

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 2



BRYAN COUNTY, GEORGIA AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
BRYAN COUNTY, UNINCORPORATED AREAS	130016
PEMBROKE, CITY OF	130017
RICHMOND HILL, CITY OF	130018



FEMA

EFFECTIVE:

PRELIMINARY
1/15/2016

FLOOD INSURANCE STUDY NUMBER
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Version Number 2.3.2.1

TABLE OF CONTENTS

Volume 1

	<u>Page</u>
SECTION 1.0 – INTRODUCTION	1
1.1 The National Flood Insurance Program	1
1.2 Purpose of this Flood Insurance Study Report	2
1.3 Jurisdictions Included in the Flood Insurance Study Project	2
1.4 Considerations for using this Flood Insurance Study Report	4
SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS	14
2.1 Floodplain Boundaries	14
2.2 Floodways	18
2.3 Base Flood Elevations	19
2.4 Non-Encroachment Zones	19
2.5 Coastal Flood Hazard Areas	20
2.5.1 Water Elevations and the Effects of Waves	20
2.5.2 Floodplain Boundaries and BFEs for Coastal Areas	21
2.5.3 Coastal High Hazard Areas	22
2.5.4 Limit of Moderate Wave Action	23
SECTION 3.0 – INSURANCE APPLICATIONS	24
3.1 National Flood Insurance Program Insurance Zones	24
3.2 Coastal Barrier Resources System	24
SECTION 4.0 – AREA STUDIED	25
4.1 Basin Description	25
4.2 Principal Flood Problems	25
4.3 Non-Levee Flood Protection Measures	27
4.4 Levees	27
SECTION 5.0 – ENGINEERING METHODS	28
5.1 Hydrologic Analyses	28
5.2 Hydraulic Analyses	35
5.3 Coastal Analyses	43
5.3.1 Total Stillwater Elevations	44
5.3.2 Waves	48
5.3.3 Coastal Erosion	48
5.3.4 Wave Hazard Analyses	48
5.4 Alluvial Fan Analyses	53
SECTION 6.0 – MAPPING METHODS	53
6.1 Vertical and Horizontal Control	53
6.2 Base Map	54
6.3 Floodplain and Floodway Delineation	55
6.4 Coastal Flood Hazard Mapping	63
6.5 FIRM Revisions	64

6.5.1	Letters of Map Amendment	65
6.5.2	Letters of Map Revision Based on Fill	65
6.5.4	Letters of Map Revision	65
6.5.3	Physical Map Revisions	66
6.5.4	Contracted Restudies	66
6.5.5	Community Map History	67
SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION		68
7.1	Contracted Studies	68
7.2	Community Meetings	70
SECTION 8.0 – ADDITIONAL INFORMATION		72
SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES		73

Figures

	<u>Page</u>
Figure 1: FIRM Panel Index	6
Figure 2: FIRM Notes to Users	7
Figure 3: Map Legend for FIRM	10
Figure 4: Floodway Schematic	18
Figure 5: Wave Runup Transect Schematic	21
Figure 6: Coastal Transect Schematic	23
Figure 7: Frequency Discharge-Drainage Area Curves	35
Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas	45
Figure 9: Transect Location Map	52

Tables

	<u>Page</u>
Table 1: Listing of NFIP Jurisdictions	3
Table 2: Flooding Sources Included in this FIS Report	15
Table 3: Flood Zone Designations by Community	24
Table 4: Coastal Barrier Resources System Information	25
Table 5: Basin Characteristics	25
Table 6: Principal Flood Problems	26
Table 7: Historic Flooding Elevations	26
Table 8: Non-Levee Flood Protection Measures	27
Table 9: Levees	27
Table 10: Summary of Discharges	31
Table 11: Summary of Non-Coastal Stillwater Elevations	35
Table 12: Stream Gage Information used to Determine Discharges	35
Table 13: Summary of Hydrologic and Hydraulic Analyses	39
Table 14: Roughness Coefficients	43
Table 15: Summary of Coastal Analyses	43

Table 16: Tide Gage Analysis Specifics	47
Table 17: Coastal Transect Parameters	50
Table 18: Summary of Alluvial Fan Analyses	53
Table 19: Results of Alluvial Fan Analyses	53
Table 20: Countywide Vertical Datum Conversion	54
Table 21: Stream-Based Vertical Datum Conversion	54
Table 22: Base Map Sources	55
Table 23: Summary of Topographic Elevation Data used in Mapping	56
Table 24: Floodway Data	58
Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams	63
Table 26: Summary of Coastal Transect Mapping Considerations	64
Table 27: Incorporated Letters of Map Change	66
Table 28: Community Map History	68
Table 29: Summary of Contracted Studies Included in this FIS Report	68
Table 30: Community Meetings	71
Table 31: Map Repositories	72
Table 32: Additional Information	73
Table 33: Bibliography and References	74

Volume 2
Exhibits

Flood Profiles	<u>Panel</u>
Belfast Siding Creek	01 P
Black Creek	02-07 P
Miles Branch	08-10 P
Mill Creek	11-12 P
Ogeechee River	13-21 P
Sterling Creek 1	22-23 P
Sterling Creek 2	24-27 P
Tivoli River	28 P
Tributary 1 to Elbow Swamp	29 P
Tributary 2 to Elbow Swamp	30 P
Tributary to Belfast Siding Creek	31 P

Volume 2
Exhibits

Transect Profiles	<u>Panel</u>
Transect 1	01-06 P
Transect 2	07-11 P
Transect 3	12-14 P
Transect 4	15-17 P
Transect 5	18-20 P
Transect 6	21-23 P
Transect 7	24-26 P
Transect 8	27-29 P
Transect 9	30-34 P
Transect 10	35-38 P

Published Separately

Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT BRYAN COUNTY, GEORGIA

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

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

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

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

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

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

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

the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as “Post-FIRM” buildings.

