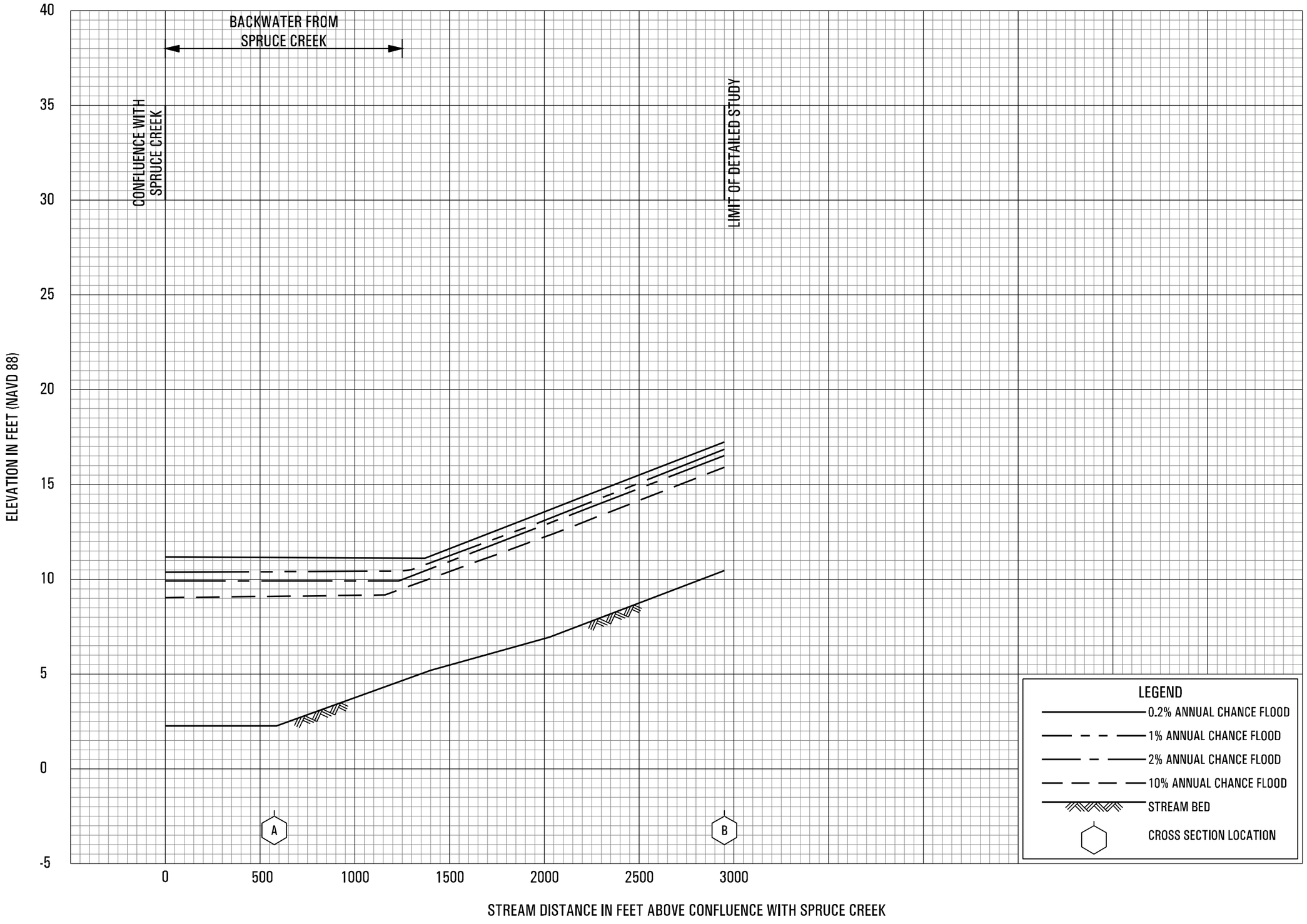
FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

