FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 6

PALM BEACH COUNTY, FLORIDA

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
ATLANTIS, CITY OF	120193	LANTANA, TOWN OF	120214
BELLE GLADE, CITY OF	120194	LOXAHATCHEE GROVES, TOWN OF	120309
BOCA RATON, CITY OF	120195	MANALAPAN, TOWN OF	120215
BOYNTON BEACH, CITY OF	120196	MANGONIA PARK, TOWN OF	120216
BRINY BREEZES, TOWN OF	120197	NORTH PALM BEACH, VILLAGE OF	120217
CLOUD LAKE, TOWN OF	120198	OCEAN RIDGE, TOWN OF	125134
DELRAY BEACH, CITY OF	125102	PAHOKEE, CITY OF	120219
GLEN RIDGE, TOWN OF	120200	PALM BEACH, TOWN OF	120220
GOLF, VILLAGE OF	120201	PALM BEACH COUNTY, UNINCORPORATED ARES	120192
GREENACRES, CITY OF	120203	PALM BEACH GARDENS, CITY OF	120221
GULF STREAM, TOWN OF	125109	PALM BEACH SHORES, TOWN OF	125137
HAVERHILL, TOWN OF	120205	PALM SPRINGS, VILLAGE OF	120223
HIGHLAND BEACH, TOWN OF	125111	RIVIERA BEACH, CITY OF	125142
HYPOLUXO, TOWN OF	120207	ROYAL PALM BEACH, VILLAGE OF	120225
JUNO BEACH, TOWN OF	120208	SOUTH BAY, CITY OF	120226
JUPITER, TOWN OF	125119	SOUTH PALM BEACH, TOWN OF	120227
JUPITER INLET COLONY, TOWN OF	125120	TEQUESTA, VILLAGE OF	120228
LAKE CLARKE SHORES, TOWN OF	120211	WELLINGTON, VILLAGE OF	125157
LAKE PARK, TOWN OF	120212	WEST PALM BEACH, CITY OF	120229
LAKE WORTH BEACH, CITY OF	120213	WESTLAKE, CITY OF	120018

REVISED:

DECEMBER 20, 2024

FLOOD INSURANCE STUDY NUMBER
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Published Separately

Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT
PALM BEACH 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, *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 Palm Beach County, Florida.

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

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
Atlantis, City of	120193	03090206	12099C0776F 12099C0777F 12099C0778G 12099C0779G	
Belle Glade, City of	120194	03090201 03090202	12099C0453F 12099C0454F 12099C0458F 12099C0459F 12099C0460F 12099C0462F 12099C0466F 12099C0467F 12099C0480F 12099C0500F	

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
Boca Raton, City of	120195	03090206	12099C0966F[1] 12099C0967F 12099C0968F[1] 12099C0969F 12099C0986G 12099C0987G 12099C0988G 12099C0989G 12099C1156F 12099C1157F 12099C1159G 12099C1176G 12099C1177G 12099C1178G 12099C1179G	
Boynton Beach, City of	120196	03090206	12099C0778G 12099C0779G 12099C0783G 12099C0786G 12099C0787G 12099C0788G 12099C0789G 12099C0791G 12099C0793G 12099C0976G 12099C0977G 12099C0981G	
Briny Breezes, Town of	120197	03090206	12099C0793G	
Cloud Lake, Town of	120198	03090206	12099C0587F	
Delray Beach, City of	125102	03090206	12099C0959F[1] 12099C0967F 12099C0976G 12099C0977G 12099C0978G 12099C0979G 12099C0981G 12099C0983G 12099C0986G 12099C0987G 12099C0991G	
Glen Ridge, Town of	120200	03090206	12099C0587F	
Golf, Village of	120201	03090206	12099C0788G 12099C0976G	

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
Greenacres, City of	120203	03090206	12099C0566F 12099C0567F 12099C0568F 12099C0569F 12099C0588F 12099C0757F 12099C0776F 12099C0778G	
Gulf Stream, Town of	125109	03090206	12099C0793G 12099C0977G 12099C0981G	
Haverhill, Town of	120205	03090206	12099C0559F 12099C0567F 12099C0578F 12099C0586F	
Highland Beach, Town of	125111	03090206	12099C0987G 12099C0989G 12099C0991G	
Hypoluxo, Town of	120207	03090206	12099C0783G 12099C0791G	
Juno Beach, Town of	120208	03090206	12099C0189G 12099C0193G 12099C0377G 12099C0381G	
Jupiter, Town of	125119	03090206	12099C0158G 12099C0159G 12099C0160G 12099C0166F 12099C0167G 12099C0169G 12099C0178G 12099C0179G 12099C0186G 12099C0187G 12099C0188F[1] 12099C0189G 12099C0191G 12099C0193G	
Jupiter Inlet Colony, Town of	125120	03090206	12099C0179G	
Lake Clarke Shores, Town of	120211	03090206	12099C0587F 12099C0589F	
Lake Park, Town of	120212	03090206	12099C0387G 12099C0391G	
Lake Worth Beach, City of	120213	03090206	12099C0589F 12099C0593G 12099C0777F 12099C0781G	

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
Lantana, Town of	120214	03090206	12099C0777F 12099C0779G 12099C0781G 12099C0783G	
Loxahatchee Groves, Town of	120309	03090201 03090206	12099C0531F 12099C0532F 12099C0533F 12099C0534F 12099C0541F 12099C0542F 12099C0551F 12099C0553F 12099C0561F	
Manalapan, Town of	120215	03090206	12099C0783G 12099C0791G	
Mangonia Park, Town of	120216	03090206	12099C0389F	
North Palm Beach, Village of	120217	03090206	12099C0379G 12099C0381G 12099C0383G 12099C0387G 12099C0391G	
Ocean Ridge, Town of	125134	03090206	12099C0791G 12099C0793G	
Pahokee, City of	120219	03090201 03090202	12099C0257F 12099C0258F 12099C0259F 12099C0262F 12099C0266F 12099C0267F	
Palm Beach, Town of	120220	03090206	12099C0393G 12099C0581G 12099C0583G 12099C0591G 12099C0593G 12099C0781G 12099C0783G	
Palm Beach County, Unincorporated Areas	120192	03090201 03090202 03090205 03090206	12099C0025F[1] 12099C0050F[1] 12099C0075F 12099C0100F 12099C0115F 12099C0125F 12099C0144F[1] 12099C0145F 12099C0150F 12099C0155F[1] 12099C0158G 12099C0159G	

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
Palm Beach County, Unincorporated Areas (continued)	120192	03090201 03090202 03090205 03090206	12099C0160G 12099C0163F[1] 12099C0164F[1] 12099C0165F[1] 12099C0166F 12099C0167G 12099C0168F 12099C0169G 12099C0178G 12099C0179G 12099C0180G 12099C0185G[1] 12099C0186G 12099C0187G 12099C0188F[1] 12099C0189G 12099C0191G 12099C0193G 12099C0225F 12099C0250F 12099C0255F 12099C0256F[1] 12099C0257F 12099C0258F 12099C0259F 12099C0262F 12099C0265F 12099C0266F 12099C0267F 12099C0270F 12099C0300F 12099C0325F 12099C0326F 12099C0330F 12099C0332F[1] 12099C0334F[1] 12099C0335F 12099C0340F 12099C0345F 12099C0351F[1] 12099C0352F[1] 12099C0353F[1] 12099C0354F 12099C0356F 12099C0357F[1] 12099C0362F 12099C0364F 12099C0365F 12099C0367F 12099C0370F 12099C0376G 12099C0377G 12099C0378F	

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
Palm Beach County, Unincorporated Areas (continued)	120192	03090201 03090202 03090205 03090206	12099C0379G 12099C0381G 12099C0383G 12099C0385G[1] 12099C0386F 12099C0387G 12099C0388F 12099C0389F 12099C0391G 12099C0393G 12099C0395G 12099C0425F 12099C0450F 12099C0453F 12099C0454F 12099C0455F 12099C0458F 12099C0459F 12099C0460F 12099C0461F 12099C0462F 12099C0463F 12099C0464F 12099C0466F 12099C0467F 12099C0470F 12099C0480F 12099C0500F 12099C0525F 12099C0530F 12099C0531F 12099C0532F 12099C0533F 12099C0534F 12099C0536F 12099C0537F 12099C0538F 12099C0539F 12099C0541F 12099C0542F 12099C0551F 12099C0552F 12099C0554F 12099C0557F 12099C0558F 12099C0559F 12099C0562F 12099C0563F 12099C0564F 12099C0566F 12099C0567F	

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
Palm Beach County, Unincorporated Areas (continued)	120192	03090201 03090202 03090205 03090206	12099C0568F 12099C0569F 12099C0576F 12099C0578F 12099C0579F 12099C0581G 12099C0583G 12099C0585G[1] 12099C0586F 12099C0587F 12099C0588F 12099C0589F 12099C0591G 12099C0593G 12099C0595G[1] 12099C0625F 12099C0650F 12099C0675F 12099C0700F 12099C0725F 12099C0730F 12099C0731F 12099C0732F 12099C0735F 12099C0740F[1] 12099C0745F[1] 12099C0751F 12099C0752F 12099C0755F 12099C0757F 12099C0760F 12099C0765F 12099C0770F 12099C0776F 12099C0777F 12099C0778G 12099C0779G 12099C0781G 12099C0783G 12099C0785G[1] 12099C0786G 12099C0787G 12099C0788G 12099C0791G 12099C0793G 12099C0795G[1] 12099C0825F 12099C0850F 12099C0875F 12099C0900F 12099C0925F 12099C0930F[1]	

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
Palm Beach County, Unincorporated Areas (continued)	120192	03090201 03090202 03090205 03090206	12099C0935F[1] 12099C0940F[1] 12099C0945F[1] 12099C0955F 12099C0959F[1] 12099C0960F 12099C0965F 12099C0966F[1] 12099C0967F 12099C0968F[1] 12099C0969F 12099C0976G 12099C0977G 12099C0978G 12099C0981G 12099C0983G 12099C0986G 12099C0987G 12099C0989G 12099C0991G 12099C0995G[1] 12099C1025F[1] 12099C1050F[1] 12099C1075F[1] 12099C1100F 12099C1125F[1] 12099C1150F 12099C1155F 12099C1156F 12099C1157F 12099C1158F 12099C1159G 12099C1177G 12099C1178G 12099C1179G 12099C1200G[1]	
Palm Beach Gardens, City of	120221	03090201 03090206	12099C0144F[1] 12099C0163F[1] 12099C0164F[1] 12099C0168F 12099C0169G 12099C0188F[1] 12099C0189G 12099C0332F[1] 12099C0334F[1] 12099C0345F 12099C0351F[1] 12099C0352F[1] 12099C0353F[1] 12099C0354F 12099C0356F 12099C0357F[1]	

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
Palm Beach Gardens, City of (continued)	120221	03090201 03090206	12099C0358F 12099C0359F 12099C0362F 12099C0364F 12099C0365F 12099C0367F 12099C0370F 12099C0376G 12099C0377G 12099C0378F 12099C0379G 12099C0381G 12099C0383G 12099C0386F 12099C0387G	
Palm Beach Shores, Town of	125137	03090206	12099C0391G 12099C0393G 12099C0395G	
Palm Springs, Village of	120223	03090206	12099C0587F 12099C0588F 12099C0589F 12099C0776F 12099C0777F	
Riviera Beach, City of	125142	03090206	12099C0383G 12099C0386F 12099C0387G 12099C0388F 12099C0389F 12099C0391G 12099C0393G 12099C0395G	
Royal Palm Beach, Village of	120225	03090201 03090206	12099C0532F 12099C0534F 12099C0542F 12099C0551F 12099C0552F 12099C0553F 12099C0554F 12099C0561F 12099C0562F	
South Bay, City of	120226	03090201 03090202 03090205	12099C0461F 12099C0462F 12099C0463F 12099C0464F	
South Palm Beach, Town of	120227	03090206	12099C0783G	
Tequesta, Village of	120228	03090206	12099C0160G 12099C0178G 12099C0179G 12099C0180G	

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
Wellington, Village of	125157	03090202 03090206	12099C0536F 12099C0537F 12099C0538F 12099C0539F 12099C0541F 12099C0542F 12099C0543F 12099C0544F 12099C0561F 12099C0562F 12099C0563F 12099C0564F 12099C0568F 12099C0730F 12099C0731F 12099C0732F 12099C0735F 12099C0751F 12099C0752F 12099C0755F	
West Palm Beach, City of	120229	03090201 03090206	12099C0354F 12099C0358F 12099C0362F 12099C0364F 12099C0367F 12099C0370F 12099C0388F 12099C0389F 12099C0393G 12099C0552F 12099C0554F 12099C0556F 12099C0557F 12099C0558F 12099C0559F 12099C0576F 12099C0577F 12099C0578F 12099C0579F 12099C0581G 12099C0583G 12099C0587F 12099C0589F 12099C0591G 12099C0593G	
Westlake, City of	120018	03090201 03090206	12099C0340F 12099C0345F 12099C0530F 12099C0531F 12099C0532F	

[1] Panel Not Printed

1.4 Considerations for using this Flood Insurance Study Report

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

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

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

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 30, "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 Palm Beach County became effective on October 5, 2017. Refer to Table 27 for information about subsequent revisions to the FIRMs.

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

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

- Previous FIS Reports and FIRMs may have included levees that were accredited as reducing the risk associated with the 1-percent-annual-chance flood based on the information available and the mapping standards of the NFIP at that time. For FEMA to continue to accredit the identified levees, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

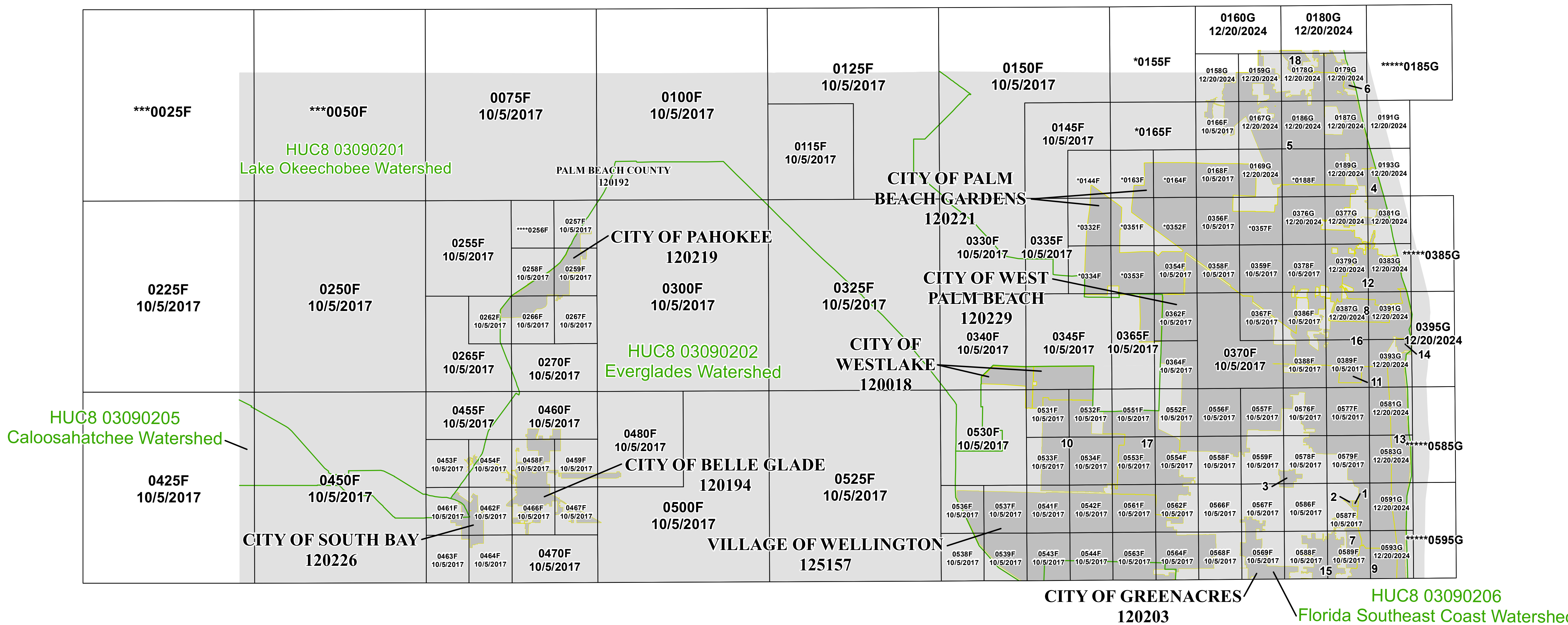
  Since the status of levees is subject to change at any time, the user should contact the appropriate agency for the latest information regarding levees presented in Table 8 of this FIS Report. For levees owned or operated by the U.S. Army Corps of Engineers (USACE), information may be obtained from the USACE National Levee Database (nld.usace.army.mil). For all other levees, the user is encouraged to contact the appropriate local community.