1.2 Purpose of this Flood Insurance Study Report

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

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

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Bryan County, Georgia.

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

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

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Bryan County, Unincorporated Areas	130016	03060202 03060203 03060204	13029C0025D 13029C0035D 13029C0040D 13029C0045D 13029C0055D 13029C0060D 13029C0065D 13029C0070D 13029C0080D 13029C0085D 13029C0090D 13029C0095D 13029C0125D 13029C0135D 13029C0150D 13029C0155D 13029C0175D 13029C0185E 13029C0200E 13029C0225E 13029C0250D 13029C0275E 13029C0276E 13029C0277E 13029C0278E 13029C0279E 13029C0283E 13029C0284E 13029C0285E 13029C0286E 13029C0287E 13029C0290E 13029C0291E 13029C0292E 13029C0295E 13029C0325E 13029C0335E 13029C0375E 13029C0400E 13029C0425E	

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
Pembroke, City of	130017	03060202 03060203	13029C0045D 13029C0065D 13029C0135D 13029C0155D	
Richmond Hill, City of	130018	03060203 03060204	13029C0277E 13029C0279E 13029C0283E 13029C0284E 13029C0286E 13029C0287E 13029C0290E 13029C0291E 13029C0292E 13029C0295E	

1.4 Considerations for using this Flood Insurance Study Report

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

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

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

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

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual

communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

The initial Countywide FIS Report for Bryan County became effective on March 2, 2009. Refer to Table 28 for information about subsequent revisions to the FIRMs.

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

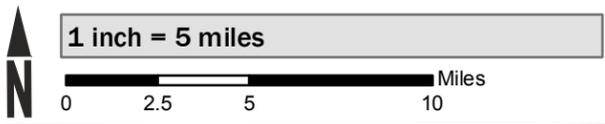
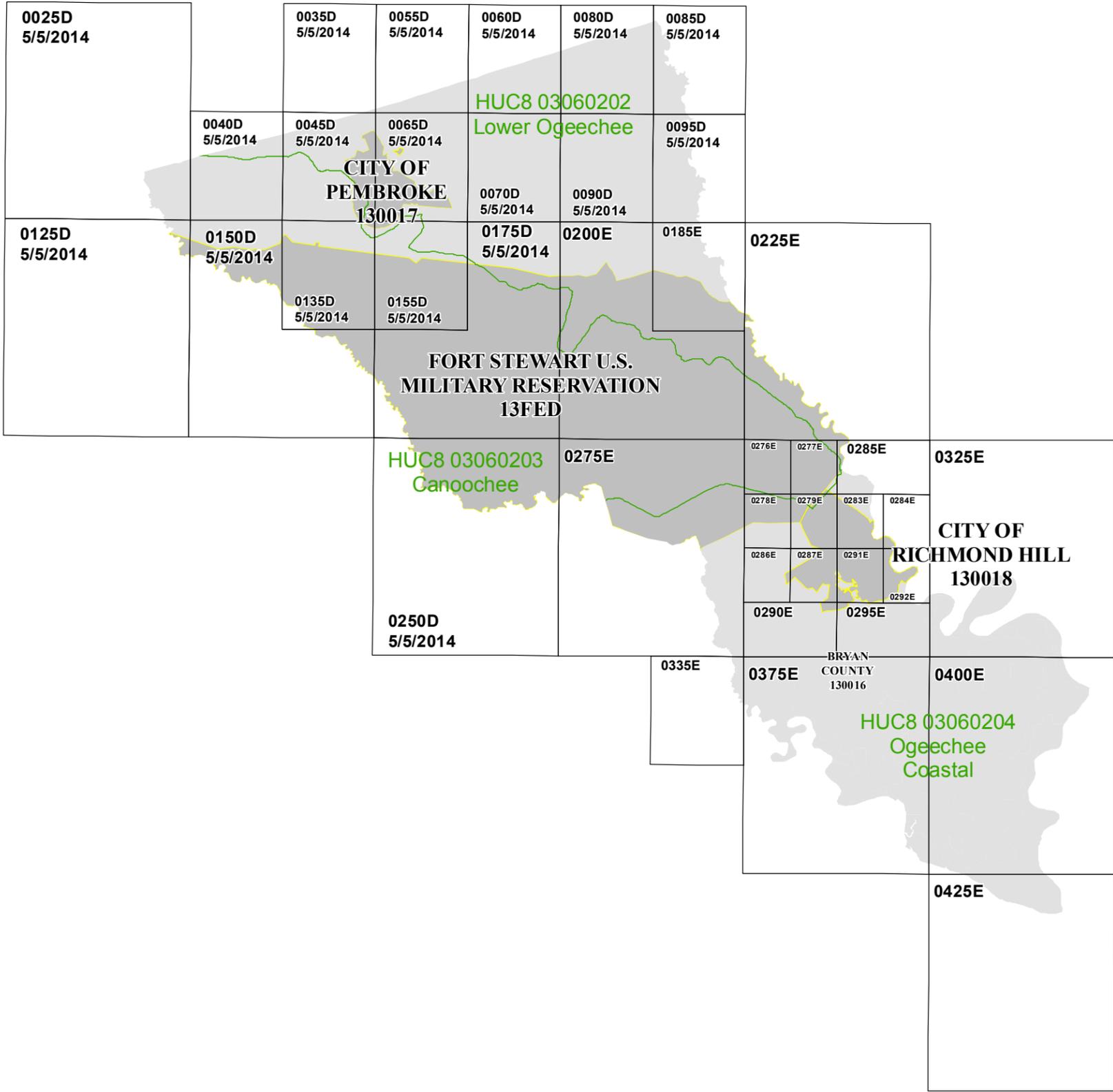
<u>Old Zone</u>	<u>New Zone</u>
A1 through A30	AE
V1 through V30	VE
B	X (shaded)
C	X (unshaded)

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

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

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

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Bryan 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 and flooding sources.