FLOOD PROFILES

SPRUCE CREEK TRIBUTARY NO. 1



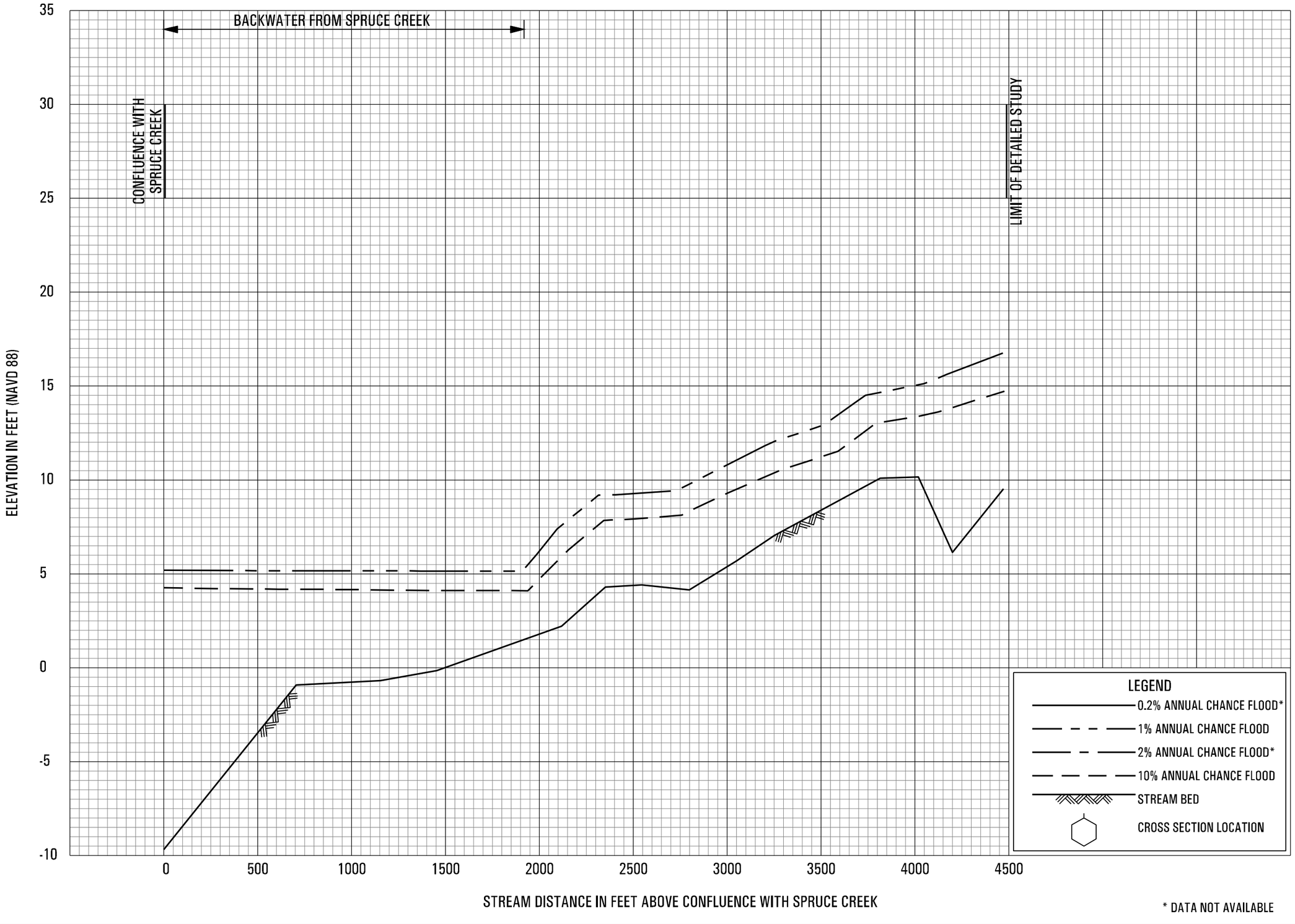
FLOOD PROFILES

SPRUCE CREEK TRIBUTARY NO. 