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

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Palm Beach 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, watershed boundaries, and USGS HUC-8 codes.

Figure 1: FIRM Index

KEY NUMBER	COMMUNITY	CID	KEY NUMBER	COMMUNITY	CID	KEY NUMBER	COMMUNITY	CID
1	Town of Cloud Lake	120198	7	Town of Lake Clarke Shores	120211	13	Town of Palm Beach	120220
2	Town of Glen Ridge	120200	8	Town of Lake Park	120212	14	Town of Palm Beach Shores	125137
3	Town of Haverhill	120205	9	City of Lake Worth Beach	120213	15	Village of Palm Springs	120223
4	Town of Juno Beach	120208	10	Town of Loxahatchee Groves	120309	16	City of Riviera Beach	125142
5	Town of Jupiter	125119	11	Town of Mangonia Park	120216	17	Village of Royal Palm Beach	120225
6	Town of Jupiter Inlet Colony	125120	12	Village of North Palm Beach	120217	18	Village of Tequesta	120228



ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before December 20, 2024.

1 inch = 25,000 feet 1:300,000

0 7,000 14,000 28,000 42,000 56,000 feet

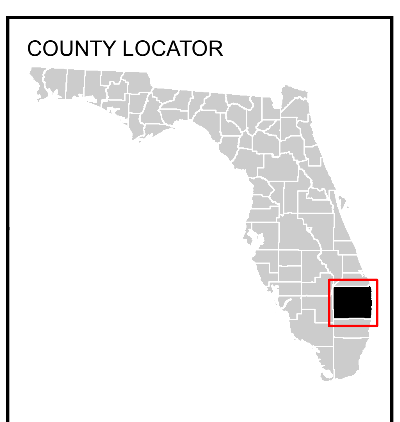
Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901;
North American Datum 1983

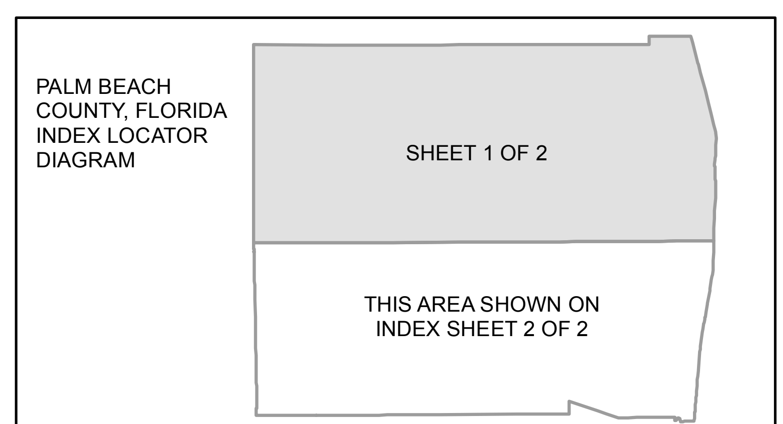
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
*** PANEL NOT PRINTED - AREA ALL WITHIN ZONE VE (EL 27)
**** PANEL NOT PRINTED - AREA ALL WITHIN ZONE VE (EL 28)
***** PANEL NOT PRINTED - OPEN WATER AREA





NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX, SHEET 1 OF 2

PALM BEACH COUNTY, FLORIDA and Incorporated Areas

PANELS PRINTED:

0075, 0100, 0115, 0125, 0145, 0150, 0158, 0159, 0160, 0166, 0167, 0168, 0169, 0178, 0179, 0180, 0186, 0187, 0189, 0191, 0193, 0225, 0250, 0255, 0257, 0258, 0259, 0262, 0265, 0266, 0267, 0270, 0300, 0325, 0330, 0335, 0340, 0345, 0354, 0356, 0358, 0359, 0362, 0364, 0365, 0367, 0370, 0376, 0377, 0378, 0379, 0381, 0383, 0386, 0387, 0388, 0389, 0391, 0393, 0395, 0425, 0450, 0453, 0454, 0455, 0458, 0459, 0460, 0461, 0462, 0463, 0464, 0466, 0467, 0470, 0480, 0500, 0525, 0530, 0531, 0532, 0533, 0534, 0536, 0537, 0538, 0539, 0541, 0542, 0543, 0544, 0551, 0552, 0553, 0554, 0556, 0557, 0558, 0559, 0561, 0562, 0563, 0564, 0566, 0567, 0568, 0569, 0576, 0577, 0578, 0579, 0581, 0583, 0586, 0587, 0588, 0589, 0591, 0593

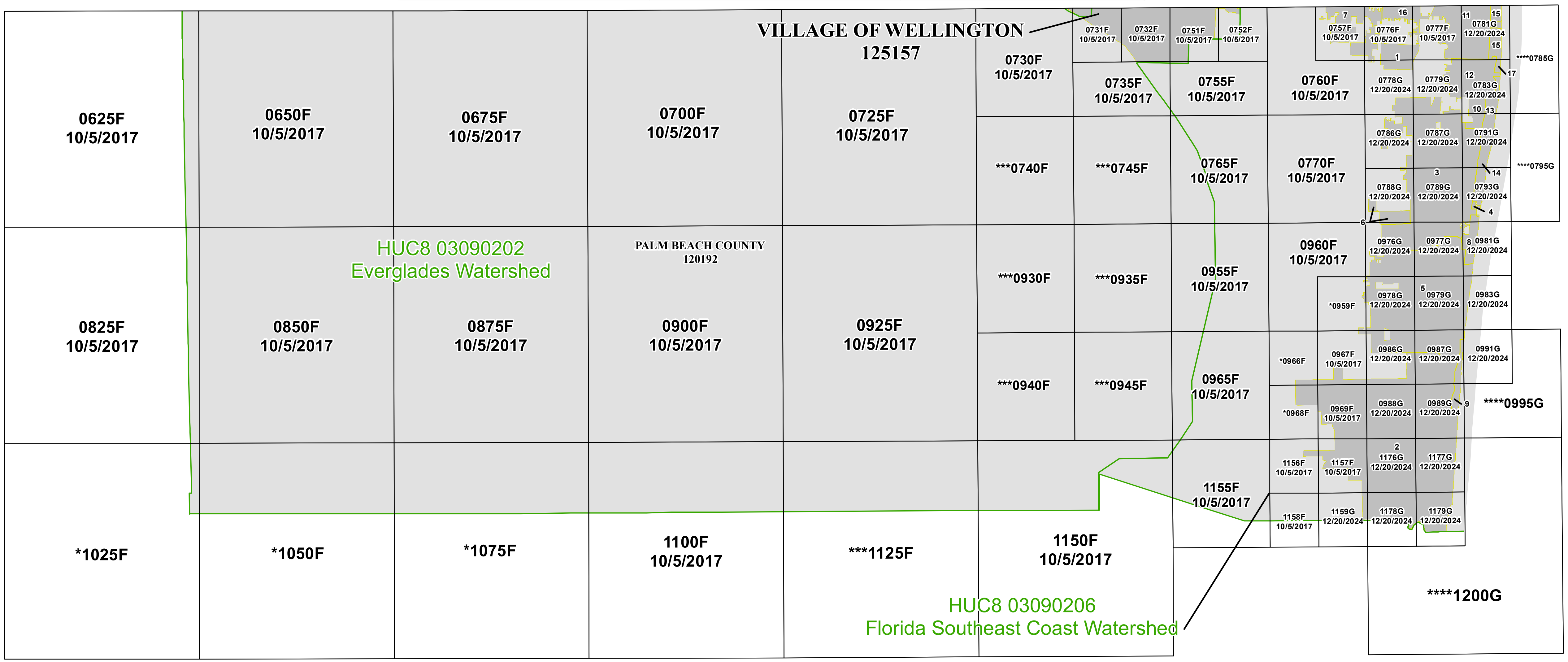
FEMA

MAP NUMBER
12099CIND1B

MAP REVISED
December 20, 2024

Figure 1: FIRM Index, continued

KEY NUMBER	COMMUNITY	CID	KEY NUMBER	COMMUNITY	CID	KEY NUMBER	COMMUNITY	CID
1	City of Atlantis	120193	7	City of Greenacres	120203	13	Town of Manalapan	120215
2	City of Boca Raton	120195	8	Town of Gulf Stream	125109	14	Town of Ocean Ridge	125134
3	City of Boynton Beach	120196	9	Town of Highland Beach	125111	15	Town of Palm Beach	120220
4	Town of Briny Breezes	120197	10	Town of Hypoluxo	120207	16	Village of Palm Springs	120223
5	City of Delray Beach	125102	11	City of Lake Worth Beach	120213	17	Town of South Palm Beach	120227
6	Village of Golf	120201	12	Town of Lantana	120214			



ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before December 20, 2024.

1 inch = 25,000 feet 1:300,000

0 7,000 14,000 28,000 42,000 56,000 feet

Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901;
North American Datum 1983

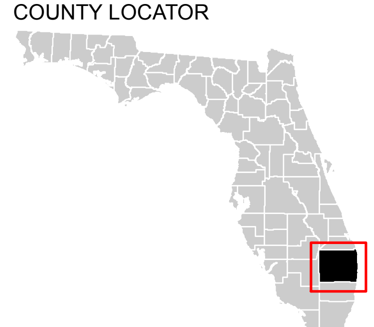
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

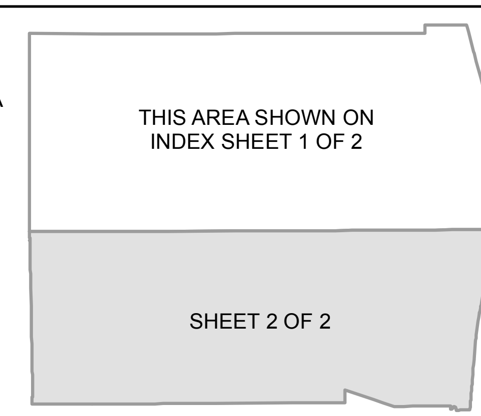
SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
*** PANEL NOT PRINTED - AREA ALL WITHIN ZONE D
**** PANEL NOT PRINTED - OPEN WATER AREA

COUNTY LOCATOR



PALM BEACH COUNTY, FLORIDA INDEX LOCATOR DIAGRAM



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX, SHEET 2 OF 2

PALM BEACH COUNTY, FLORIDA and Incorporated Areas

PANELS PRINTED:

0625, 0650, 0675, 0700, 0725, 0730, 0731, 0732, 0735, 0751, 0752, 0755, 0757, 0760, 0765, 0770, 0776, 0777, 0778, 0779, 0781, 0783, 0786, 0787, 0788, 0789, 0791, 0793, 0825, 0850, 0875, 0900, 0925, 0955, 0960, 0965, 0967, 0969, 0976, 0977, 0978, 0979, 0981, 0983, 0986, 0987, 0988, 0989, 0991, 1100, 1150, 1155, 1156, 1157, 1158, 1159, 1176, 1177, 1178, 1179

FEMA

MAP NUMBER
12099CIND2B

MAP REVISED
December 20, 2024

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

Figure 2: FIRM Notes to Users

NOTES TO USERS

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

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

For community and countywide map dates, refer to Table 27 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.

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 the North American Datum 1983; Western Hemisphere. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

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

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 30 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on this FIRM was provided by Palm Beach County, dated 2009 and 2019; the United States Geological Survey, dated 2004; and the Federal Emergency Management Agency, dated 2014 and 2017. Aerial imagery was provided by the United States Department of Agriculture, dated 2017, and has a ground sample resolution of 1 meter.

BASE MAP INFORMATION (10/05/2017): Base map information shown on this FIRM was provided in digital format by Palm Beach County. The original orthophotographic base imagery was provided in color with a one-foot pixel resolution at a scale of 1" = 200' from photography flown November 2010 - January 2011.

For information about base maps, refer to Section 6.2 "Base Map" in this FIS Report.

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

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

Figure 2: FIRM Notes to Users

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Palm Beach 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 27 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on the FIRM panels issued before December 20, 2024.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Palm Beach County, Florida, effective December 20, 2024.

NON-ACCREDITED LEVEE SYSTEM: This panel contains a levee system that has not been accredited and is therefore not recognized as reducing the 1-percent-annual-chance flood hazard.

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 Palm Beach 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.
	Regulatory Floodway determined in Zone AE.

Figure 3: Map Legend for FIRM

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. See Notes to Users for important information.
	Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
NO SCREEN	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
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

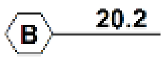
REFERENCE MARKERS	
	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Coastal Transect
	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
$^{42}76^{000\text{m}}\text{E}$	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

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

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

Depending on the accuracy of available topographic data (Table 22), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1-percent and 0.2-percent-annual-chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1-percent-annual-chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1-percent and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM. Figure 3, “Map Legend for FIRM”, describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Palm Beach County, respectively.

Table 2, “Flooding Sources Included in this FIS Report,” lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 12. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1-percent-annual-chance floodplain corresponds to the SFHAs. The 0.2-percent-annual-chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

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

Within this jurisdiction, there are one or more levees that have not been demonstrated by the communities or levee owners to meet the requirements of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. As such, the floodplain boundaries in this area are subject to change. Please refer to Section 4.4 of this FIS Report for more information on how this may affect the floodplain boundaries shown on this FIRM.