Map Projection:
 Universal Transverse Mercator Zone 17 North
 North American Datum 1983

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
[HTTP://MSC.FEMA.GOV](http://MSC.FEMA.GOV)

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP INDEX

BRYAN COUNTY, GEORGIA and Incorporated Areas

PANELS PRINTED:
 0025D, 0035D, 0040D, 0045D, 0055D, 0060D, 0065D, 0070D, 0080D, 0085D, 0090D, 0095D, 0125D, 0135D, 0150D, 0155D, 0175D, 0185E, 0200E, 0225E, 0250D, 0275E, 0276E, 0277E, 0278E, 0279E, 0283E, 0284E, 0285E, 0286E, 0287E, 0290E, 0291E, 0292E, 0295E, 0325E, 0335E, 0375E, 0400E, 0425E

PRELIMINARY
1/15/2016


 MAP NUMBER
 13029CIND1C
 MAP REVISED

Figure 1: FIRM Panel Index

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

Figure 2: FIRM Notes to Users

NOTES TO USERS

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

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

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

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

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

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

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 Coordinate System, Georgia East FIPS 1001. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

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

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

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

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by USDA National Aerial Imagery Program dated 2013 and with a resolution of 1 meter. 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 Bryan County, Georgia, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Bryan County, Georgia, effective January 15, 2016.

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

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

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

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

Figure 3: Map Legend for FIRM

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

Figure 3: Map Legend for FIRM

	Regulatory Floodway determined in Zone AE.
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
	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	
<p style="margin-left: 40px;"> <i>Aqueduct</i> <i>Channel</i> <i>Culvert</i> <i>Storm Sewer</i> </p>	Channel, Culvert, Aqueduct, or Storm Sewer
<p style="margin-left: 40px;"> <i>Dam</i> <i>Jetty</i> <i>Weir</i> </p>	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
<p style="margin-left: 40px;"> <i>Bridge</i> </p>	Bridge

Figure 3: Map Legend for FIRM

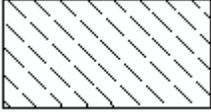
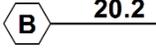
<p>COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): <i>CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.</i></p>	
 CBRS AREA 09/30/2009	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
 OTHERWISE PROTECTED AREA 09/30/2009	Otherwise Protected Area
<p>REFERENCE MARKERS</p>	
	River mile Markers
<p>CROSS SECTION & TRANSECT INFORMATION</p>	
	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
 	<p>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.</p> <p>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.</p>
	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	
 <i>Missouri Creek</i>	River, Stream or Other Hydrographic Feature
	Interstate Highway
	U.S. Highway
	State Highway
	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
4276⁰⁰⁰mE	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16' 52.5"	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

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

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

Depending on the accuracy of available topographic data (Table 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1% and 0.2% annual chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1% annual chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary is shown on the FIRM. 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 Bryan County, Georgia, respectively.

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

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

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 (Flooding controlled by Atlantic Ocean)	Bryan County, Unincorporated Areas; Richmond Hill, City of	Entire Coastline	Entire Coastline	03060204	24		N	VE, AE	2015
Belfast Siding Creek	Bryan County, Unincorporated Areas	Approximately 1,400 feet upstream of Belfast Siding Road	Just downstream of Seaboard Coastline Railroad	03060204	1.39		N	AE	2011
Black Creek	Bryan County, Unincorporated Areas	Confluence with Ogeechee River	State Highway 30/ U.S. Highway 280	03060202	5.73		N	AE	1980
Black Creek	Bryan County, Unincorporated Areas	From State Highway 30/ U.S. Highway 280	County Boundary	03060202	3.53		N	AE	2014
Elbow Swamp	Bryan County, Unincorporated Areas	From Sterling Creek 2	US Hwy 17	03060204	3.69		N	A	2014
Georges Branch	Bryan County, Unincorporated Areas	Confluence of Mill Creek	County Boundary	03060202	2.80		N	A	2014
Miles Branch	Bryan County, Unincorporated Areas	From confluence with Ogeechee River	Approximately 1,500 feet upstream of U.S. Highway 16 / State Highway 404	03060202	3.41		N	AE	2014
Mill Creek	Bryan County, Unincorporated Areas	confluence of Black Creek	Approximately 1,300 feet upstream of State Highway 30/ U.S. Highway 280	03060202	3.83		N	AE	2014

Table 2: Flooding Sources Included in this FIS Report - continued

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Mill Creek	Bryan County, Unincorporated Areas	Approximately 1,300 feet upstream of State Highway 30/ U.S. Highway 280	Pembroke City Limits	03060202	10.78		N	A	2014
Ogeechee River	Bryan County, Unincorporated Areas	Approximately 12,200 ft downstream of State Highway 204	Approximately 5.4 miles upstream of State Highway 204	03060202	7.7		N	AE	2014
Ogeechee River	Bryan County, Unincorporated Areas	Approximately 5.4 miles upstream of State Highway 204	County Boundary	03060202	13.4		N	AE	2014
Poplar Swamp	Bryan County, Unincorporated Areas	State Road 144	Interstate 95	03060204	3.71		N	A	2014
Sterling Creek 1	Bryan County, Unincorporated Areas	From U.S. highway 17	Interstate 95	03060204	1.77		Y	AE	2014
Sterling Creek 2	Bryan County, Unincorporated Areas	From U.S. highway 17	downstream of Harris Trail Road	03060204	4.45		Y	AE	2014
Tivoli River	Bryan County, Unincorporated Areas	Approximately 7.39 miles upstream of confluence with Belfast River	Approximately 8.55 miles upstream of confluence with Belfast River	03060204	1.16		N	AE	2003