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



* DATA NOT AVAILABLE

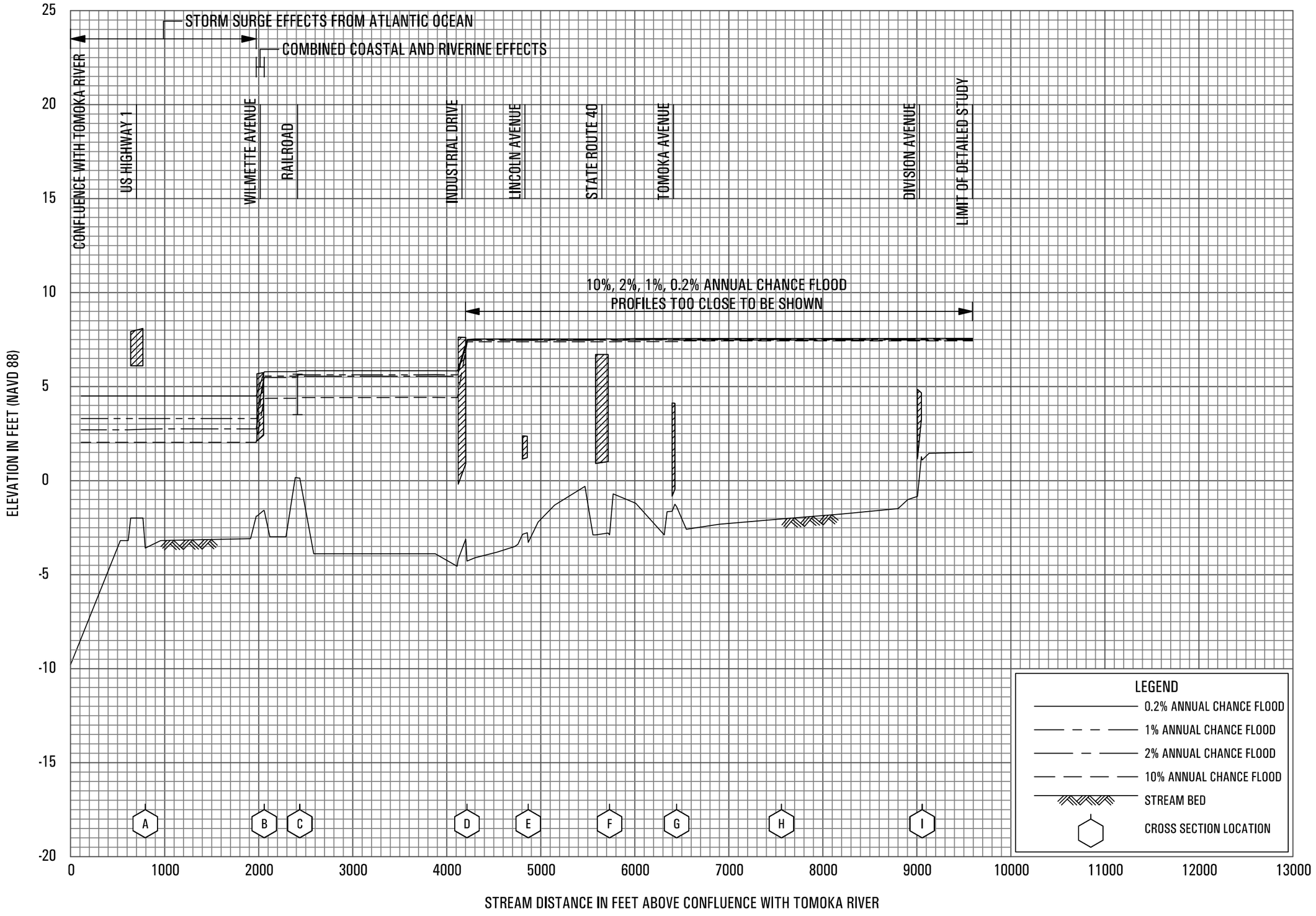
FLOOD PROFILES

SPRUCE CREEK TRIBUTARY A