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	Boca Raton, City of; Boynton Beach, City of; Briny Breezes, Town of; Delray Beach, City of; Gulf Stream, Town of; Highland Beach, Town of; Juno Beach, Town of; Jupiter, Town of; Jupiter Inlet Colony, Town of; Lake Worth Beach, City of; Lantana, Town of; Manalapan, Town of; North Palm Beach, Village of; Ocean Ridge, Town of; Palm Beach, Town of; Palm Beach County, Unincorporated Areas; Palm Beach Shores, Town of; Riviera Beach, City of; South Palm Beach, Village of; Tequesta, Village of	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	03090206	45.6	N/A	N	AE, VE	September 2019
C-51 Basin	Cloud Lake, Town of; Glen Ridge, Town of; Greenacres, City of; Haverhill, Town of; Lake Clarke Shores, Town of; Lake Worth Beach, City of; Loxahatchee Groves, Town of; Palm Beach County, Unincorporated Areas; Palm Beach Gardens, City of; Palm Springs, Village of; Royal Palm Beach, Village of; Wellington, Village of; West Palm Beach, City of	Within Palm Beach County	Within Palm Beach County	03090201 03090202 03090206	N/A	13.5	N	AE	May 2015

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
C-51 Canal	Lake Worth Beach, City of; West Palm Beach, City of	At North Federal Highway / County Highway 5	At the Railroad	03090206	0.4	N/A	N	AE	May 2015
E-2E Canal	Palm Beach County, Unincorporated Areas	Confluence with Hillsboro Canal	At Glades Road	03090206	2.5	N/A	N	AE	February 2014
E-3 Canal	Boca Raton, City of; Palm Beach County, Unincorporated Areas	Confluence with Hillsboro Canal	At Yamato Road control structure	03090206	4.5	N/A	Y	AE	February 2014
E-4 Canal	Boca Raton, City of	Confluence with Hillsboro Canal	At Congress Avenue control structure	03090206	18.5	N/A	Y	AE	February 2014
Hillsboro Canal	Palm Beach County, Unincorporated Areas	Confluence with E-3 Canal and E-4 Canal	Approximately 1.2 miles upstream of Interstate Highway 95	03090202	4.0	N/A	N	AE	May 1996

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
Intracoastal Waterway	Boca Raton, City of; Boynton Beach, City of; Briny Breezes, Town of; Delray Beach, City of; Gulf Stream, Town of; Highland Beach, Town of; Hypoluxo, Town of; Juno Beach, Town of; Jupiter, Town of; Jupiter Inlet Colony, Town of; Lake Park, Town of; Lake Worth Beach, City of; Lantana, Town of; Manalapan, Town of; North Palm Beach, Village of; Ocean Ridge, Town of; Palm Beach, Town of; Palm Beach County, Unincorporated Areas; Palm Beach Gardens, City of; Palm Beach Shores, Town of; Riviera Beach, City of; South Palm Beach, Village of; Tequesta, Village of; West Palm Beach, City of	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	03090206	46.4	N/A	N	AE, VE	September 2019
Jupiter Creek	Jupiter, Town of; Palm Beach County, Unincorporated Areas	Confluence with Southwest Fork Loxahatchee River	Approximately 40 feet upstream of Toney Penna Drive	03090206	1.6	N/A	Y	AE	September 2012
Keller Canal	Lake Clarke Shores, Town of; Lake Worth Beach, City of; Palm Beach County, Unincorporated Areas; Palm Springs, Village of	Confluence with C-51 Canal	Confluence with Lake Osborne / At Park Road	03090206	2.8	N/A	N	AE	May 2005
L-14 Canal	Atlantis, City of; Greenacres, City of; Palm Beach County, Unincorporated Areas	Confluence with Lake Osborne	At Military Trail	03090206	2.2	N/A	N	AE	May 2005

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
L-16 Canal	Palm Beach County, Unincorporated Areas	Confluence with Lake Osborne	At Military Trail	03090206	2.2	N/A	N	AE	May 2005
Lake Okeechobee	Pahokee, City of; Palm Beach County, Unincorporated Areas	Entire shoreline	Entire shoreline	03090201	31.3	218.0	N	VE	September 2012
Lake Osborne	Lake Worth Beach, City of; Palm Beach County, Unincorporated Areas	Confluence with Keller Canal	At Hypoluxo Road	03090206	3.1	N/A	N	AE	May 2005
Loxahatchee River	Jupiter, Town of; Palm Beach County, Unincorporated Areas	Martin County boundary	Approximately 850 feet upstream of Martin County boundary	03090206	0.2	N/A	N	AE	November 2016
Zone A Flooding Sources	Boca Raton, City of; Delray Beach, City of; Jupiter, Town of; Palm Beach County, Unincorporated Areas; West Palm Beach, City of	Within Palm Beach County	Within Palm Beach County	03090202 03090205 03090206	6.0	N/A	N	A	May 1996
Zone AH Ponding	Boca Raton, City of; Lake Park, Town of; Mangonia Park, Town of; Palm Beach County, Unincorporated Areas; Palm Beach Gardens, City of; Riviera Beach, City of; West Palm Beach, City of	Within Palm Beach County	Within Palm Beach County	03090206	7.3	N/A	N	AH	May 1996
Zone AO Ponding	Jupiter, Town of; Palm Beach County, Unincorporated Areas; Palm Beach Gardens, City of	Within Palm Beach County	Within Palm Beach County	03090201 03090202 03090206	65.0	N/A	N	AO	May 1996

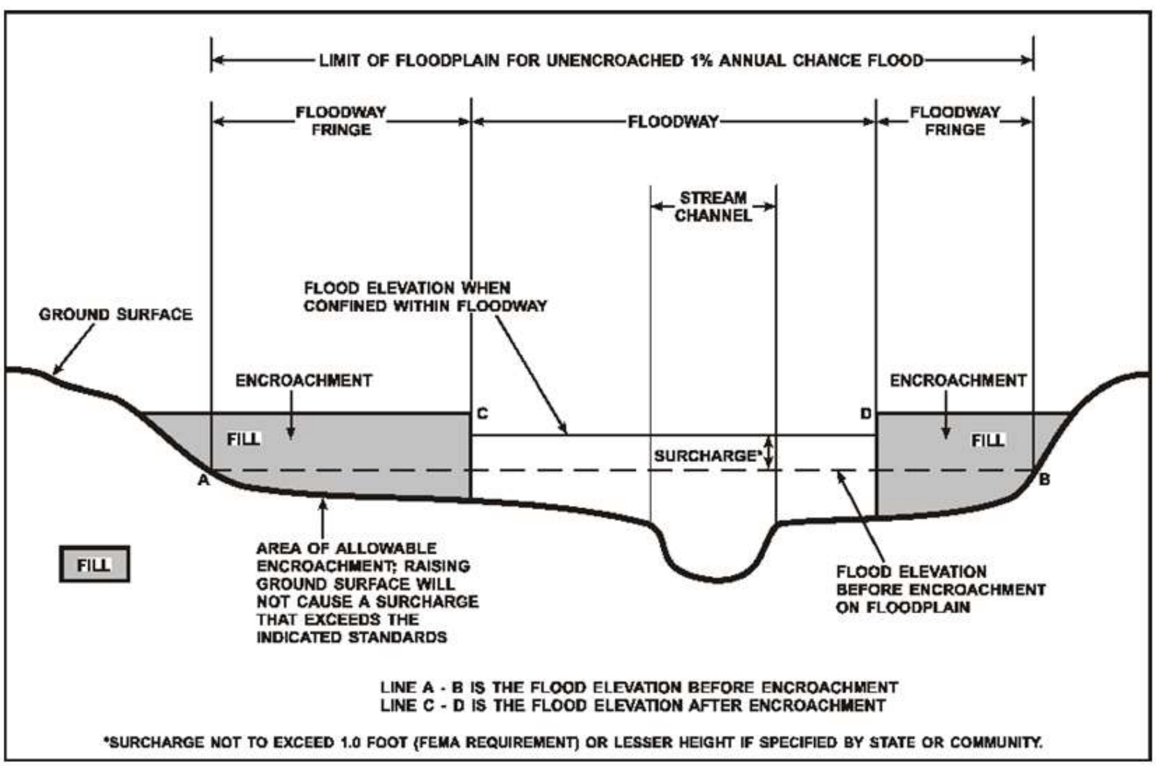
2.2 Floodways

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

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

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

Figure 4: Floodway Schematic



Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 23, “Floodway Data.”

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

2.3 Base Flood Elevations

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

BFEs are primarily intended for flood insurance rating purposes. 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. 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. For example, the user may use the FIRM to determine the stream station of a location of interest and then use the profile to determine the 1-percent annual chance elevation at that location. Because only selected cross sections may be shown on the FIRM for riverine areas, the profile should be used to obtain the flood elevation between mapped cross sections. Additionally, for riverine areas, whole-foot elevations shown on the FIRM may not exactly reflect the elevations derived from the hydraulic analyses; therefore, elevations obtained from the profile may more accurately reflect the results of the hydraulic analysis.

2.4 Non-Encroachment Zones

This section is not applicable to this Flood Risk Project.

2.5 Coastal Flood Hazard Areas

For most areas along rivers, streams, and small lakes, BFEs and floodplain boundaries are based on the amount of water expected to enter the area during a 1-percent-annual-chance flood and the geometry of the floodplain. Floods in these areas are typically caused by 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.

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-percent-annual-chance stillwater elevation is the stillwater elevation that has been calculated for a storm surge from a 1-percent-annual-chance storm. The 1-percent-annual-chance storm surge can be determined from analyses of 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-percent-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.

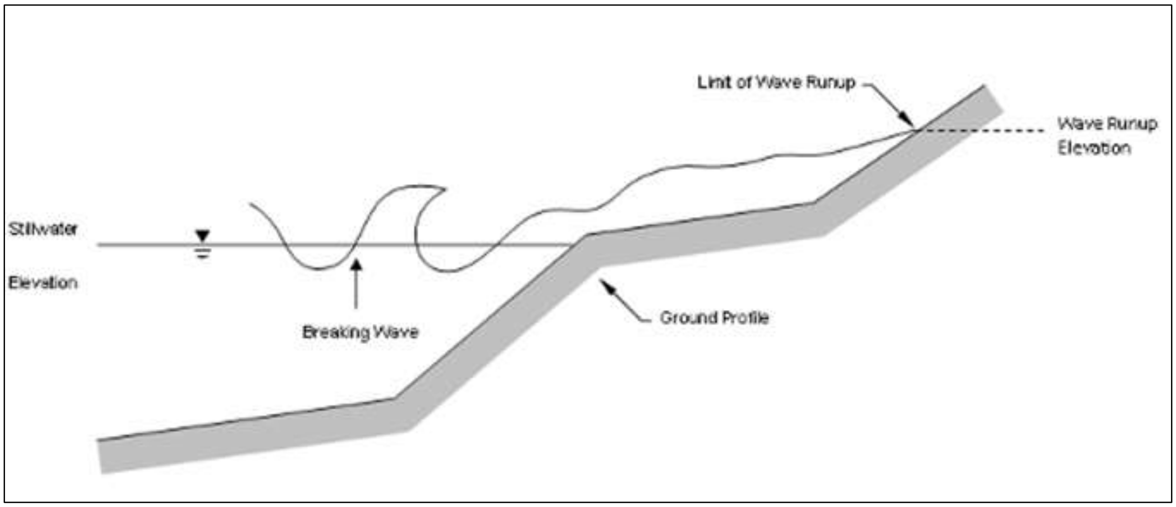
- *Storm-induced erosion* is the modification of existing topography by erosion caused by a specific storm event, as opposed to general erosion that occurs at a more constant rate.

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

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

Table 25 presents the types of coastal analyses that were used in mapping the 1-

percent-annual-chance floodplain in coastal areas.

Coastal BFEs

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

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

Parameters that were included in calculating coastal BFEs for each transect included in this FIS Report are presented in Table 16, "Coastal Transect Parameters." The locations of transects are shown in Figure 9, "Transect Location Map." More detailed information about the methods used in coastal analyses and the results of intermediate steps in the coastal analyses are presented in Section 5.3 of this FIS Report. Additional information on specific mapping methods is provided in Section 6.4 of this FIS Report.

2.5.3 Coastal High Hazard Areas

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

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

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

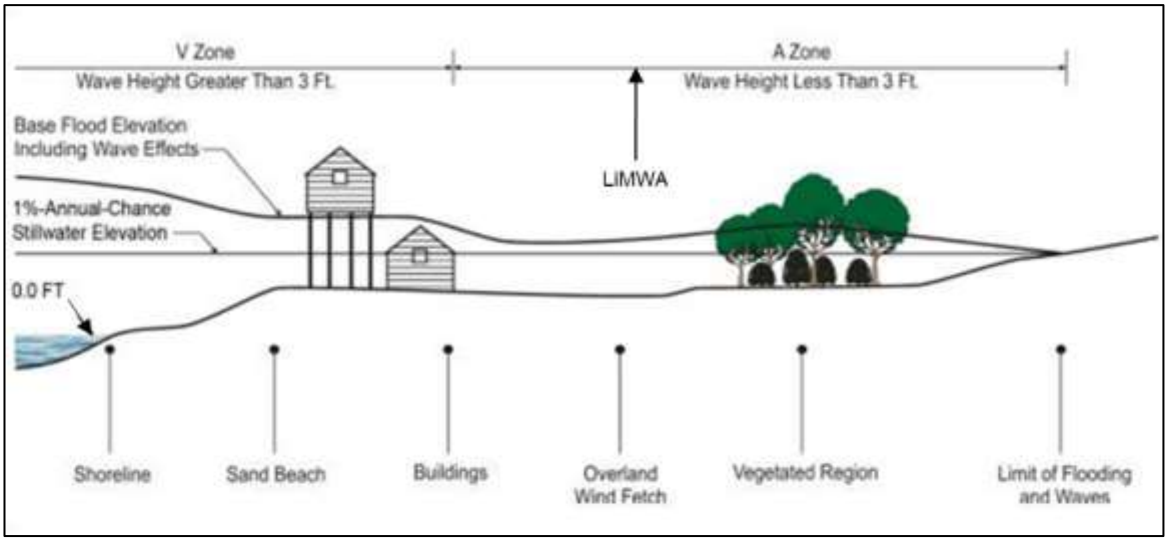
CHHAs are designated as "V" zones (for "velocity wave zones") and are subject to more stringent regulatory requirements and a different flood insurance rate structure. The areas of greatest risk are shown as VE on the FIRM. Zone VE is further subdivided into elevation zones and shown with BFEs on the 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-percent-annual-chance stillwater elevation, and the ground profile as well as the location of the Zone VE and Zone AE areas in an area without a PFD subject to overland wave propagation. This figure also illustrates energy dissipation and regeneration of a wave as it moves inland.