Table 2: Flooding Sources Included in this FIS Report - continued

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Tributary 1 to Elbow Swamp	Bryan County, Unincorporated Areas	From Clarktown Road	Approximately 7,430 feet upstream	03060204	1.04		N	AE	2013
Tributary 2 to Elbow Swamp	Bryan County, Unincorporated Areas	Confluence with Tributary 1 to Elbow Swamp	Approximately 960 feet upstream	03060204	0.18		N	AE	2013
Tributary to Belfast Siding	Bryan County, Unincorporated Areas	At the confluence with Belfast Siding Creek	Just downstream of Interstate Highway 95/State Highway 405	03060204	0.48		N	AE	2011
Unnamed Flooding Source	Bryan County, Unincorporated Areas	Seaboard Coastline Railroad	Just downstream of Interstate Highway 95/State Highway 405	03060204	1.60		N	AH	2011

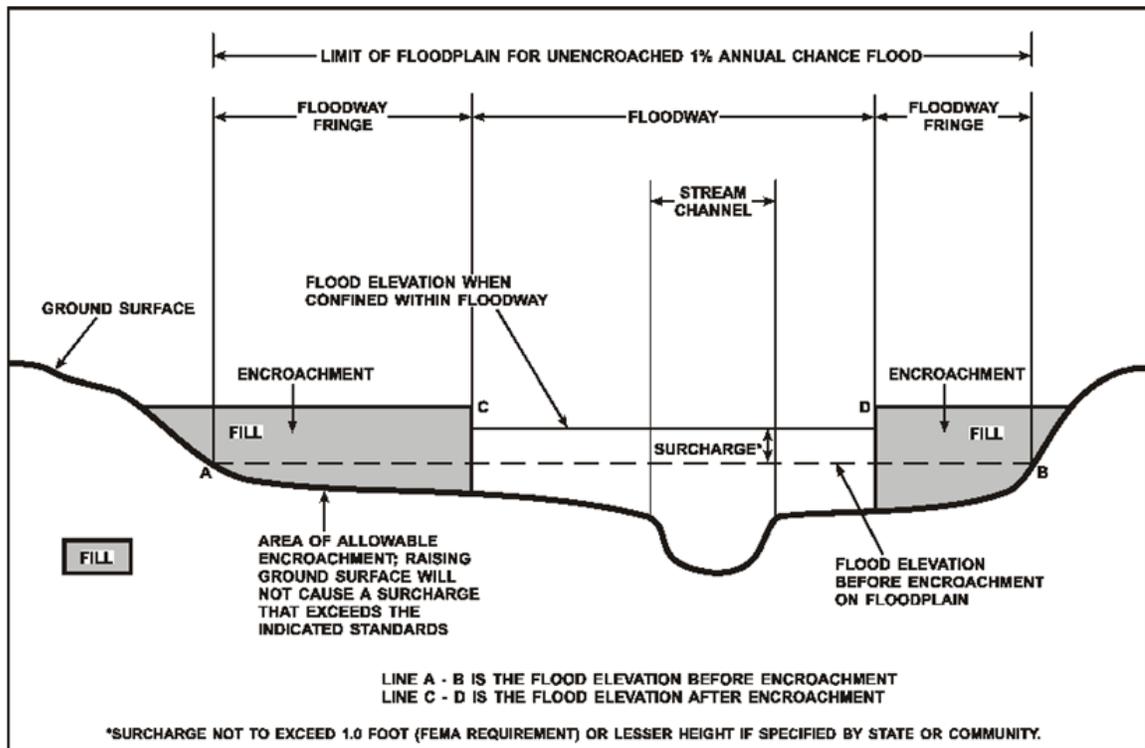
2.2 Floodways

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

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

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

Figure 4: Floodway Schematic



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

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

2.3 Base Flood Elevations

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

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

2.4 Non-Encroachment Zones

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

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

2.5 Coastal Flood Hazard Areas

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

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

2.5.1 Water Elevations and the Effects of Waves

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

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

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

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

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

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

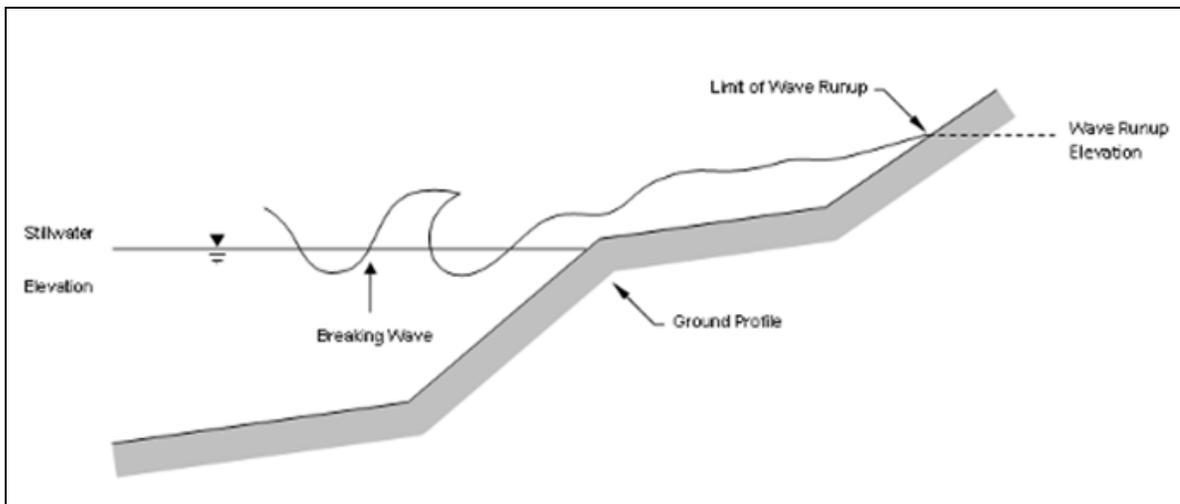
Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1% annual chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since tidal gages are often sited in areas sheltered from wave action and do not capture this information.