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



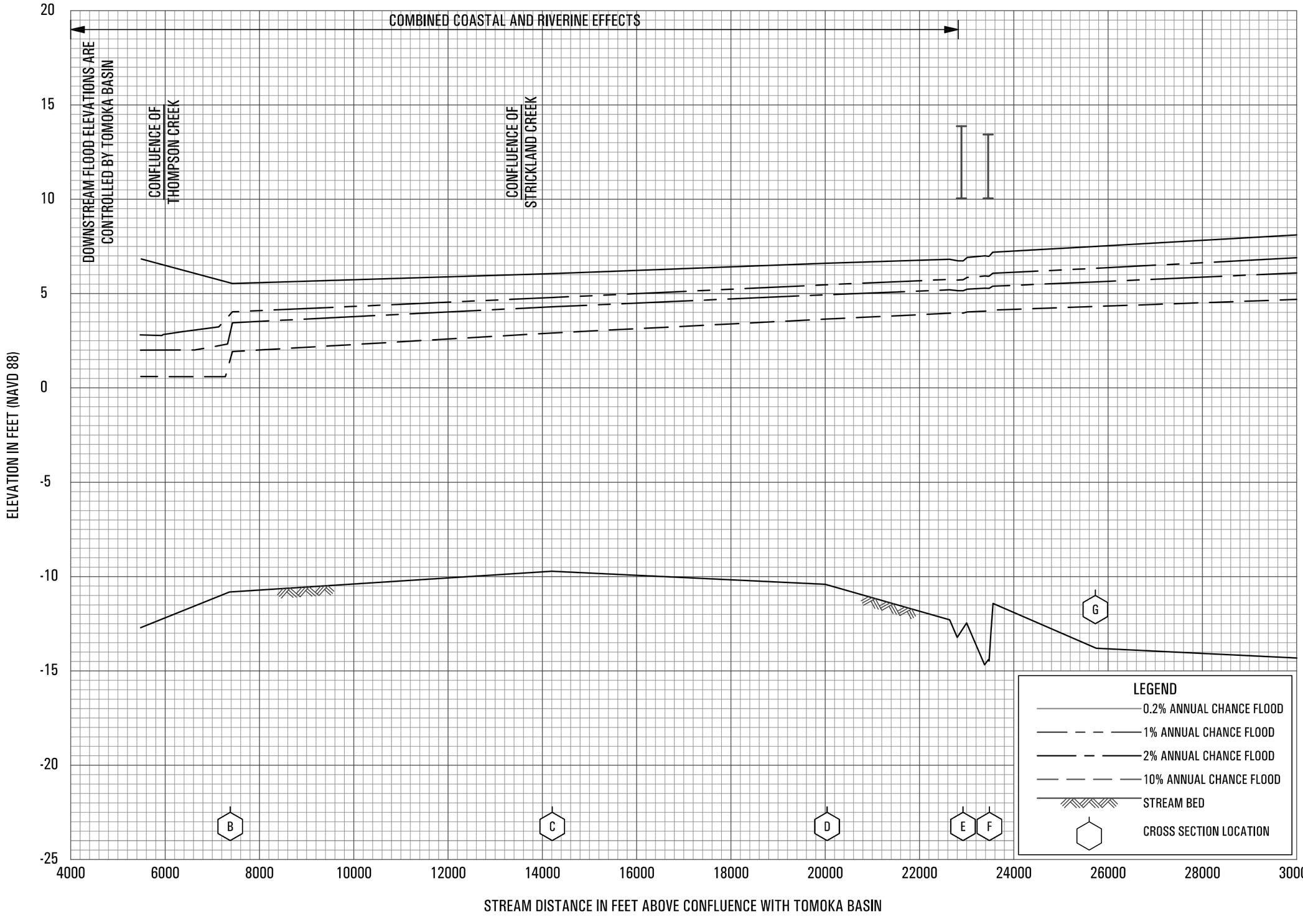
FLOOD PROFILES

THOMPSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



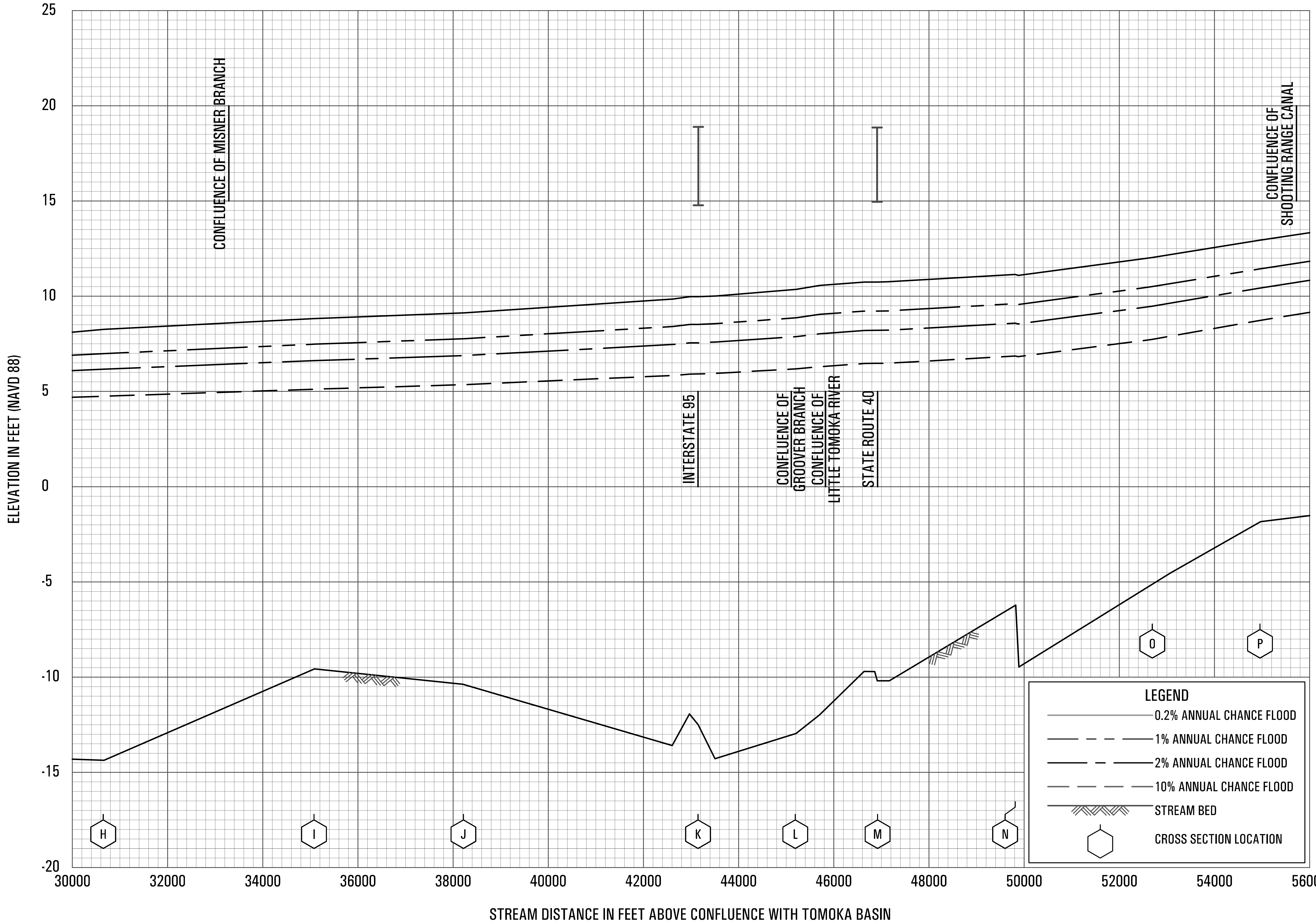
FLOOD PROFILES

TOMOKA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