Figure 6: Coastal Transect Schematic



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

Coastal floodplains are shown on the FIRM using the symbology described in Figure 3, "Map Legend for FIRM." In many cases, the BFE on the FIRM is higher than the stillwater elevations shown in Table 16 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-percent-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.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

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

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

Table 3 lists the flood insurance zones in Palm Beach County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Atlantis, City of	AE, X
Belle Glade, City of	AE, VE, X
Boca Raton, City of	A, AE, AH, AO, VE, X
Boynton Beach, City of	AE, VE, X
Briny Breezes, Town of	AE, AO, VE, X
Cloud Lake, Town of	AE, X
Delray Beach, City of	A, AE, VE, X
Glen Ridge, Town of	AE, X
Golf, Village of	AE, X
Greenacres, City of	AE, X
Gulf Stream, Town of	AE, AO, VE, X
Haverhill, Town of	AE, X
Highland Beach, Town of	AE, VE, X
Hypoluxo, Town of	AE, VE, X
Juno Beach, Town of	AE, VE, X
Jupiter, Town of	A, AE, AO, VE, X
Jupiter Inlet Colony, Town of	AE, VE, X

Table 3: Flood Zone Designations by Community (continued)

Community	Flood Zone(s)
Lake Clarke Shores, Town of	AE, X
Lake Park, Town of	AE, AH, VE, X
Lake Worth Beach, City of	AE, VE, X
Lantana, Town of	AE, VE, X
Loxahatchee Groves, Town of	AE, X
Manalapan, Town of	AE, AO, VE, X
Mangonia Park, Town of	A, AE, AH, X
North Palm Beach, Village of	AE, AO, VE, X
Ocean Ridge, Town of	AE, AO, VE, X
Pahokee, City of	AE, VE, X
Palm Beach, Town of	AE, AO, VE, X
Palm Beach County, Unincorporated Areas	A, AE, AH, AO, D, VE, X
Palm Beach Gardens, City of	AE, AH, AO, X
Palm Beach Shores, Town of	AE, VE, X
Palm Springs, Village of	AE, X
Riviera Beach, City of	AE, AH, AO, VE, X
Royal Palm Beach, Village of	AE, X
South Bay, City of	AE, X
South Palm Beach, Town of	AE, VE, X
Tequesta, Village of	AE, VE, X
Wellington, Village of	AE, X
West Palm Beach, City of	A, AE, AH, VE, X
Westlake, City of	AE, X

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 4 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 4: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)[1]
Caloosahatchee	03090205	Caloosahatchee River	This watershed contains a very small portion of the county and is located in the middle of the western county boundary.	16.9
Everglades	03090202	Everglades	Largest watershed within the county, encompassing the southwestern half of the county	1,167.3
Florida Southeast Coast	03090206	Atlantic Ocean	This watershed runs along the Atlantic Ocean coastline. It has the largest presence in the county.	623.7
Lake Okeechobee	03090201	Lake Okeechobee	This watershed is located in the northwestern part of the county.	410.7

[1] Total drain area of watershed inside the county

4.2 Principal Flood Problems

Table 5 contains a description of the principal flood problems that have been noted for Palm Beach County by flooding source.

Table 5: Principal Flood Problems

Flooding Source	Description of Flood Problems
Canal C-17	North Palm Beach is vulnerable to flooding from Canal C-17 during periods of heavy rainfall and the canal's capacity to accommodate additional storm runoff is exceeded.
Coastal and Inland Flooding Sources	Coastal areas are subject to inundation from ocean surges as the result of hurricanes and tropical storms. Inland areas become flooded during the rainy season when intense rainfall accumulates in low, flat areas and the capacity of streams is exceeded. Most of the communities in Palm Beach County and the Unincorporated Areas are susceptible to surface flooding because of the flat terrain. During the rainy season, the water table rises and the amount of water that can be absorbed decreases. As a result, water accumulates in low lying areas and either slowly infiltrates or eventually flows into a canal or storm drain. Much of the unincorporated land in the county is covered by ponded water during the rainy season and development has only taken place where measures such as drainage ditches, culverts, and elevated foundations are employed to minimize water damage. The flooding that results from extreme rainfalls is generally shallow and is characterized by its low velocities of flow.

Table 5: Principal Flood Problems (continued)

Flooding Source	Description of Flood Problems
Lake Okeechobee	The cities of Pahokee and Belle Glade are vulnerable to flooding from similar storm surges at Lake Worth.
Lake Worth	Flooding from ocean storm surges may be augmented with storm surges on Lake worth and subsequent rising water levels in areas adjacent to Lake Worth and the Intracoastal Waterway. The rise of water level in Lake Worth causes a rise in the water level in the Intracoastal Waterway, which is compounded by any increases caused by rainfall runoff. These effects are complicated by wave action in Jupiter Inlet and Jupiter Sound for Jupiter Colony and by Pelican Pond for Juno Beach.
Loxahatchee River	The communities of Jupiter and Tequesta are affected by flooding of the Loxahatchee River and its tributaries.
North Palm Beach Canal	North Palm Beach is vulnerable to flooding from North Palm Beach Canal during periods of heavy rainfall and the canal's capacity to accommodate additional storm runoff is exceeded.

Table 6 contains information about historic flood elevations in the communities within Palm Beach County.

Table 6: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Atlantic Ocean	City of West Palm Beach	N/A	September 1928	N/A	FIS 2017
Atlantic Ocean	Palm Beach County	N/A	October 1947	N/A	WHA 1982
Atlantic Ocean	Palm Beach County	N/A	August 1949	N/A	FIS 2017
Atlantic Ocean	Palm Beach County	N/A	October 1965	N/A	FIS 2017

4.3 Non-Levee Flood Protection Measures

Table 7 contains information about non-levee flood protection measures within Palm Beach County such as dams, jetties, and or dikes. Levees are addressed in Section 4.4 of this FIS Report.

Table 7: Non-Levee Flood Protection Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Atlantic Ocean	N/A	Seawalls	Along the shoreline	Rising sand dunes and seawalls provide considerable protection along the open coast. They are expected to remain in tact during the 1-percent-annual-chance storm surge and are considered effective wave energy dissipaters.
Intracoastal Waterway	N/A	Bulkheads	Along the shoreline	These bulkheads are capable of dissipating wave energy.
Lake Worth	N/A	Bulkheads	Along the shoreline	These bulkheads are capable of dissipating wave energy.

4.4 Levee Systems

For purposes of the NFIP, FEMA only recognizes levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with comprehensive floodplain management criteria. The Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) describes the information needed for FEMA to determine if a levee system reduces the flood hazard from the 1-percent-annual-chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate flood hazard zone.

Levee systems that are determined to reduce the hazard from the 1-percent-annual-chance flood are accredited by FEMA. FEMA can also grant provisional accreditation to a levee system that was previously accredited on an effective FIRM and for which FEMA is awaiting data and/or documentation to demonstrate compliance with 44 CFR 65.10. These levee systems are referred to as Provisionally Accredited Levees, or PALs. Provisional accreditation provides communities and levee owners with a specified timeframe to obtain the necessary data to confirm the levee system's accreditation status. Accredited levee systems and PALs are shown on the FIRM using the symbology shown in Figure 3. If the required information for a PAL is not submitted within the required timeframe, or if information indicates that a levee system no longer meets 44 CFR 65.10, FEMA will consider the levee system as non-accredited and issue an effective FIRM showing the levee-impacted area as a SFHA or Zone D.

FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levee systems that exist within Flood County. Table 8, "Levee Systems," lists all accredited levee systems, PALs, and non-accredited levee systems shown on the FIRM for this FIS Report. Other categories of levees may also be included in the table. The Levee ID shown in this table may not match numbers based on other identification systems that were listed in previous FIS Reports. Levee systems identified in the table are displayed on the FIRM with notes to users to indicate their flood hazard mapping status.

Please note that the information presented in Table 8 is subject to change at any time. For that reason, the latest information regarding the levee systems presented in the table may be obtained by accessing the National Levee Database. For additional information, contact the levee owner/sponsor or the local community shown in Table 30.

Table 8: Levee Systems

Community	Flooding Source	NLD Levee System ID	NLD Levee System Name	Levee System Status on Effective FIRM	FIRM Panel(s)	Levee Owner(s) / Sponsor(s)
Palm Beach Gardens, City of	Canal C-18	1404000449	*	Non-Accredited	12099C0358F	South Florida Water Management District
Palm Beach Gardens, City of	Canal C-18	1404200071	*	Non-Accredited	12099C0358F 12099C0359F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	Hillsboro Canal	3404000051	*	Non-Accredited	12099C0500F 12099C0700F 12099C0725F 12099C0925F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	Hillsboro Canal	3404000083	*	Non-Accredited	12099C0925F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	L-8 Canal	3404000046	*	Non-Accredited	12099C0100F 12099C0300F 12099C0325F 12099C0340F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	L-8 Canal	3404000046	*	Non-Accredited	12099C0100F 12099C0300F 12099C0325F 12099C0340F 12099C0530F 12099C0536F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	L-12	3404000028	*	Non-Accredited	12099C0257F 12099C0300F 12099C0325F 12099C0525F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	L-19 Canal New River Canal	3404000092	*	Non-Accredited	12099C0900F 12099C0925F 12099C1100F	South Florida Water Management District

Table 8: Levee Systems (continued)

Community	Flooding Source	NLD Levee System ID	NLD Levee System Name	Levee System Status on Effective FIRM	FIRM Panel(s)	Levee Owner(s) / Sponsor(s)
Palm Beach County, Unincorporated Areas	L-19 Canal New River Canal	3404000095	*	Non-Accredited	12099C0525F 12099C0725F 12099C0925F	South Florida Water Management District
Belle Glade, City of; Pahokee, City of; Palm Beach County, Unincorporated Areas	Lake Okeechobee	*	*	Non-Accredited	12099C0100F 12099C0255F 12099C0257F 12099C0258F 12099C0259F 12099C0262F 12099C0265F 12099C0270F 12099C0300F 12099C0425F 12099C0450F 12099C0453F 12099C0454F 12099C0455F 12099C0460F 12099C0461F	USACE
Palm Beach County, Unincorporated Areas	Lake Okeechobee	3404000028	*	Non-Accredited	12099C0257F 12099C0300F 12099C0325F 12099C0525F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	Lake Okeechobee	3404000328	*	Non-Accredited	12099C0525F	South Florida Water Management District

Table 8: Levee Systems (continued)

Community	Flooding Source	NLD Levee System ID	NLD Levee System Name	Levee System Status on Effective FIRM	FIRM Panel(s)	Levee Owner(s) / Sponsor(s)
Palm Beach County, Unincorporated Areas; Wellington, Village of	Loxahatchee Wildlife Refuge	3404000088	*	Non-Accredited	12099C0536F 12099C0538F 12099C0539F 12099C0730F 12099C0731F 12099C0765F 12099C0955F 12099C0965F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	Miami Canal	3404000033	*	Non-Accredited	12099C0450F 12099C0650F 12099C0850F	South Florida Water Management District
Palm Beach County, Unincorporated Areas	North New River Canal	3404000054	*	Non-Accredited	12099C0675F 12099C0875F 12099C0900F 12099C1100F	South Florida Water Management District

* Data not available

SECTION 5.0 – ENGINEERING METHODS

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

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

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 12. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 9. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 10. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 16.) Stream gage information is provided in Table 11.

Table 9: Summary of Discharges

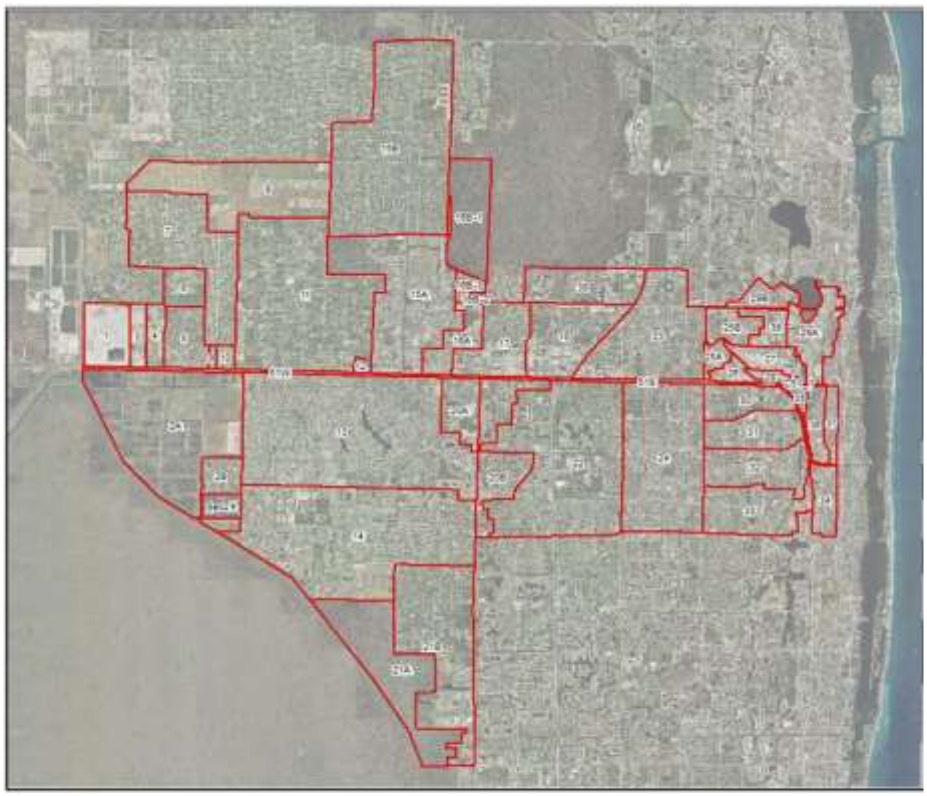
Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)				
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
C-51 Canal	**	**	*	*	*	*	*
E-2E Canal	**	**	*	*	*	*	*
E-3 Canal	Control structure at the downstream outlet	10.74	732	*	1,491	1,693	2,021
E-3 Canal	Palmetto Park Road	5.66	488	*	679	725	824
E-3 Canal	Potomac Road	1.02	255	*	373	383	405
E-4 Canal	Southwest 18th Street	12.95	3,197	*	5,317	6,192	8,373
E-4 Canal	NW 20th Street	6.54	1,084	*	1,796	2,033	2,382
E-4 Canal	Clint Moore Road	0.42	106	*	196	252	279
Hillsboro Canal	At Intracoastal Waterway	64.0	1,600	*	4,000	6,000	9,800
Jupiter Creek	At mouth	2.45	1,063	*	1,401	1,556	1,775
Jupiter Creek	At Indian Town Road	2.16	845	*	1,095	1,208	1,367
Jupiter Creek	At Pennock Lane	0.80	399	*	481	496	501
Jupiter Creek	At Toney Penna Drive	0.56	156	*	210	271	334
Keller Canal	At confluence with C-51 / West Palm Beach Canal	**	1,162	*	*	1,232	*
L-14 Canal	At mouth	5.80	735	*	*	1,363	*
L-14 Canal	At Military Trail	3.40	450	*	*	892	*
L-16 Canal	At mouth	1.60	385	*	*	583	*
L-16 Canal	At Military Trail	0.90	191	*	*	411	*
Lake Osborne	At Hypoluxo Road	**	1,781	*	*	3,419	*
Loxahatchee River	At County Boundary	55.0	2,857	*	4,189	4,771	6,155

* Not calculated for this Flood Risk Project

** Data not available

The following figure shows the subbasin locations within the C-51 basin. Stillwater elevations for the 10- and 1-percent-annual-chance floods for the C-51 Canal in Palm Beach County are summarized in Table 10.