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

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

- *Overland wave propagation* describes the combined effects of variation in ground elevation, vegetation, and physical features on wave characteristics as waves move onshore.
- *Wave runup* is the uprush of water from wave action on a shore barrier. It is a function of the roughness and geometry of the shoreline at the point where the stillwater elevation intersects the land.
- *Wave overtopping* refers to wave runup that occurs when waves pass over the crest of a barrier.

Figure 5: Wave Runup Transect Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

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

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

Floodplain Boundaries

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

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

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

Coastal BFEs

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

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

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

2.5.3 Coastal High Hazard Areas

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

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

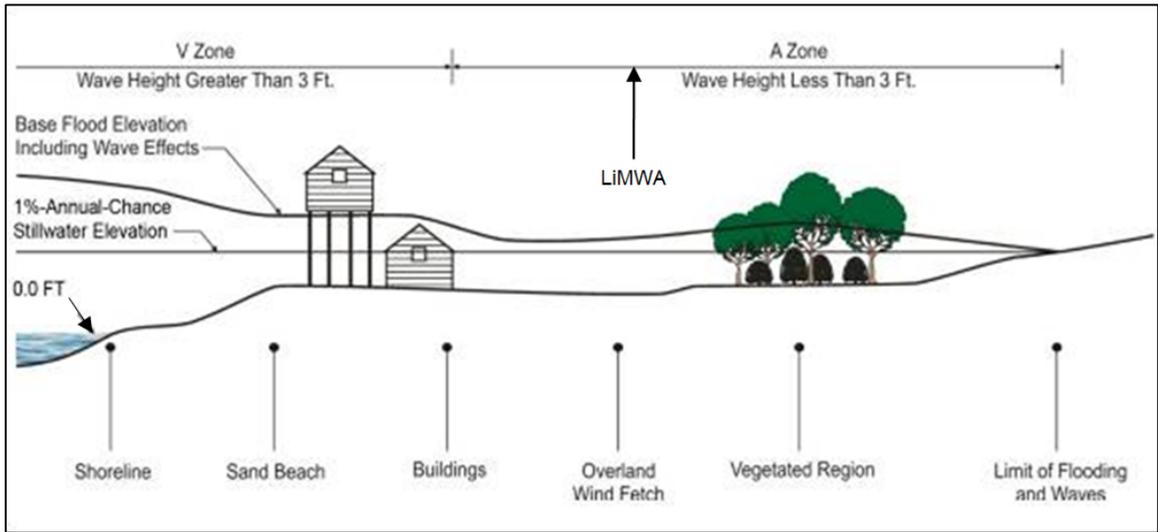
CHHAs are designated as “V” zones (for “velocity wave zones”) and are subject to more stringent regulatory requirements and a different flood insurance rate structure. The areas of greatest risk are shown as VE on the FIRM. Zone VE is further subdivided into elevation zones and shown with BFEs on the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

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

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

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

Figure 6: Coastal Transect Schematic



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

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

2.5.4 Limit of Moderate Wave Action

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

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

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

floodplain management requirements than the minimum NFIP requirements in the LiMWA. The NFIP Community Rating System provides credits for these actions.

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

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

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

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

Table 3 lists the flood insurance zones in Bryan County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Bryan County, Unincorporated Areas	A, AE, AH, VE, X
Pembroke, City of	A, X
Richmond Hill, City of	A, AE, X

3.2 Coastal Barrier Resources System

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

Table 4: Coastal Barrier Resources System Information

Primary Flooding Source	CBRS/OPA Type	Date CBRS Area Established	FIRM Panel Number(s)
Atlantic Ocean (flooding controlled by Atlantic Ocean)	OPA	11/16/1991	13029C0400E 13029C0425E

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

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

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Canoochee	03060203	Canoochee River, Clyde Creek, Malden Branch, Savage Creek	Begins at confluence with Ogeechee River, extends northwest, affecting one third of Flood County	N/A
Lower Ogeechee	03060202	Ogeechee River, Mill Creek	Encompasses the upper northeastern portion of Bryan County	N/A
Ogeechee Coastal	03060204	Atlantic Ocean (flooding controlled by Atlantic Ocean)	Coastal watershed within Bryan County	N/A

4.2 Principal Flood Problems

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

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
Atlantic Ocean (flooding controlled by Atlantic Ocean)	<p>The geographic location along the Atlantic Ocean places Bryan County in the hurricane path from storms originating in the warm tropical areas of the Atlantic Ocean, Caribbean Sea and the Gulf of Mexico. During this century, Bryan County has felt the effects of some hurricanes, but has not been in the direct path.</p> <p>Hurricanes normally occur in the summer and early fall months. According to the Environmental Science Services Administration (ESSA), major hurricanes have impacted the area in August 1911, September 1924, September 1928, September 1929, August 1940, October 1947, August and September 1964 (ESSA 1970a). In 2007 Georgia Emergency Management Agency (GEMA) published declared states of emergency associated with hurricanes and tropical storms occurring in October 1994, July and September 1996, September 1999, and September 2005 (GEMA 2007).</p> <p>The National Weather Service maintains a river gage on the Ogeechee River at Eden, Georgia (USACE 1975) and also makes daily river stage and flood forecasts at that location. Flood stage at Eden is 9.0 feet and the highest stage ever reported was 20.0 feet in October 1929. Other high stages recorded are 15.2 feet on April 1936, 14.2 feet on March 1939 and 14.7 feet on March 1944. A stage of 14 feet is known to cause crop damage. Stages greater than 14 feet in damages to fishing camps, houses, rural roads, pastures and lumber interests downstream of Eden. During heavy and prolonged rains, flooding occurs along small streams and low lying areas adjacent to populated areas of the County.</p>

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

Table 7: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Ogeechee River	Eden, Georgia	20.0	1929	N/A	USGS gage
Ogeechee River	Eden, Georgia	15.2	1936	N/A	USGS gage
Ogeechee River	Eden, Georgia	14.2	1939	N/A	USGS gage
Ogeechee River	Eden, Georgia	14.7	1944	N/A	USGS gage

4.3 Non-Levee Flood Protection Measures

This section is not applicable to this Flood Risk Project.