FLOOD PROFILES

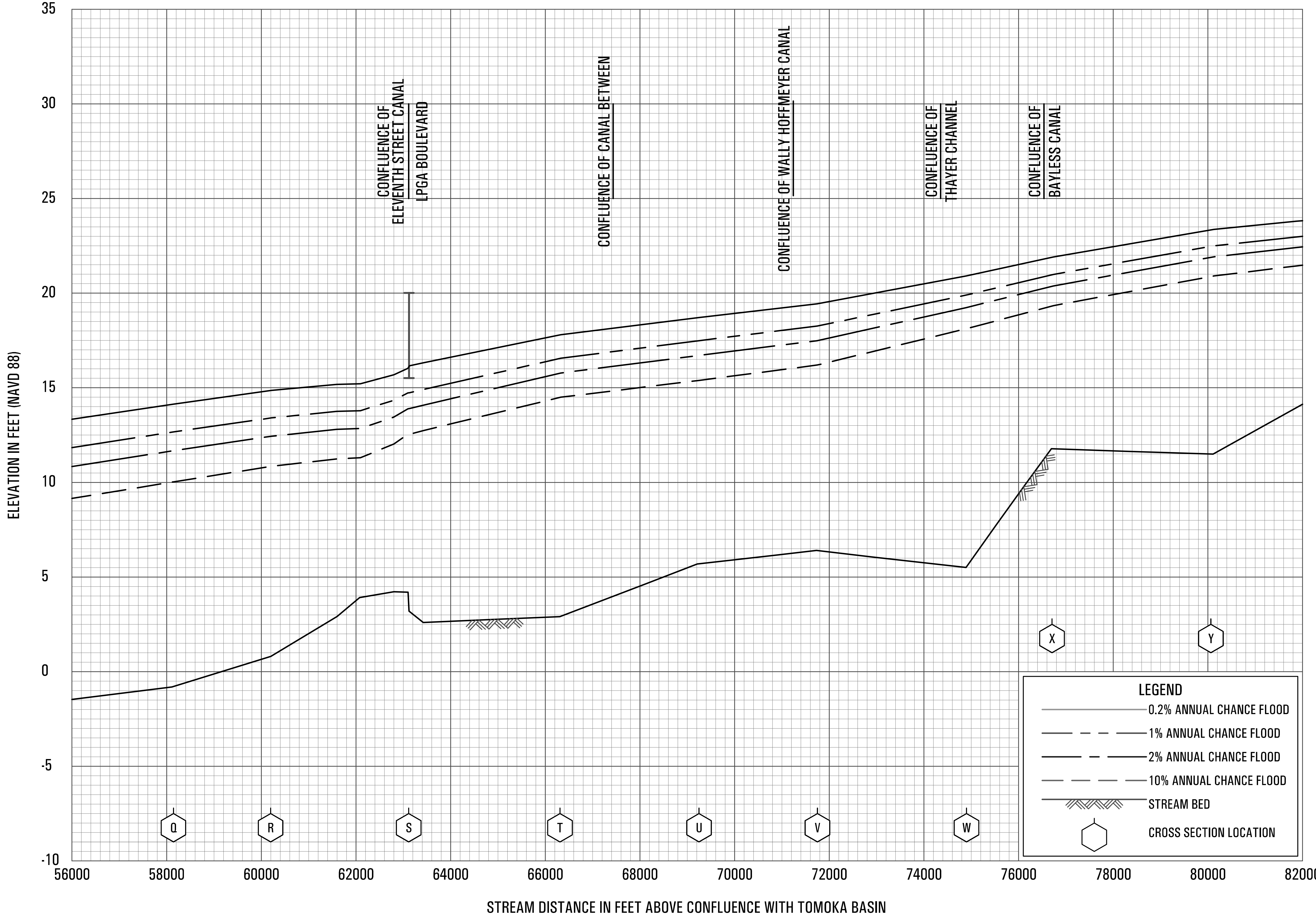
TOMOKA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