C-51 Subbasins



Collective Water Resources first mapped AE zones from the C-51 model based on the subbasin shapefile provided by South Florida Water Management District (SFWMD). Peak elevations from the model were used to map level-pool floodplains for each subbasin. BFEs were first assigned based on the subbasin shapefile for the SFWMD C-51 model. The subbasin shapefile was not created in GIS and preceded floodplain mapping needs, so the BFEs had to be adjusted based on floodplain connectivity. If this adjustment was not made, multiple BFEs would be assigned for one continuous flooded area. Engineering judgment was used to assign BFEs for each flooded area when an adjustment was needed. This engineering adjustment is the reason that some BFEs do not match the SFWMD reported values in all areas.

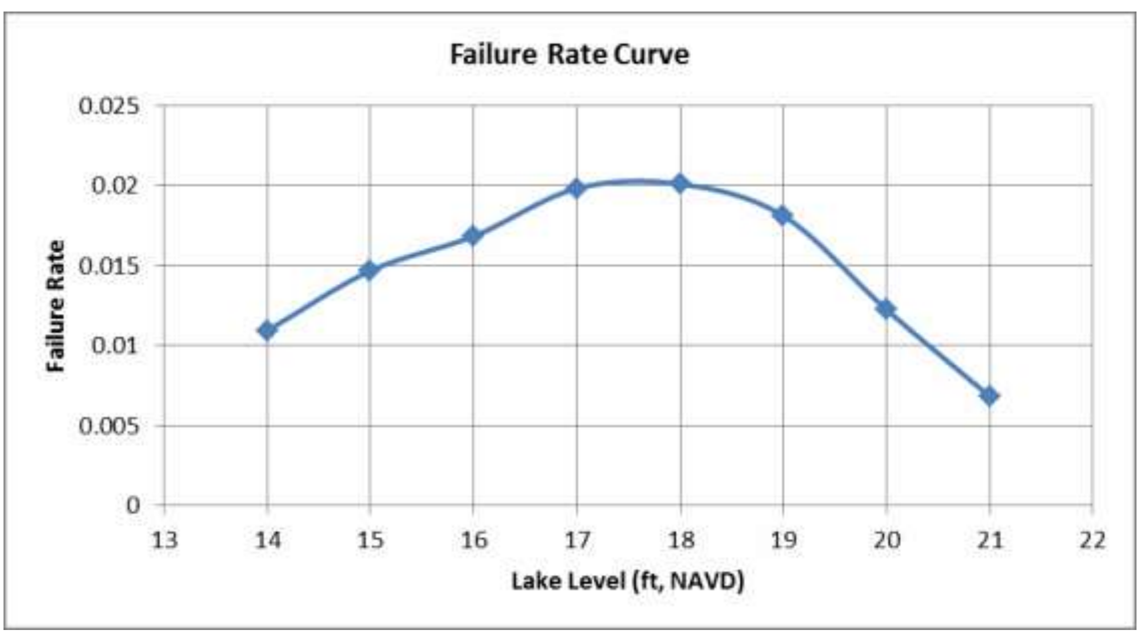
Lake Okeechobee/Herbert Hoover Dike Analysis

Watershed IV Alliance — a Joint Venture (JV) including AECOM and Taylor Engineering, Inc. — conducted a study to estimate the 1percent-annual-chance-flood elevations downstream of the unaccredited Herbert Hoover Dike (HHD or Dike) surrounding Lake Okeechobee. The state-of-the-art study approach, consistent with FEMA's Guidelines and Specifications, Analysis and Mapping Procedures for Non-Accredited Levees (revised), and coastal surge study methodologies, incorporated a Technical Steering Committee including Messrs. Donald Resio, PhD and Arthur Miller, PhD, P.E.

The study of HHD failure and associated flood risks comprised three major tasks: (1) an analysis of stage-frequencies for lake water levels, (2) establishment of dike fragility curves for each dike reach, and (3) joint probability analyses of downstream flood inundations created by various dike breach scenarios (11 breach locations and 8 lake water levels). For a given water level behind the dike, task 1 established the frequency of occurrence of the water level, and task 2 established the associated dike failure probability. Considering these probabilities, along with the results of the model simulations for various lake level breaches, task 3 established the joint probability of HHD failure (failure rate at each breach location) and corresponding probability of downstream flood elevations associated with dike breaching. The 1999 USACE *Herbert Hoover Dike Major Rehabilitation Evaluation Report*, called the MRR (USACE 1999), provided the critical lake stage-frequency curve and dike fragility curves representing each reach (breach location) around HHD. Based on FEMA-funded LiDAR topography, a 2011 USACE study performed by Taylor Engineering provided the advanced, 2-dimensional hydrodynamic dam breach model (MIKE modeling system) to simulate breaches and the associated downstream flooding caused by seepage/piping and slope stability. (This study did not address alternative mechanisms of failure such as overtopping.) Because the USACE's main study goal was part of emergency planning, rather than mitigation and flood insurance rate map production, this study included additional activities aimed at estimating 1-percent-annual-chance flood elevations, including additional hydrodynamic simulations and statistical analyses.

A component of the statistical analyses (task 3), the following figure illustrates the calculated HHD failure rate (events per year) for lake levels from 14 ft. to 21 ft., NAVD88.

HDD Failure Rate (Events per Year) for Various Lake Okeechobee Lake Levels



Note the calculated failure rates in the figure apply to the total dike system (i.e., the total dike failure rate at a given lake level represents the combined failure rate of all reaches). Each dike reach around the circumference of the lake must receive a portion of the total failure rate. Because the dike comprises 11 reaches with an established fragility curve for each reach based on characteristic geotechnical conditions for that reach, the failure probability of each reach provides the basis to allocate (through Equation 1) the total failure rate.

$$Rate_{i,j} = \frac{P_{i,j}}{\sum_{i=1A..}^{8} P_{i,j}} \times TotalRate_j \qquad \text{(Equation 1)}$$

Here, i denotes the reach number from 1A to 8; j denotes the lake level from 14 ft. to 21 ft.; $Rate_{i,j}$ is the occurrence rate of each breach; $TotalRate_j$ is the total dike failure rate.

The “Allocated Failure Rate (Events per Year) for each Breach Simulation” table below, shows the rate for each breach simulation. Note the MRR fragility curves indicate a 100% chance of failure at a lake level of 20 ft. NAVD88 somewhere along HHD; therefore, the allocated rates for all reaches at 21 ft. (from Equation 1) are combined into the allocated rates at 20 ft. in the following table, and the allocated rates for 21 ft. are set to zero.

Allocated Failure Rate (Events per Year) for each Breach Simulation

	Lake Level (NAVD88)							
Reach	**14 ft**	**15 ft**	**16 ft**	**17 ft**	**18 ft**	**19 ft**	**20 ft**	**21 ft**
1A	0.000117	0.000157	0.000181	0.000266	0.001551	0.001585	0.001925	0
1B	0.000117	0.000157	0.000181	0.000266	0.001351	0.001375	0.001724	0
1C	0.003464	0.004644	0.005321	0.007578	0.004713	0.003815	0.003712	0
2	0.003892	0.00523	0.006028	0.004256	0.00377	0.003318	0.003389	0
3	0.002997	0.004027	0.004642	0.004965	0.004271	0.003737	0.003761	0
4	3.89E-05	5.23E-05	6.03E-05	8.87E-05	0.000184	0.000179	0.000209	0
5	3.89E-05	5.23E-05	6.03E-05	8.87E-05	0.000184	0.000179	0.000209	0
6A	1.56E-05	2.09E-05	3.01E-06	4.61E-05	7.54E-05	7.21E-05	8.36E-05	0
6B	2.34E-05	3.14E-05	4.52E-06	7.09E-05	0.000117	0.000112	0.000131	0
7	0.000195	0.000261	0.000301	0.002114	0.003701	0.003562	0.003728	0
8	3.89E-05	5.23E-05	6.03E-05	8.87E-05	0.000184	0.000179	0.000209	0

Applied to the breach flooding simulation results, the statistical analysis yielded a statistical flood surface, which represents flood levels at every computational node for a given flood frequency, in this case the 1-percent-annual-chance. The statistical surface then became the basis for work maps that show the extent of 1- percent-annual-chance flooding, proposed Base Flood Elevations, and proposed Special Flood Hazard Area zones. A detailed report documents the study approach and results. Engineering and mapping products are consistent with FEMA’s Guidelines and Specifications and the study’s scope of work.

Revised Zone AEs, from the above results, were mapped where appropriate. In areas that do not reach the 1-percent-annual-chance flood level, Zone X-Shaded was mapped using the simulated flood inundation from a breach with an initial lake level of 20 ft. NAVD88. Also, some Special Flood Hazard Areas remained unchanged depending on the location and flooding source, and Zone A’s were mapped where the 1-percent-annual-chance flood level was not determined due to lack of modeling data (breach location limitations).

The study also included coordination with stakeholders, specifically the USACE, South Florida Water Management District, and local communities. Leveraging existing studies and reports, including the USACE's HHD breach model and MRR, also proved critical to the cost-effective and timely completion of this scope of work. The USACE authorized the use of its HHD hydrodynamic breach model in May 2011 as the foundation for this study and provided other supporting insight, information, and clarification about the MRR data, Lake Okeechobee water levels and regulation, and ongoing HHD improvements.

Table 10: 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
C-51 Basin	Subbasin 1	17.34	*	*	19.24	*
C-51 Basin	Subbasin 2A	*	*	*	13.44	*
C-51 Basin	Subbasin 2B	13.04	*	*	13.84	*
C-51 Basin	Subbasin 3	13.64	*	*	14.54	*
C-51 Basin	Subbasin 4	14.94	*	*	15.54	*
C-51 Basin	Subbasin 5	15.84	*	*	17.24	*
C-51 Basin	Subbasin 6	17.04	*	*	17.24	*
C-51 Basin	Subbasin 7	17.54	*	*	17.64	*
C-51 Basin	Subbasin 8	18.14	*	*	18.54	*
C-51 Basin	Subbasin 9	15.84	*	*	17.24	*
C-51 Basin	Subbasin 10	17.54	*	*	17.64	*
C-51 Basin	Subbasin 11	17.54	*	*	17.64	*
C-51 Basin	Subbasin 12	17.54	*	*	17.64	*
C-51 Basin	Subbasin 13	14.04	*	*	15.44	*
C-51 Basin	Subbasin 14	14.04	*	*	15.44	*
C-51 Basin	Subbasin 15A	14.44	*	*	16.84	*
C-51 Basin	Subbasin 15B	17.94	*	*	18.64	*
C-51 Basin	Subbasin 16A	14.44	*	*	16.84	*
C-51 Basin	Subbasin 16B-1	17.64	*	*	18.64	*
C-51 Basin	Subbasin 16B-2	17.84	*	*	18.84	*
C-51 Basin	Subbasin 16B-3	17.54	*	*	18.34	*
C-51 Basin	Subbasin 17	12.94	*	*	14.54	*
C-51 Basin	Subbasin 18	12.94	*	*	14.54	*
C-51 Basin	Subbasin 20A	13.94	*	*	16.04	*

Table 10: 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
C-51 Basin	Subbasin 20B	14.44	*	*	15.54	*
C-51 Basin	Subbasin 21A	15.94	*	*	16.44	*
C-51 Basin	Subbasin 21B	16.24	*	*	16.64	*
C-51 Basin	Subbasin 22	15.24	*	*	16.54	*
C-51 Basin	Subbasin 23	14.64	*	*	15.84	*
C-51 Basin	Subbasin 24	15.34	*	*	16.44	*
C-51 Basin	Subbasin 25A	13.14	*	*	12.54	*
C-51 Basin	Subbasin 25B	13.14	*	*	12.64	*
C-51 Basin	Subbasin 26	11.74	*	*	12.44	*
C-51 Basin	Subbasin 27	9.34	*	*	12.74	*
C-51 Basin	Subbasin 28	9.84	*	*	11.54	*
C-51 Basin	Subbasin 29A	12.04	*	*	12.74	*
C-51 Basin	Subbasin 29B	12.44	*	*	13.44	*
C-51 Basin	Subbasin 30	10.94	*	*	11.94	*
C-51 Basin	Subbasin 31	9.04	*	*	11.14	*
C-51 Basin	Subbasin 32	9.24	*	*	11.34	*
C-51 Basin	Subbasin 33	9.44	*	*	11.14	*
C-51 Basin	Subbasin 34	10.74	*	*	11.04	*
C-51 Basin	Subbasin 35	9.64	*	*	11.64	*
C-51 Basin	Subbasin 36	11.24	*	*	12.54	*
C-51 Basin	Subbasin 37	14.04	*	*	14.94	*
C-51 Basin	Subbasin 38	15.34	*	*	17.44	*
C-51 Basin	Subbasin 39	11.84	*	*	11.94	*
C-51 Basin	Sect24	14.44	*	*	15.14	*

* Data not available

Figure 7: Frequency Discharge-Drainage Area Curves

[Not Applicable to this Flood Risk Project]

Table 11: 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
C-51 Canal	S-5AE-TW	SFWMD	River Station 109730	N/A	8/26/2012	08/29/2012
C-51 Canal	S-319-HW	SFWMD	River Station 97736	N/A	8/26/2012	08/29/2012
C-51 Canal	S-155A-HW	SFWMD	River Station 57830	N/A	8/26/2012	08/29/2012
C-51 Canal	S-155A-TW	SFWMD	River Station 57630	N/A	8/26/2012	08/29/2012
C-51 Canal	S-155-HW	SFWMD	River Station 750	N/A	8/26/2012	08/29/2012
Loxahatchee River	265906080093500	USGS	At mile 9.1 near Jupiter, FL	*	1971	Present

* Data not available

5.2 Hydraulic Analyses

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

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed in Table 23, “Floodway Data.”

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 12. Roughness coefficients are provided in Table 13. 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 12: 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
C-51 Basin	Within Palm Beach County	Within Palm Beach County	Other	Other	May 2015	AE	Collective Water Resources performed an engineering analysis of the C-51 Basin study, created by South Florida Water Management District (SFWMD). The C-51 model was developed using an unsteady flow model. The discharge values vary with time change from cross section to cross section. A breakdown of flow values by subbasin is presented in the C-51 Basin Rule report prepared by SFWMD (SFWMD 2015). Detailed hydrologic and hydraulic information about C-51 Basin is provided in the narrative below.
C-51 Canal	At North Federal Highway / County Highway 5	At the Railroad	HEC-HMS 3.5 (USACE 2010b)	HEC-RAS 4.1.0 (USACE 2010a)	May 2015	AE	Detailed hydrologic and hydraulic information about C-51 Canal (also known as West Palm Beach Canal) is provided in the narrative below. Note that the profile for C-51 Canal was only created for this reach.
E-2E Canal	Confluence with Hillsboro Canal	At Glades Road	S2DMM (TCE 2013)	S2DMM (TCE 2013)	February 2014	AE	Detailed hydrologic and hydraulic information about E-2E Canal is provided in the narrative below.
E-3 Canal	Confluence with Hillsboro Canal	At Yamato Road control structure	S2DMM (TCE 2013)	S2DMM (TCE 2013) & HEC-RAS 4.1.0 (USACE 2010a)	February 2014	AE w/ Floodway	Detailed hydrologic and hydraulic information about E-3 Canal is provided in the narrative below.
E-4 Canal	Confluence with Hillsboro Canal	At Congress Avenue control structure	S2DMM (TCE 2013)	S2DMM (TCE 2013) & HEC-RAS 4.1.0 (USACE 2010a)	February 2014	AE w/ Floodway	Detailed hydrologic and hydraulic information about E-4 Canal (also known as El Rio Canal and Lake Ida Canal) is provided in the narrative below.