Table 8: Non-Levee Flood Protection Measures

[Not Applicable to this Flood Risk Project]

4.4 Levees

This section is not applicable to this Flood Risk Project.

Table 9: Levees

[Not Applicable to this Flood Risk Project]

SECTION 5.0 – ENGINEERING METHODS

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

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

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

5.1 Hydrologic Analyses

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

Precountywide FIS

For the Mill Creek and Black Creek studied in detail, discharge-frequency relationships for riverine flooding were based on the regional flood analysis as outlined in the USGS publication Open- File Report 76-511, titled Flood Frequency Analysis for Small Natural Streams in Georgia (USGS, 1976) This regional analysis is based on statistical computations of discharge records at various sites in Georgia, regressed against basin characteristics. The 0.2-percent-annual-chance discharge values were extrapolated from the lower frequency floods.

For the Tivoli River, peak discharges were estimated using published USGS regional regression equations (Stamey and Hess 1993).

March 2, 2009 Initial Countywide FIS

For approximate Zone A modeled streams peak discharges were estimated by published USGS regional regression equations (Stamey and Hess 1993).

May 5, 2014 Revised Countywide FIS

Approximately 172 stream miles of Approximate studies, 26 miles of Limited Detail study, and 39 miles of detailed study stream miles were studied as part of the revised analyses. The two-dimensional XPSWMM-2D software package (version 2011), gage analysis, and USGS regression equations were utilized for hydrologic modeling.

To obtain the 1% annual chance flow rate on the Canoochee River, a gage analysis of annual peak flow records at stream gage 02203000 – Canoochee River near Claxton, GA was performed. PEAKFQ-Win is a program produced by the USGS to evaluate the flood frequency of annual peak flow records according to the USGS's Bulletin 17-B, "Guidelines for Determining Flood Flow Frequency." The Canoochee River gage near Claxton, GA has an excellent historic record, with 73 years of peak flow data. The 1% annual chance flood (100-year) event at this gage site was calculated to be 16,490 cfs.

The inflow hydrographs, Tributary Number 1 of George's Branch and Black Creek were produced by running 2D simulations on adjacent Bulloch County, Georgia. Trib 1 on George's Branch is a very small watershed, and the resulting hydrograph of 370 cfs was directly imported from the Bulloch County 2D model.

The inflow hydrograph on Black Creek, however, was developed in a slightly different fashion. The 100-year peak discharge value from Black Creek upstream of Bryan County was 42,102 cfs. This discharge value falls outside (on the high side) of the confidence intervals of the regional flood frequency curve. Just downstream of the Bulloch/Bryan County boundaries is gage #02202600, Black Creek near Blitchton, GA. With 31 years of data, PeakFQ gives a 1% annual chance flood event (100-year) of 17,890 cfs.

For streams modeled using the detail method, peak discharges were estimated using USGS regression equations (USGS 2009).

Countywide Revision

For streams studied by detail, limited detail, and approximate methods, the two-dimensional XPSWMM-2D software package (version 2011), gage analysis, and USGS regression equations were utilized for hydrologic modeling.

To obtain the 1% annual chance flow rate on the Canoochee River, a gage analysis of annual peak flow records at stream gage 02203000 - Canoochee River near Claxton, GA was performed. PEAKFQ-Win is a program produced by the USGS to evaluate the flood frequency of annual peak flow records according to the USGS's Bulletin 17-B, "Guidelines for Determining Flood Flow Frequency." The Canoochee River gage near Claxton, GA has an excellent historic record, with 73 years of peak flow data. The 1% annual chance flood (100-year) event at this gage site was calculated to be 16,490 cfs.

For streams modeled using the detail method, peak discharges were estimated using USGS regression equations (USGS 2009).

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

Table 10: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
BLACK CREEK	At confluence with Ogeechee River	296.0	6,200	*	10,100	12,350	*	17,700
BLACK CREEK	Just downstream of confluence of Mill Creek	292.8	6,050	*	9,850	12,050	*	17,000
BLACK CREEK	Just upstream of confluence of Mill Creek	231.0	4,999	*	8,093	9,633	*	13,133
BLACK CREEK	2,000 feet downstream of 3rd Avenue at State Highway 30 / U.S. Highway 280	228.0	4,959	*	8,030	9,559	*	13,033
BLACK CREEK	At county boundary	217.0	4,810	*	7,795	9,282	*	12,662
BELFAST SIDING CREEK	Approximately 1,120 feet upstream of Belfast Siding Road	2.5	*	*	*	543	*	*
BELFAST SIDING CREEK	Just upstream of the confluence of Tributary to Belfast Siding Creek	0.6	*	*	*	276	*	*
BELFAST SIDING CREEK	Just downstream of Seaboard Coastline Railroad	0.2	*	*	*	65	*	*
MILES BRANCH	At the confluence with Ogeechee River	3.6	381	*	662	808	*	1,153
MILES BRANCH	Immediate downstream of State Highway 80	2.2	281	*	492	602	*	864
MILL CREEK	At confluence with Black Creek	60.2	2,181	*	3,612	4,334	*	5,996