53P



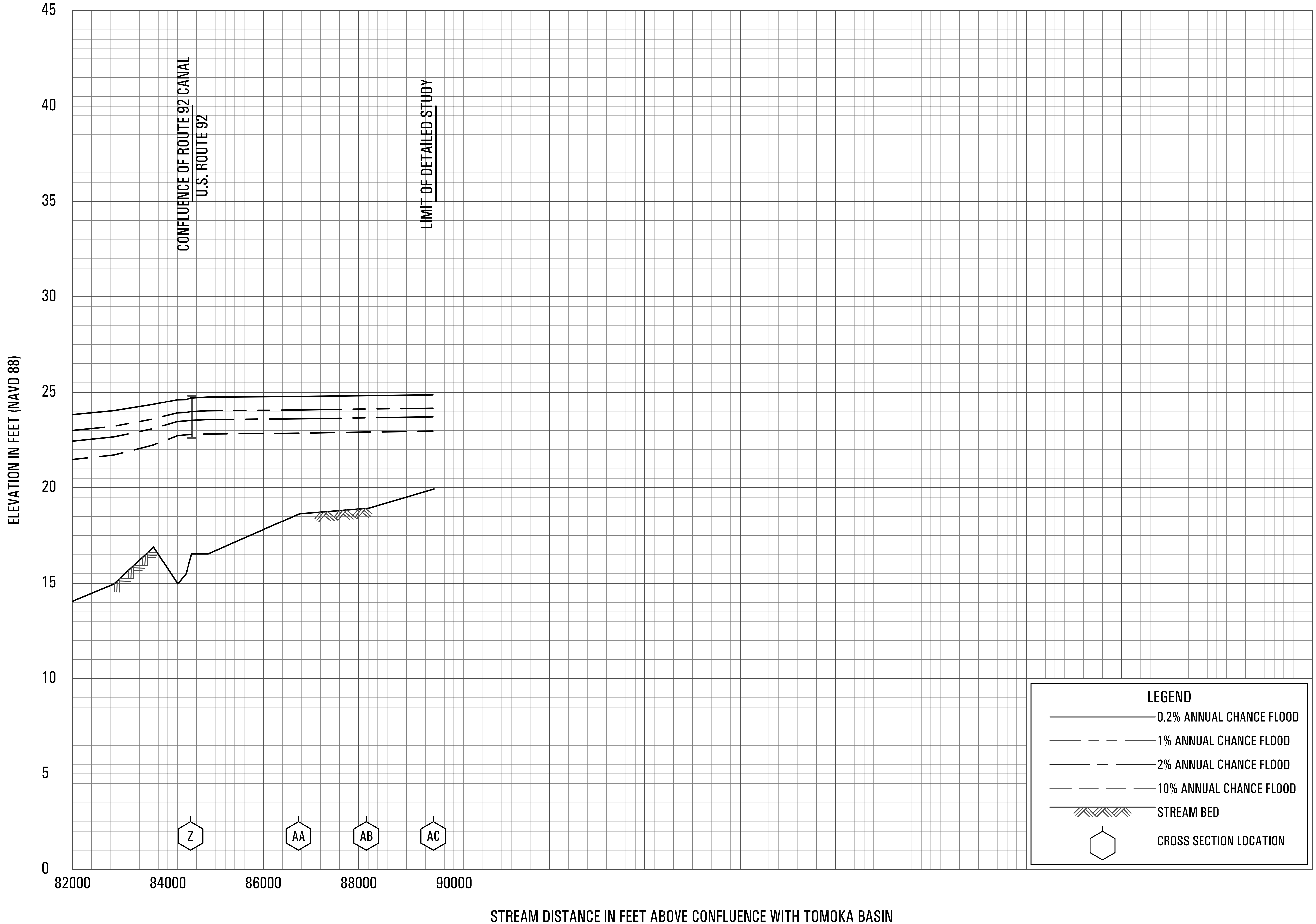
FLOOD PROFILES

TOMOKA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS



FLOOD PROFILES

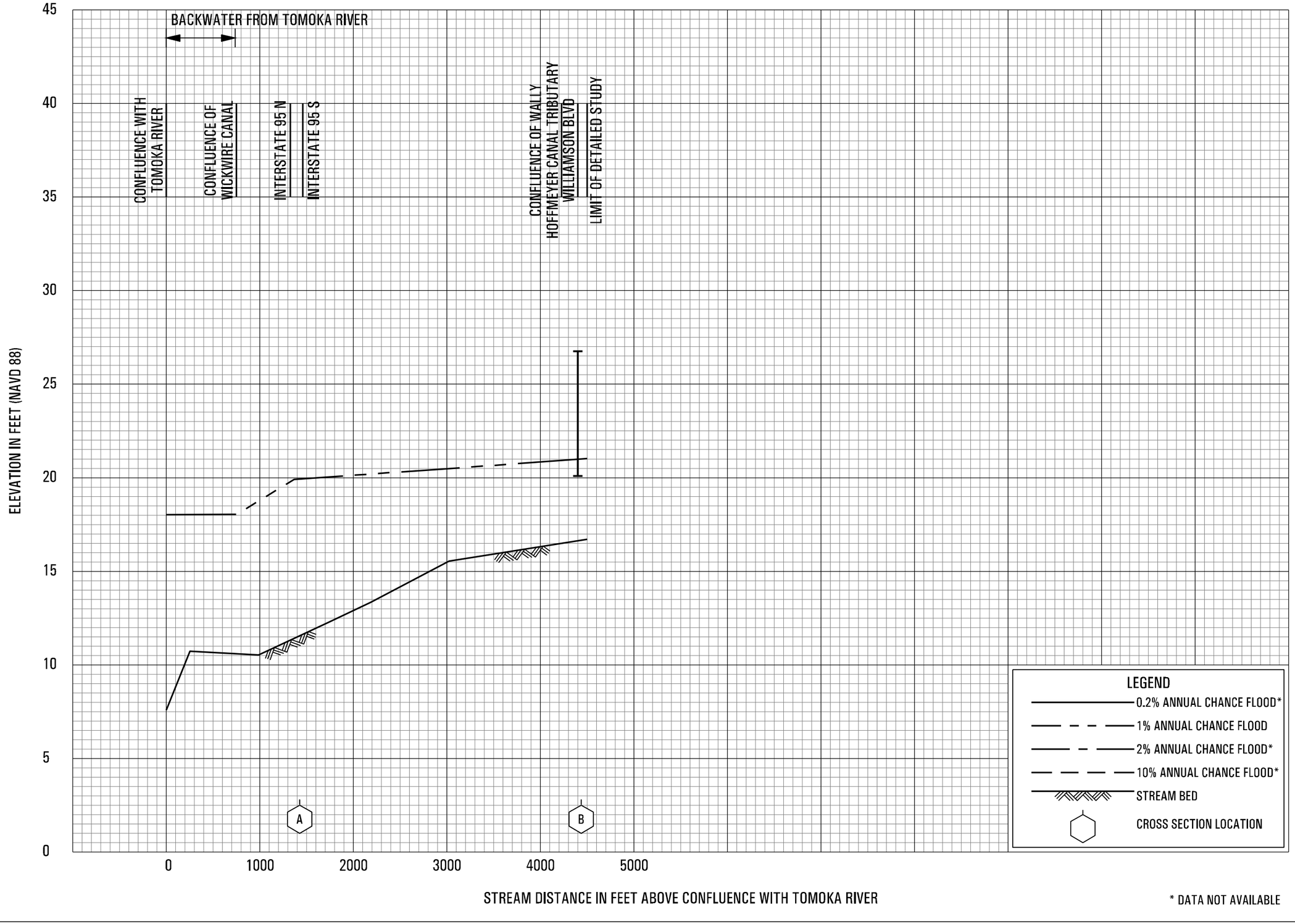
TOMOKA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS

55P



FLOOD PROFILES

WALLY HOFFMEYER CANAL

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUSIA COUNTY, FL

AND INCORPORATED AREAS