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Hillsboro Canal	Confluence with E-3 Canal and E-4 Canal	Approximately 1.2 miles upstream of Interstate Highway 95	HEC-1 (USACE 1998)	UNET 4.0 (USACE 2001)	May 1996	AE	Hillsboro Canal is entirely influenced by the Intracoastal Waterway, therefore, no flood profile is available (FIS 2017).
Jupiter Creek	Confluence with Southwest Fork Loxahatchee River	Approximately 40 feet upstream of Toney Penna Drive	HEC-1 (USACE 1998)	HEC-2 (USACE 1991)	September 2012	AE w/ Floodway	Combined probability analysis was calculated for each riverine cross section that intersected the coastal surge.
Keller Canal	Confluence with C-51 Canal	Confluence with Lake Osborne / At Park Road	HEC-1 (USACE 1998)	UNET 4.0 (USACE 2001)	May 2005	AE	Combined in C51 UNET model
L-14 Canal	Confluence with Lake Osborne	At Military Trail	HEC-1 (USACE 1998)	UNET 4.0 (USACE 2001)	May 2005	AE	Combined in C51 UNET model
L-16 Canal	Confluence with Lake Osborne	At Military Trail	HEC-1 (USACE 1998)	UNET 4.0 (USACE 2001)	May 2005	AE	Combined in C51 UNET model
Lake Okeechobee	Entire shoreline	Entire shoreline	Other	Other	September 2012	VE	Detailed hydrologic and hydraulic information about Lake Okeechobee is provided in the narrative below.
Lake Osborne	Confluence with Keller Canal	At Hypoluxo Road	HEC-1 (USACE 1998)	UNET 4.0 (USACE 2001)	May 2005	AE	Combined in C51 UNET model
Loxahatchee River	Martin County boundary	Approximately 850 feet upstream of Martin County boundary	Other	Other	November 2016	AE	Combined probability analysis was calculated for each riverine cross section that intersected the coastal surge.
Zone A Flooding Sources	Within Palm Beach County	Within Palm Beach County	Other	Other	May 1996	A	Specific hydrologic and hydraulic methods were not mentioned in the previous FIS reports.
Zone AH Ponding	Within Palm Beach County	Within Palm Beach County	Other	Other	May 1996	AH	Detailed hydrologic and hydraulic information about Zone AH Ponding is provided in the narrative below.
Zone AO Ponding	Within Palm Beach County	Within Palm Beach County	Other	Other	May 1996	AO	Detailed hydrologic and hydraulic information about Zone AO Ponding outside of the coastal area is provided in the narrative below.

C-51 Basin Hydrologic Method

The hydrologic analyses for C-51 Canal were performed using HEC-HMS version 3.5 (USACE 2010b) following SFWMD Technical Memorandum "Frequency Analysis of One and Three-Day Rainfall Maxima for Central and Southern Florida." The storm events used in the analysis are the 10-percent-annual-chance, 72- hours with 10.1 inches of rainfall depth and 1-percent-annual-chance, 72-hours with 16.3 inches of rainfall depth.

The unit hydrograph method was altered for this analysis to recompute peak rate values; the Delmarva unit hydrograph method was applied in place of the SCS unit hydrograph. Total runoff volumes computed with both methods were the same, the Delmarva method was used because it resulted in lower peak rate values. Curve numbers were developed based on hydrologic soil groups, soil conditions and existing land use. The hydrological parameters were adjusted during model calibration process. The runoff hydrographs for the C-51 Canal were generated for each sub-basin. The SCS method assumes the initial abstraction (I, inches) is equal to 0.2 times the basin storage (S, inches). Initial abstraction value entries were left blank to allow HEC-HMS to compute using the default values (SFWMD 2015).

The C-51 model was developed using an unsteady flow model. The discharges for C-51 are not listed in Table 6 because the discharge values vary with time and change from cross section to cross section. A breakdown of flow values by subbasin is presented in the C-51 Basin Rule report prepared by SFWMD (SFWMD 2015).

For the 2000 FIS, all detailed hydrologic studies were performed using HEC-1 (USACE 1998) except for the C-51 Canal, which was studied using HEC-HMS 3.5 (FIS 2000).

C-51 Basin Hydraulic Method

For the C-51 Canal, peak stage elevations of the 10- and 1-percent annual chance recurrence intervals were computed for each sub-basin using HEC-RAS v4.1 (USACE 2010a) unsteady model. The boundary condition at the eastern canal limit is a fixed stage of elevation 4.6 ft. NGVD. The western limit coincides with the location of flood control structure S5A-E. The upstream (western) boundary condition is specified by flow discharged through the S-5AE structure at the rate of 300 cfs whenever structure S-155A is discharging to the east and equals zero when the S-155A structure is closed. The inflow value was taken from the seepage estimation performed by USACE for design of the STA-1E storage area. The initial conditions for peripheral reaches were specified by assuming flows. An initial flow in the range of 10 to 30 cfs was specified for the equalizer and lateral canals, and initial flow for C-51 reaches ranges from 100 to 300 cfs. The stage-storage relationship of each storage area was computed from the digital terrain model that was developed using recent LiDAR data.

The necessary channel cross sections and hydraulics structures were obtained from a variety of sources including DeGrove Surveyors, Inc., Greenhorne and O'Mara, the South Florida Water Management District, Lake Worth Drainage District, and USACE.

Channel roughness factors (Manning's "n") used in the hydraulic computations were selected on the basis of field observations, aerial photos, and photographs of the canal and floodplain areas. The Manning's values were adjusted during calibration. Roughness values used for the main channels ranged from 0.030 to 0.050, with overbank roughness values of 0.080.

The unsteady HEC-RAS model for C-51 Canal was calibrated using gage data collected during Tropical Storm Isaac (August 26-29, 2012). The available gages on C-51 Canal with stage and flow measurements from the South Florida Water Management District are S-5AE-TW, S-319-HW, S-155AHW, S-155A-TW and S-155-HW (SFWMD 2015).

E-2E/E3/E4 Basin Hydrologic and Hydraulic Methods

The hydrologic analyses for E-2E/E3/E4 basin were performed by Tomasello Consulting Engineers, Inc. using S2DMM. S2DMM is a FEMA approved model that was specifically designed for South Florida watersheds. The calibrated S2DMM was applied to design rainfall conditions for the 10-year, 50-year, 100-year, and 500-year return frequencies. The SFWMD modified Type II rainfall distribution was used in each design event (TCE 2014a).

Flows by S2DMM during simulations of the 100 year rainfall event were applied to a HEC-RAS 3.1.2 (USACE 2004) model setup of the primary channels for the hydraulic analyses of the E3/E4 canals (TCE 2014a).

The E-3 and E-4 floodways were evaluated using the S2DMM model (TCE 2013) by applying encroachments into the contiguous floodplain adjacent to the E-3 and E-4 channels as described herein. For the S2DMM floodway run, encroachment is modeled by blocking surface flow across the grids that the E-3 and E-4 channels bisect. This was done in the S2DMM model by adding barriers to stop flow outside the banks of the canals (TCE 2014b).

Keller Canal, L-14 Canal, L-16 Canal, Lake Osborne

Detailed hydraulic studies for 16.3 miles of riverine flooding sources taken from the FIS 2000 were performed using HEC-2 (USACE 1991) or UNET (USACE 2001), except for C-51 Canal, which was studied using HEC-RAS 4.1.0 (USACE 2010a). The flood profile for Keller Canal is completely inundated by backwater from C-51 Canal and Lake Osborne, and has been omitted from this FIS report.

Please note that only the 10- and 1-percent-annual-chance recurrence intervals were computed for Keller Canal, Lake Osborne, L-14 and L-16 Canals

Roughness coefficients (Manning's “n”) were chosen by engineering judgment and based on field observation of the channel and floodplain areas. Table 13 contains the channel and overbank “n” values for the streams studied by detailed methods.

Please note, Hillsboro Canal is entirely influenced by the Intracoastal Waterway; therefore, no flood profile is available.

Ponding and Shallow Flow Analyses

FEMA granted permission for Palm Beach County to re-map sections of AO Zones in the southwestern portion of the county, affecting Palm Beach County Unincorporated areas and the City of Boca Raton, using current Environmental Resource Permits (ERPs) from the SFWMD. Collective Water Resources used peak elevations as provided in the ERPs (rounded to the first decimal place) became the static base flood elevations (BFEs) for these flood hazard areas. If a neighborhood was partially in the AO Zone and partially in the adjacent X Zone, Collective Water Resources placed the neighborhood in the X Zone. Floodplains were mapped based on the peak elevations wherever possible. If issues related to the re-mapping could not be overcome, the neighborhood remained in the AO Zone. Floodplains and static BFEs were reviewed by Collective Water Resources for each neighborhood; modifications were made as needed and final results were back-checked by a professional engineer (CWR 2014).

Lands in southeastern Florida are extremely flat, with slopes often less than 1.0 foot per mile. Canals do not typically overflow their banks; instead, flooding is typically sheet flooding, with unpredictable flow paths. Overland flow was studied by considering flow barriers such as roads, levees, railways, and natural topography. The assumption was made that water would flow to low areas when flow barriers did not obstruct its movement.

Overland flow depths were partly based on the kinematic wave approach, which relates the depth of water to rainfall intensity, the path length, slope, and surface roughness (Eagleson 1970). In the kinematic wave analysis of surface flow, the flow depth at the end of a catchment of length, “L,” is given by the equation

$$y = \left[\frac{L_i}{a}\right]^{\frac{1}{m}}$$

for rainfall durations equal to or greater than the time of concentration. In this expression, *i* is the rainfall intensity and *a* is a constant, 1.49 $s^{½}$/n. Here, “n” is the Manning's roughness coefficient and “s” is ground slope. Values assumed for Manning's “n” for shallow overland flow ranged from 0.100 to 0.200, depending upon the ground cover and estimated depth of flow. The constant, “m”, was taken as 5/3. The time of concentration was calculated from the equation

$$t_c = \left[\frac{{L_i}^{1-m}}{a}\right]^{\frac{1}{m}}$$

When the rainfall duration is less than the time of concentration, the flow depth becomes simply y = it, where “t” is the rainfall duration. The time “$t*_c$” required to reach maximum flow depth is given by the equation

$$t *_c = \frac{{L_y}^{(1-m)}}{a}$$

Because rainfall duration affects intensity, a unique intensity results for catchments of different lengths and slopes. The discharge per unit width may be calculated from the equation $q = ay^m$. The previously described calculations, as well as duration-intensity and infiltration relationships, were coded into a computer program. A set of tables was generated that showed the flow depth and discharge for a wide range of land slopes and flow distances. These values were utilized in evaluating the depths of overland flow.

The hydraulic analysis also utilized a volumetric ponding analysis to determine the amount and distribution of excess water in the low areas. The final ponding depth was based on the volume of water that migrated to the low areas and the amount of excess water that remained ponded in the low areas after allowances were made for discharge to the coast via the canal system.

In Atlantis, the analysis showed that flood water from rainfall could fill land depressions up to an elevation of 14 feet for the 1-percent-annual-chance event. The area of the greatest ponding depth lies in the eastern portion of the city around Congress Lake. Shallow ponding depths occur in areas throughout the city.

In Lake Clarke Shores, the analyses showed that floodwaters from rainfall could fill land depressions up to an elevation of 12 feet for the 1-percent-annual-chance event. Shallow ponding depths occur in areas throughout the town, with the greatest depths along the banks of the various water bodies.

In Mangonia Park, the analyses showed that excess rainfall forms temporary ponds in the low areas. The area of the greatest ponding depth lies east of Australian Avenue, where water-surface elevations can reach approximately 17 feet. Shallow ponding depths occur in areas throughout the town. The only area not subject to shallow ponding is the ridge lying west of Australian Avenue.

For overland flow, surface roughness coefficients (Manning's “n”) were estimated from field observations. The values ranged from 0.100 to 0.200, depending on vegetation, ground cover, and estimated depth of surface water.

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
C-51 Basin	N/A	N/A
C-51 Canal	0.035[1]	0.100-0.200
E-2E Canal	N/A	N/A
E-3 Canal	N/A	N/A
E-4 Canal	0.035[1]	0.100-0.200
Hillsboro Canal	0.035[1]	0.100-0.200
Jupiter Creek	N/A	N/A
Keller Canal	N/A	N/A
L-14 Canal	N/A	N/A
L-16 Canal	N/A	N/A
Lake Okeechobee	N/A	N/A
Lake Osborne	N/A	N/A
Loxahatchee River	0.035	0.100
Zone A Flooding Sources	N/A	N/A
Zone AH Ponding	N/A	N/A
Zone AO Ponding	N/A	N/A
Old Studies	0.015-0.060	0.060-0.190

[1]Average

5.3 Coastal Analyses

For the areas of Palm Beach 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 14 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 14: Summary of Coastal Analyses