Table 10: Summary of Discharges - continued

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
MILL CREEK	Approximately 7,080 feet upstream of Black Creek Church Road	34.5	1,547	*	2,587	3,115	*	4,336
MEDWAY / LAURELVIEW / JERICO RIVER	At the Atlantic Ocean	158.0	4,300	*	6,900	8,400	*	11,100
MEDWAY / LAURELVIEW / JERICO RIVER	At Seaboard Coastline Railroad	77.0	2,800	*	4,500	5,450	*	7,400
OGEECHEE RIVER	Approximately 12,000 ft downstream of State Highway 204	3004.0	29,002	*	46,367	54,756	*	76,408
OGEECHEE RIVER	Just upstream of confluence of Black Creek	2982.0	28,806	*	46,023	54,350	*	75,842
OGEECHEE RIVER	Just downstream of State Highway 80	2650.0	25,600	*	40,900	48,300	*	67,400
OGEECHEE RIVER	At county boundary	2647.0	25,569	*	40,850	48,241	*	67,318
STERLING CREEK 1	Just downstream of Interstate Highway 95 / State Highway 405	1.3	206		363	446	*	644
STERLING CREEK 2	Just downstream of Harris Trail	13.8	879	*	1,492	1,807	*	2,540
STERLING CREEK 2	Just downstream of Timber Trail	2.8	328	*	573	700	*	1,002
STERLING CREEK 2	Just downstream of State Highway 17/25	1.9	259	*	454	556	*	800

Table 10: Summary of Discharges - continued

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
TIVOLI RIVER	Approximately 39,000 feet upstream of confluence with Belfast River	1.4	*	*	*	420	*	*
TIVOLI RIVER	Approximately 45,150 feet upstream of confluence with Belfast River	0.1	*	*	*	80	*	*
TRIBUTARY 1 TO ELBOW SWAMP	Approximately 1,550 feet downstream of Clarktown Road	0.5	*	*	*	165	*	*
TRIBUTARY 1 TO ELBOW SWAMP	Approximately 4,465 feet downstream of Clarktown Road	0.4	*	*	*	106	*	*
TRIBUTARY 1 TO ELBOW SWAMP	Approximately 2,720 feet downstream of Clarktown Road	0.1	*	*	*	66	*	*
TRIBUTARY 2 TO ELBOW SWAMP	Approximately 800 feet downstream of confluence with Tributary 1 to Elbow Swamp	0.1	*	*	*	63	*	*
TRIBUTARY 2 TO ELBOW SWAMP	Approximately 800 feet downstream of confluence with Tributary 1 to Elbow Swamp	0.1	*	*	*	56	*	*
TRIBUTARY TO BELFAST SIDING CREEK	Just upstream of confluence with Belfast Siding Creek	1.8	*	*	*	358	*	*

Table 10: Summary of Discharges - continued

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
TRIBUTARY TO BELFAST SIDING CREEK	Just downstream of Interstate Highway 95 / State Highway 405	1.5	*	*	*	278	*	*

*Not calculated for this Flood Risk Project

Figure 7: Frequency Discharge-Drainage Area Curves

[Not Applicable to this Flood Risk Project]

Table 11: Summary of Non-Coastal Stillwater Elevations

[Not Applicable to this Flood Risk Project]

Table 12: Stream Gage Information used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
Canoochee River	02203000	USGS	Canoochee River near Claxton, GA	N/A	N/A	N/A
Black Creek	02202600	USGS	Black Creek near Blitchton, GA	N/A	N/A	N/A

5.2 Hydraulic Analyses

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

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

Precountywide FIS

Cross sections for the backwater analyses of the Ogeechee River, Black Creek and Mill Creek were obtained from the aerial photographs flown in June 1979 at a scale of 1:9,600 (Abrams Aerial Survey Corporation, 1979). The below-water sections were obtained by field

measurement. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry.

Water-surface elevations (WSELs) of floods of the selected recurrence intervals for Black Creek and Mill Creek computed using the USACE Hydrologic Engineering Center HEC-2 step-backwater computer program (HEC, 1976). Flood profiles were drawn showing the computed WSELs for floods of the selected recurrence intervals.

HEC-RAS, Version 3.0.1 (HEC 2001) was used to compute the WSELs for the Tivoli River.

Starting WSELs for Black Creek, Mill Creek, and Tivoli River were calculated using the slope-area method.

March 2, 2009 Initial Countywide FIS

For streams studied by approximate methods, the models do not include field surveys that determine the specifics of channel and floodplain geometry. The digitized USGS quadrangle topographic contours dataset was used for the development of geometric data for the hydraulic models and floodplain mapping for the approximately studied streams. Low flow channels were added to the cross section data at selected points along the studied streams. HEC-GeoRAS was used to generate preprocessing data.

May 5, 2014 Revised Countywide FIS

Approximately 172 stream miles of Approximate studies, 26 miles of Limited Detail study, and 39 miles of detailed study stream miles were studied as part of the revised analyses. The two-dimensional XPSWMM-2D software package (version 2011) and HEC-RAS version 4.1.0 were utilized for hydraulic modeling.

One-dimensional channels were imbedded into the 2D model to represent the channel Portion of the Limited Detail studied under the revised study. For Limited Detail streams, the survey team only measured the structure opening, not actual elevation data. This arrangement is slightly different than a typical HEC-RAS bridge geometry editor. For bridges that were surveyed, typically two components were entered into XP-SWMM. First, the channel geometry was entered, including the bridge piers (if any). The second component would describe the bridge deck and low chord of the bridge.