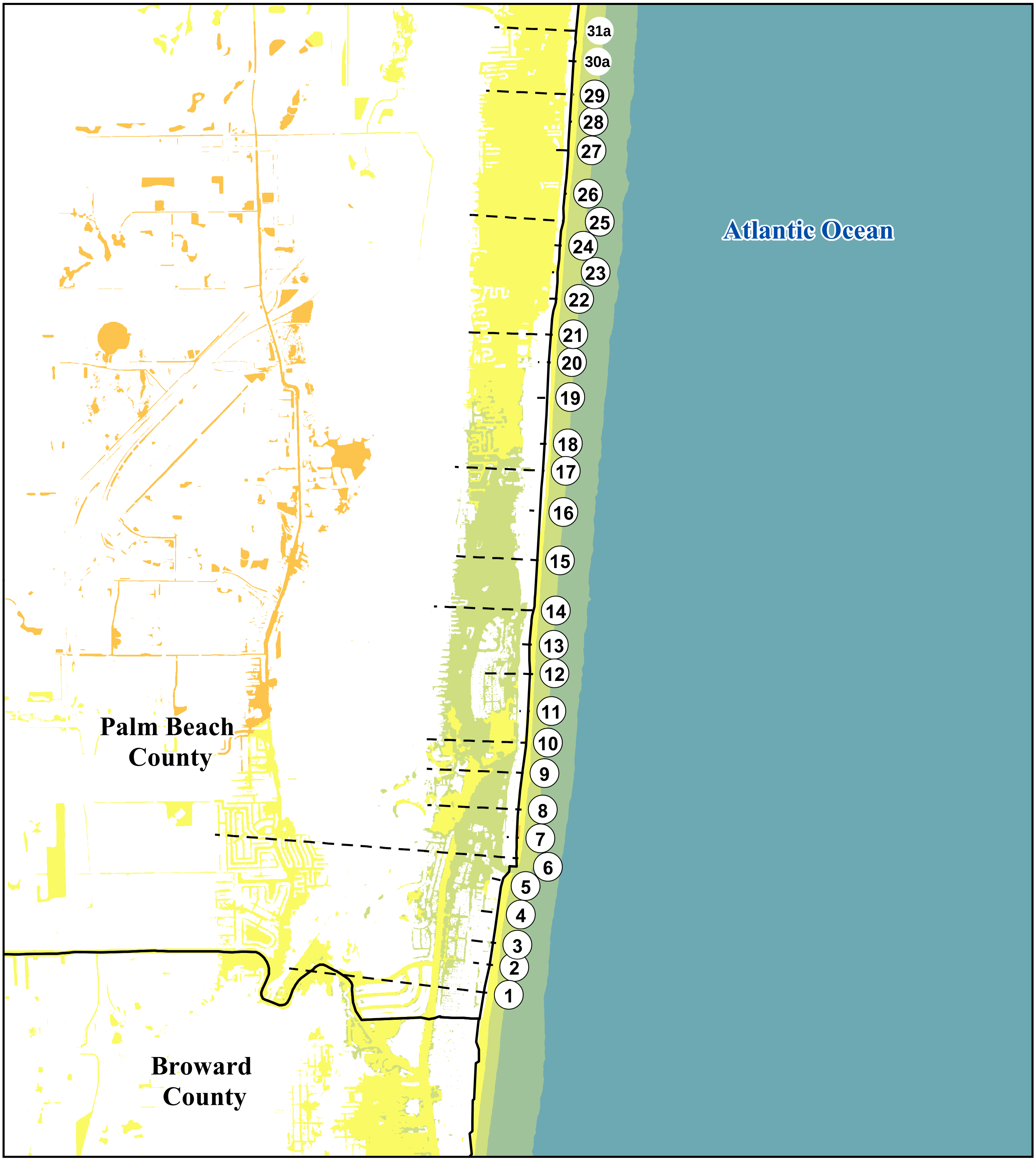
Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Erosion	FEMA's Erosion Assessment	09/11/2019
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Overland Wave Propagation	WHAFIS	09/11/2019
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Stillwater Frequency Analysis	SURGESTAT (low frequency)	07/25/2018
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Stillwater Frequency Analysis	Regional Tidal Frequency Analysis (high frequency)	07/11/2019
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Storm Climatology Statistical Analyses	JPM-OS	06/08/2015
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Storm Surge including Regional Wave Setup	ADCIRC + SWAN	06/01/2018
Atlantic Ocean	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Wave Runup	RUNUP2.0; SPM; TAW	09/11/2019
Intracoastal Waterway[1]	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Overland Wave Propagation	WHAFIS 4.0	09/11/2019
Loxahatchee River	Entire coastline of Palm Beach County	Entire coastline of Palm Beach County	Overland Wave Propagation	WHAFIS 4.0	09/11/2019

[1] Intracoastal Waterway includes the following flooding sources: Hidden Valley Canal, Jupiter Sound, Lake Boca Raton, Lake Rogers, Lake Worth, Lake Worth Creek, Lake Wyman, Loxahatchee River, North Palm Beach Waterway

5.3.1 Total Stillwater Elevations

The total stillwater elevations (stillwater including storm surge plus wave setup) for the 1-percent-annual-chance flood were determined for areas subject to coastal flooding. The models and methods that were used to determine storm surge and wave setup are listed in Table 14. The stillwater elevation that was used for each transect in coastal analyses is shown in Table 16, “Coastal Transect Parameters.” Figure 8 shows the total stillwater elevations for the 1-percent-annual-chance flood that was determined for this coastal analysis.

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



Elevation (Feet, NAVD88)

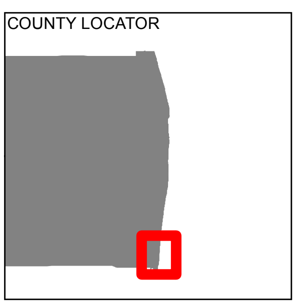
- <5.0
- 5.0 - 5.5
- 5.5 - 6.0
- 6.0 - 6.5
- 6.5 - 7.0
- 7.0 - 7.5
- 7.5 - 8.0
- 8.0 - 8.5
- >8.5
- County Boundaries
- Coastal Transects

1 inch = 5,000 feet 1:60,000

0 1,000 2,000 4,000 6,000 8,000 Feet

N

Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88



NATIONAL FLOOD INSURANCE PROGRAM

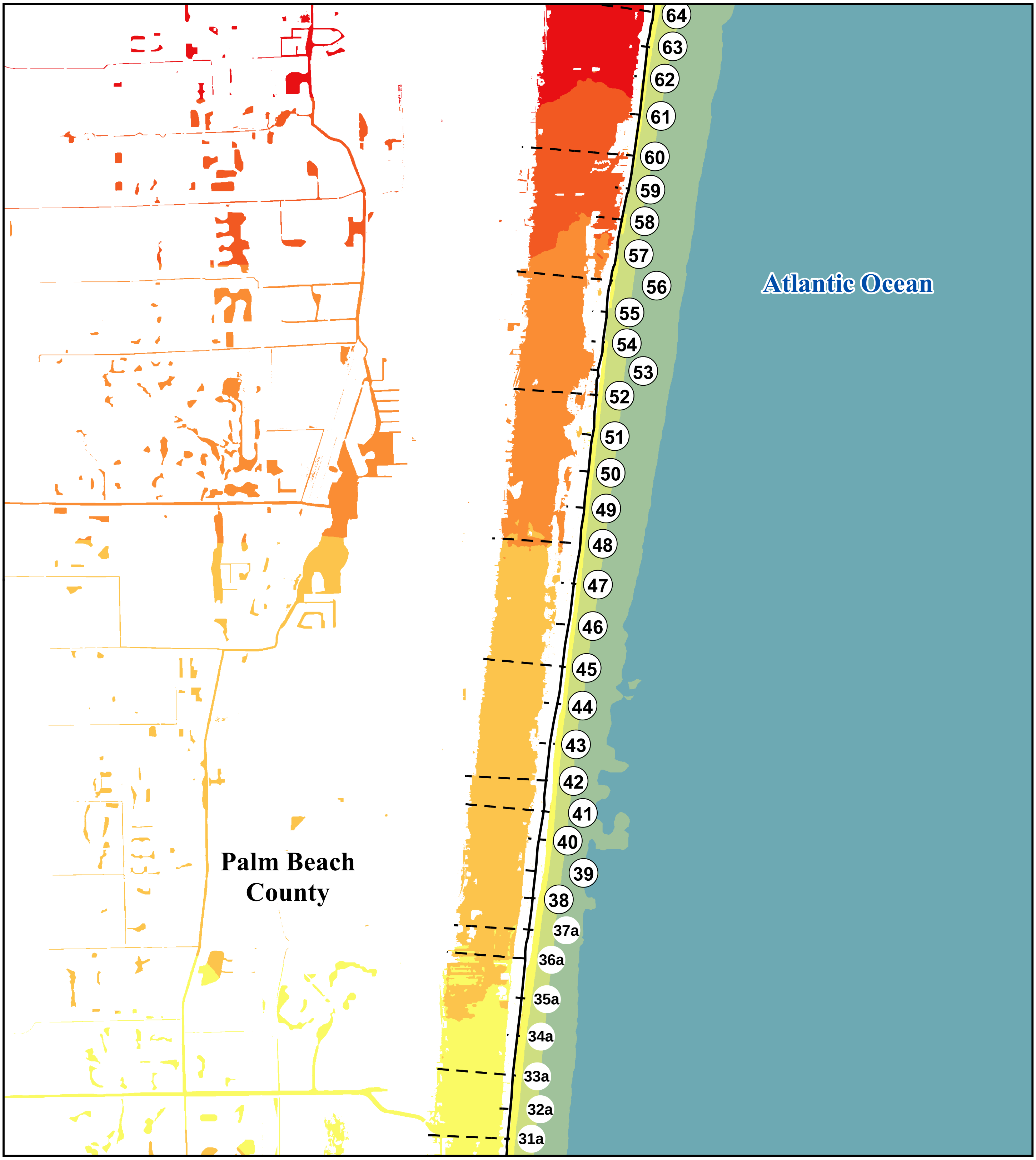
1 Percent-Annual-Chance Stillwater Elevation Map

PALM BEACH 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: 1% Annual Chance Total Stillwater Elevations for Coastal Areas



Elevation (Feet, NAVD88)

<5.0 | 6.0 - 6.5 | 7.5 - 8.0
5.0 - 5.5 | 6.5 - 7.0 | 8.0 - 8.5
5.5 - 6.0 | 7.0 - 7.5 | >8.5

County Boundaries

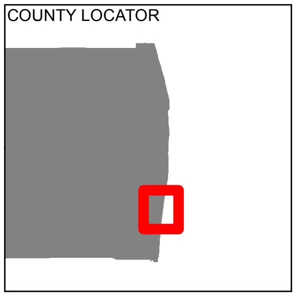
Coastal Transects

1 inch = 5,000 feet 1:60,000

0 1,000 2,000 4,000 6,000 8,000 Feet

Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

1 Percent-Annual-Chance Stillwater Elevation Map

PALM BEACH 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: 1% Annual Chance Total Stillwater Elevations for Coastal Areas

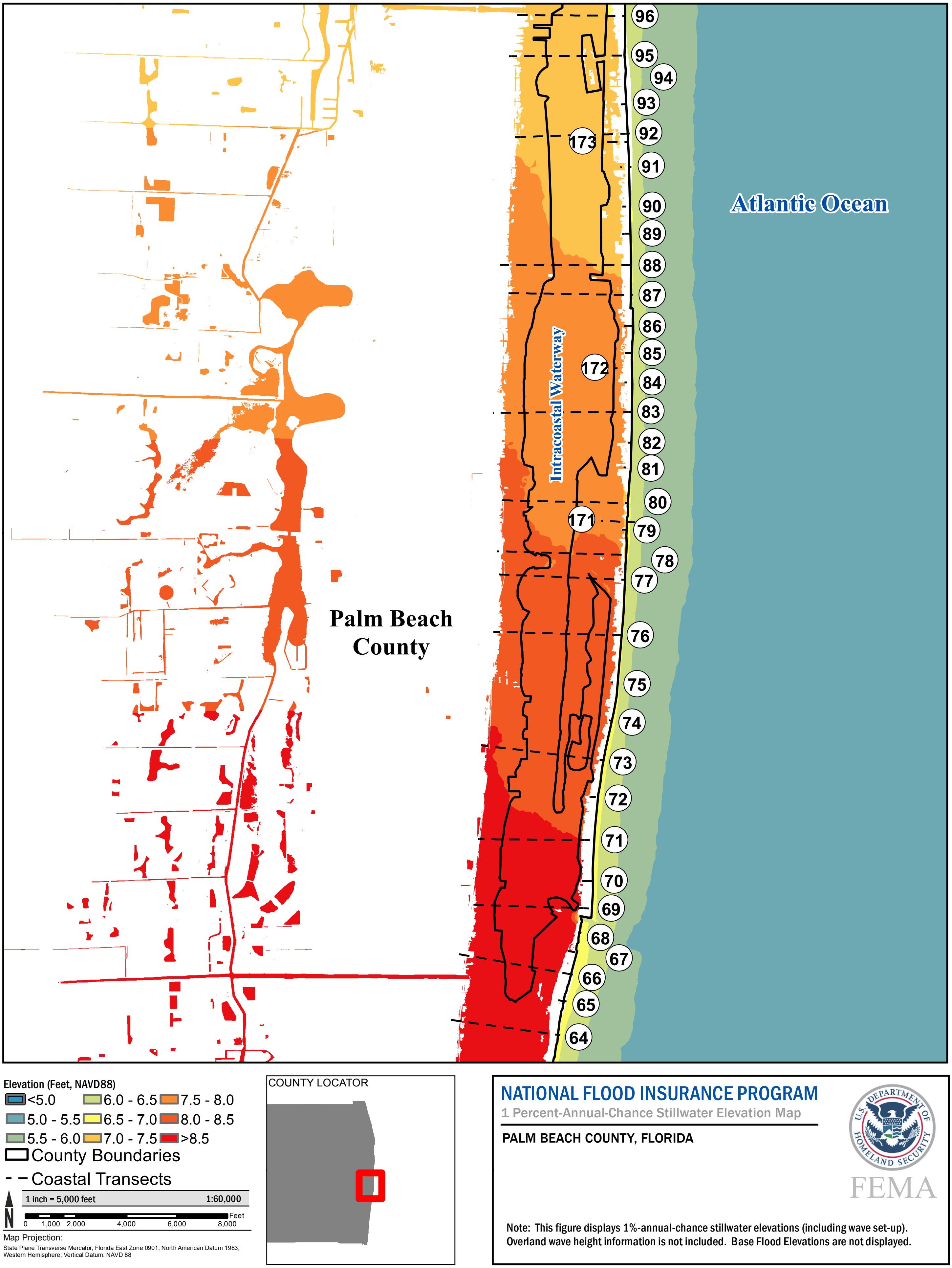
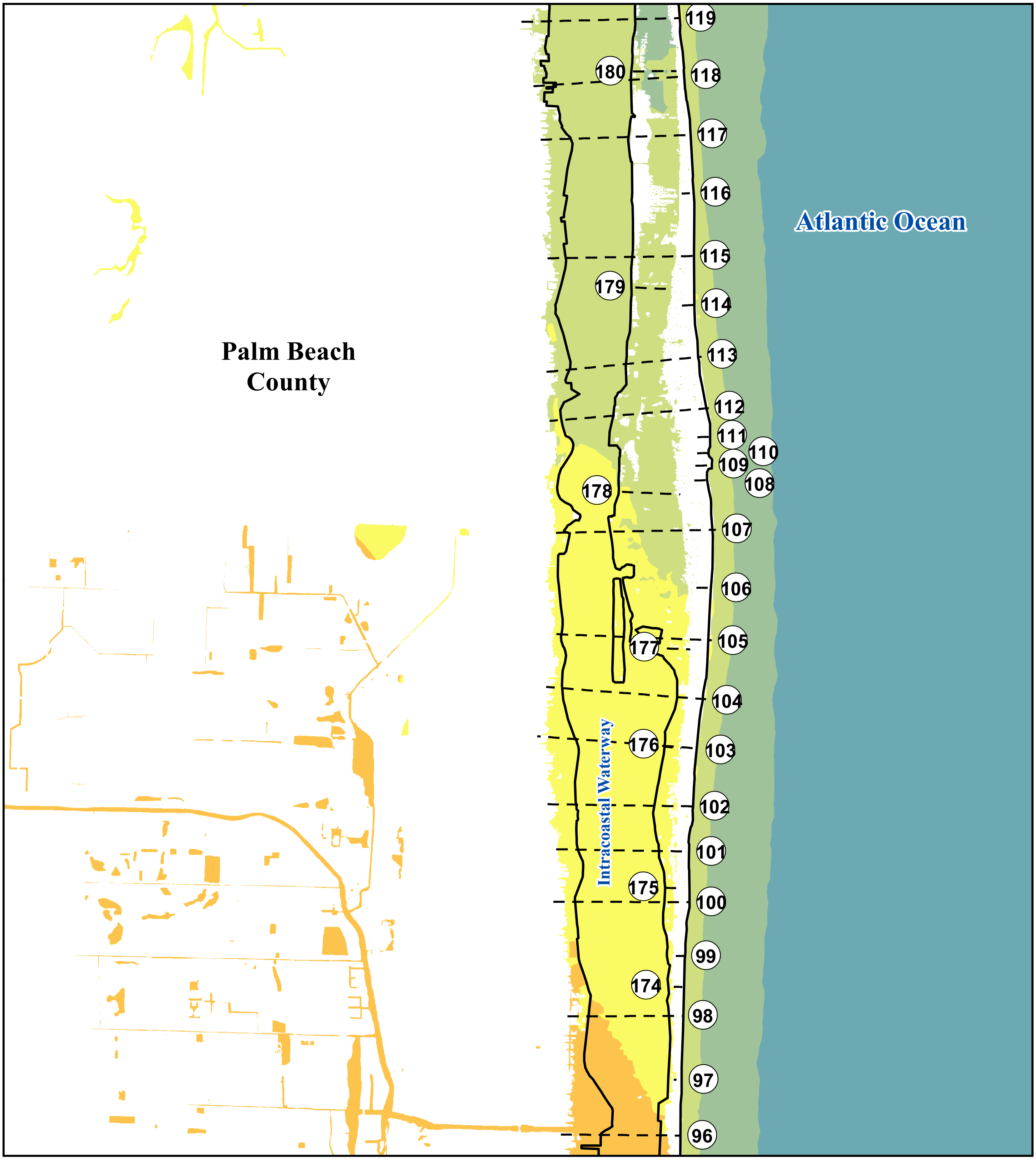


Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas



Elevation (Feet, NAVD88)

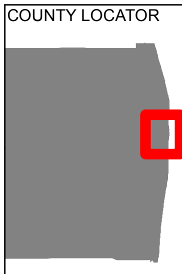
- <5.0
- 5.0 - 5.5
- 5.5 - 6.0
- 6.0 - 6.5
- 6.5 - 7.0
- 7.0 - 7.5
- 7.5 - 8.0
- 8.0 - 8.5
- >8.5
- County Boundaries
- Coastal Transects

1 inch = 5,000 feet 1:60,000

0 1,000 2,000 4,000 6,000 8,000 Feet

Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

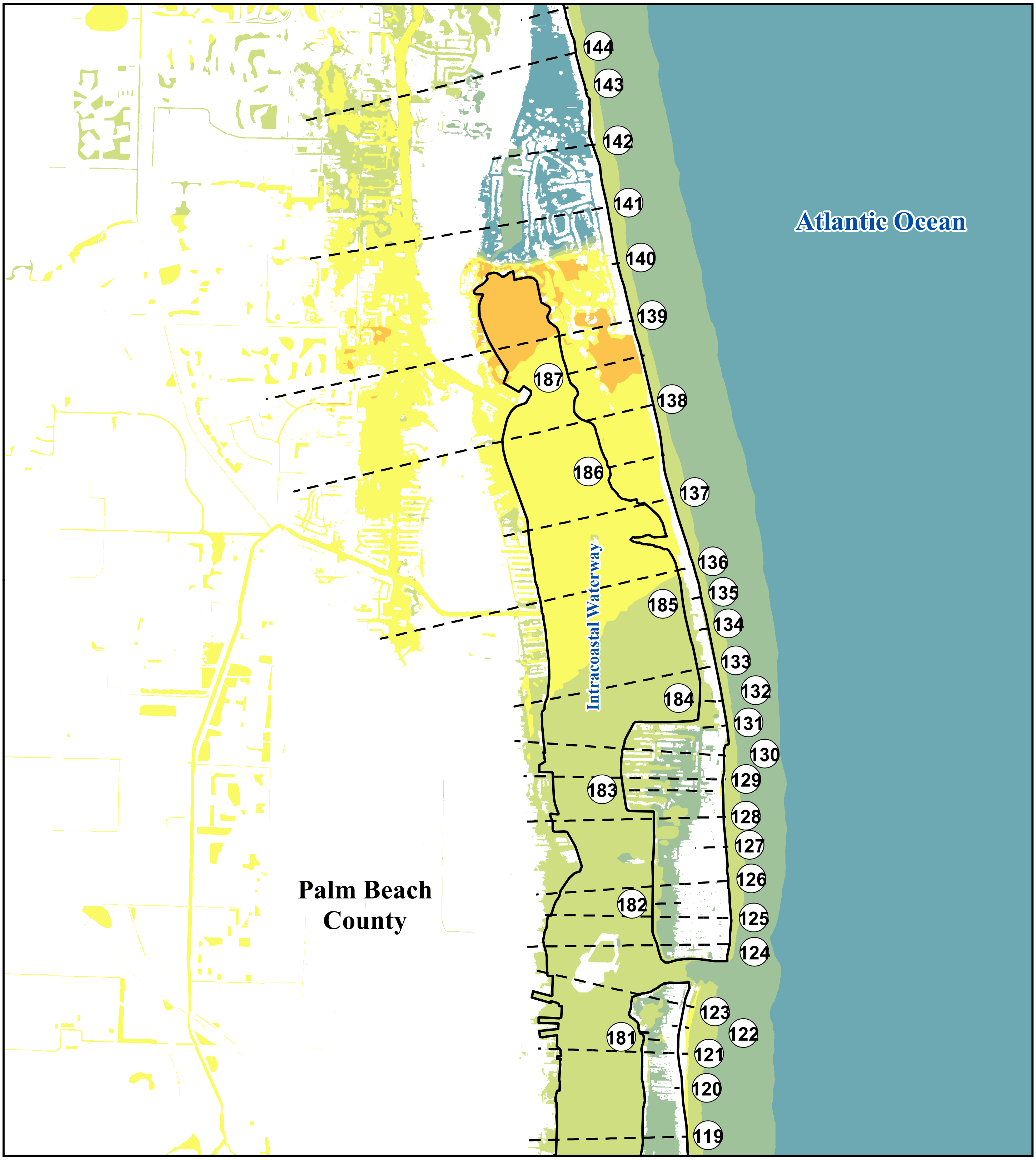
1 Percent-Annual-Chance Stillwater Elevation Map

PALM BEACH 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: 1% Annual Chance Total Stillwater Elevations for Coastal Areas



Elevation (Feet, NAVD88)

- <5.0
- 5.0 - 5.5
- 5.5 - 6.0
- 6.0 - 6.5
- 6.5 - 7.0
- 7.0 - 7.5
- 7.5 - 8.0
- 8.0 - 8.5
- >8.5

County Boundaries

Coastal Transects

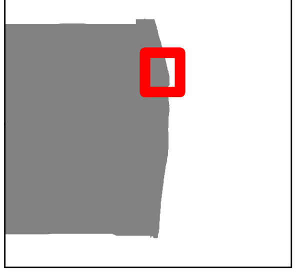
1 inch = 5,000 feet 1:60,000

0 1,000 2,000 4,000 6,000 8,000 Feet

N

Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

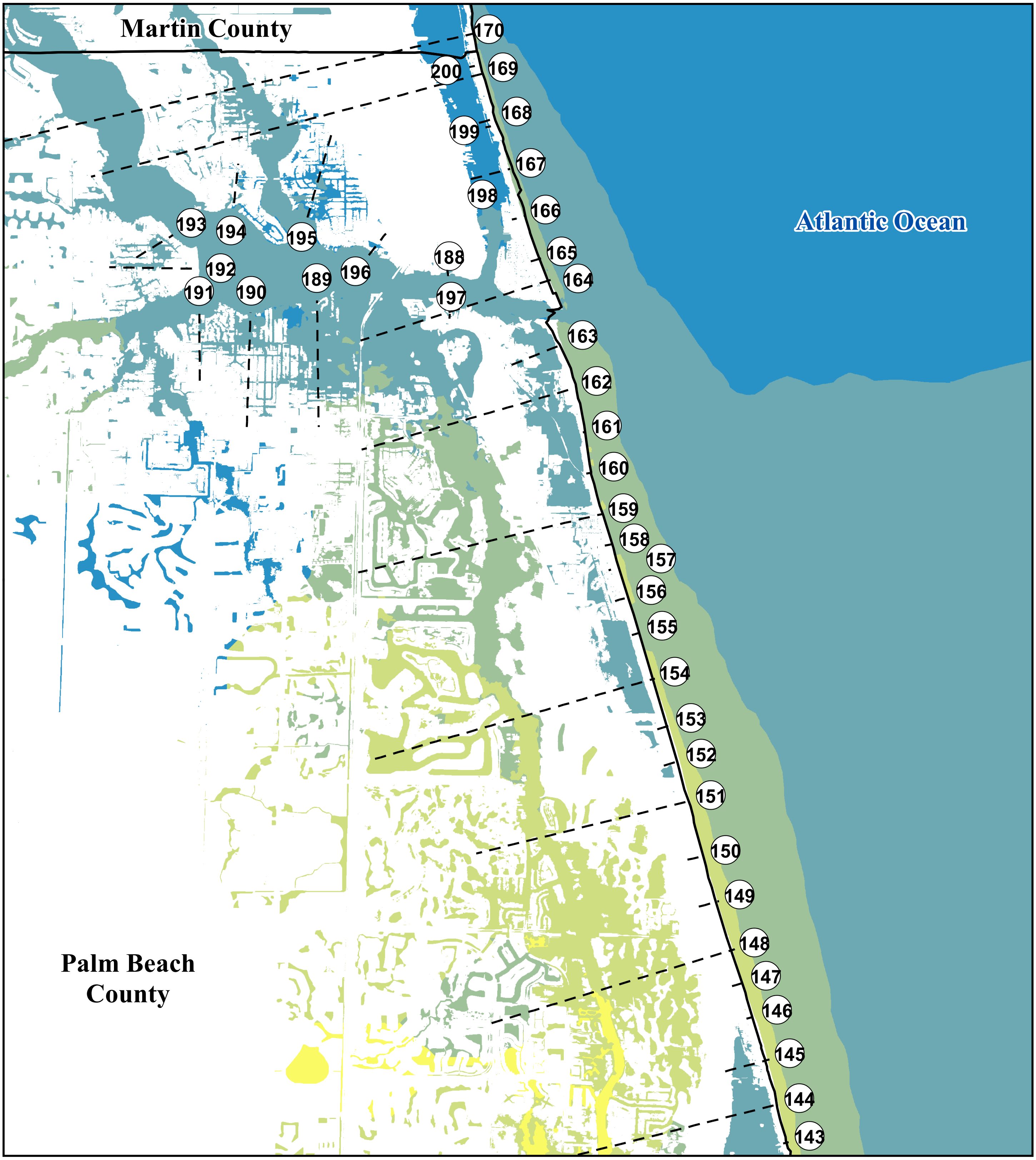
1 Percent-Annual-Chance Stillwater Elevation Map

PALM BEACH 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: 1% Annual Chance Total Stillwater Elevations for Coastal Areas



Elevation (Feet, NAVD88)

- <5.0
- 5.0 - 5.5
- 5.5 - 6.0
- 6.0 - 6.5
- 6.5 - 7.0
- 7.0 - 7.5
- 7.5 - 8.0
- 8.0 - 8.5
- >8.5
- County Boundaries
- Coastal Transects

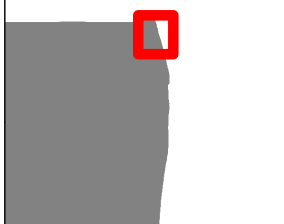
1 inch = 5,000 feet 1:60,000

0 1,000 2,000 4,000 6,000 8,000 Feet

N

Map Projection:
State Plane Transverse Mercator, Florida East Zone 0901; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

1 Percent-Annual-Chance Stillwater Elevation Map

PALM BEACH COUNTY, FLORIDA

U.S. DEPARTMENT OF HOMELAND SECURITY

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 South Florida Storm Surge 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 (Resio 2007) and Toro et. al. (Toro 2010), was applied to compute Stillwater Elevations (SWELs), which include the storm surge component and the wave setup component.

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 15 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. 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 (FEMA 2008). The methods from this previous study were applied to updated tide records, through the end of 2017. As much as ten years of additional data, from 2008 to 2017, were added to the analysis where available. In addition, the regionalization of the tide gages from the previous study was reviewed and re-evaluated in light of the additional available data and observation of revised L-moment parameters that characterize the regionalization.

Table 15: Tide Gage Analysis Specifics

Gage Name	Managing Agency of Tide Gage Record	Gage Type	Start Date	End Date	Statistical Methodology
Key West 8724580	NOAA	Tide	1932	2017	L-moments, GEV
Lake Worth Pier 8722670	NOAA	Tide	1992	2017	L-moments, GEV
Virginia Key 8723214	NOAA	Tide	1993	2017	L-moments, GEV

Combined Riverine and Tidal Effects

A combined rate of occurrence analysis was conducted to compute a 1-percent-annual-chance BFE for areas subject to flooding by both coastal and riverine flooding mechanisms. Since riverine and coastal analyses were based on independent events, the resulting combined BFE would be higher than that of their individual occurrence. In other words, at the location where the computed 1-percent-annual-chance coastal flood level equals the computed 1-percent-annual-chance riverine flood level, there was a greater than 1-percent-annual-chance of this flood level being equaled or exceeded.

In Palm Beach County, combined rate of occurrence calculations were performed for E-3 Canal, E-4 Canal, and Jupiter Creek, Loxahatchee River.

Wave Setup Analysis

Wave setup was computed during the storm surge modeling through the methods and models listed in Table 14 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 14. 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-percent-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 16 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 14, "Summary of Coastal Analyses". For the 0.2-percent-annual-chance event, wave profiles were created to indicate the results of the wave height analysis at each transect (Exhibit 2). Such wave profiles may show greater detail than the mapping product, due to limitations of the map scale and smoothing tolerances applied during boundary cleanup.

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-percent-annual-chance flood. Wave runup elevations were modeled using the methods and models listed in Table 14. Wave runup is defined as the maximum vertical extent of wave uprush on a beach or structure. FEMA's 2018 Guidelines and Specifications require the 2-percent wave runup level be computed for the coastal feature being evaluated (cliff, coastal bluff, dune, or structure) (FEMA 2018). The 2-percent-exceedence runup is the runup exceeded by 2-percent of the runup values calculated at the shoreline/structure face. Each transect defined within the study area was evaluated for the applicability of wave runup, and if necessary, the appropriate runup methodology was selected and applied to each transect. Runup elevations were then compared to WHAFIS results to determine the dominant process affecting BFEs and associated flood hazard levels. Based on wave runup rates, wave overtopping was computed following the FEMA 2018 Guidelines and Specifications. Wave runup analysis for the 0.2-percent-annual-chance event was not performed for this study and is not included in the profiles.