In addition to bridges that were surveyed, a number of channel cross-sections were surveyed for the detailed study streams, as well. Between surveyed cross-sections, we utilized a tool that linearly interpolates the five cross-section points that describe a channel within its banks. All model links within the 1D model without channel survey data were defined with channel cross-sections cut from the LIDAR data with interpolated channels.

Since subcritical flow regime was assumed for all 1D channels, downstream boundary conditions are required. In accordance with FEMA guidelines Appendix C, the starting water surface elevation chosen for profile computations were based on normal depth method. Manning's n values for both the channel and overbanks were entered into the hydraulic model to represent the values that were estimated from aerial photography from ESRI Servers. Manning's n roughness parameters were set to 0.05 for channels and 0.12 for overbank areas for all 1D streams.

The hydraulic modeling for Black Creek, Miles Branch, Mill Creek, and Ogeechee River are based on detailed, steady state, one dimensional models using the USACE, HEC-RAS software, version 4.1.0. A 2' Digital Elevation Model (DEM) extracted from the Terrain dataset was used to extract cross-section station data, with the exception of Sterling Creeks 1 & 2 which used 10' DEM in the non-revised panel areas. To supplement the digital topography data, field surveyed cross-section and road crossing data was incorporated in the hydraulics models. The hydraulic structures were assumed to be unobstructed. Known water surface elevations from the downstream effective study were utilized as a boundary condition for Black Creek model. Normal depth was used as a boundary condition for all other streams.

Countywide Revision

For detail, limited detail, and approximate study streams, the two-dimensional XPSWMM-2D software package (version 2011) and HEC-RAS version 4.1.0 were utilized for hydraulic modeling.

One-dimensional channels were imbedded into the 2D model to represent the channel Portion of the Limited Detail studied under the revised study. For Limited Detail streams, the survey team only measured the structure opening, not actual elevation data. This arrangement is slightly different than a typical HEC-RAS bridge geometry editor. For bridges that were surveyed, typically two components were entered into XP-SWMM. First, the channel geometry was entered, including the bridge piers (if any). The second component would describe the bridge deck and low chord of the bridge.

In addition to bridges that were surveyed, a number of channel cross-sections were surveyed for the detailed study streams, as well. Between surveyed cross-sections, we utilized a tool that linearly interpolates the five cross-section points that describe a channel within its banks. All model links within the 1D model without channel survey data were defined with channel cross-sections cut from the LIDAR data with interpolated channels.

Since subcritical flow regime was assumed for all 1D channels, downstream boundary conditions are required. In accordance with FEMA guidelines Appendix C, the starting water surface elevation chosen for profile computations were based on normal depth method. Manning's n values for both the channel and overbanks were entered into the hydraulic model to represent the values that were estimated from aerial photography from ESRI Servers. Manning's n roughness parameters were set to 0.05 for channels and 0.12 for overbank areas for all 1D streams.

The hydraulic modeling for Ogeechee River are based on detailed, steady state, one dimensional models using the USACE, HEC-RAS software, version 4.1.0. A 2' Digital Elevation Model (DEM) extracted from the Terrain dataset was used to extract cross-section station data, with the exception of Sterling Creeks 1 & 2 which used 10' DEM in the non-revised panel areas. To supplement the digital topography data, field surveyed cross-section and road crossing data was incorporated in the hydraulics models. The hydraulic structures were assumed to be unobstructed. Known water surface elevations from the downstream effective study were utilized as a boundary condition for Black Creek model. Normal depth was used as a boundary condition for all other streams.

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 13. Roughness coefficients are provided in Table 14. Roughness coefficients are values

representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 13: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Belfast Siding Creek	Approximately 1,400 feet upstream of Belfast Siding Road	Just downstream of Seaboard Coastline Railroad	HEC-RAS	HEC-RAS	2011	AE	
Black Creek	Confluence with Ogeechee River	State Highway 30/ U.S. Highway 280	USGS regional flood analysis	HEC-2 step- backwater computer program	1980	AE	
Black Creek	From State Highway 30/ U.S. Highway 280	County Boundary	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	
Elbow Swamp	From Sterling Creek 2	US Hwy 17	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	A	
Georges Branch	Confluence of Mill Creek	County Boundary	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	A	
Miles Branch	From confluence with Ogeechee River	Approximately 1,500 feet upstream of U.S. Highway 16 / State Highway 404	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	

Table 13: Summary of Hydrologic and Hydraulic Analyses - continued

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Mill Creek	confluence of Black Creek	Approximately 1,300 feet upstream of State Highway 30/ U.S. Highway 280	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	
Mill Creek	Approximately 1,300 feet upstream of State Highway 30/ U.S. Highway 280	Pembroke City Limits	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	A	
Ogeechee River	Approximately 12,200 ft downstream of State Highway 204	Approximately 5.4 miles upstream of State Highway 204	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	
Ogeechee River	Approximately 5.4 miles upstream of State Highway 204	County Boundary	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	
Poplar Swamp	State Road 144	Interstate 95	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	A	

Table 13: Summary of Hydrologic and Hydraulic Analyses - continued

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Sterling Creek 1	From U.S. highway 17	Interstate 95	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	
Sterling Creek 2	From U.S. highway 17	downstream of Harris Trail Road	XPSWMM-2D (version 2011)	XPSWMM- 2D (version 2011) and HEC-RAS version 4.1.0	2014	AE	
Tivoli River	Approximately 7.39 miles upstream of confluence with Belfast River	Approximately 8.55 miles upstream of confluence with Belfast River	USGS regional regression equations	HEC-RAS version 3.0.1	2003	AE	
Tributary 1 to Elbow Swamp	From Clarktown Road	Approximately 7,430 feet upstream	HEC-RAS	HEC-RAS	2013	AE	
Tributary 2 to Elbow Swamp	From Clarktown Road	Approximately 7,430 feet upstream	HEC-RAS	HEC-RAS	2013	AE	
Tributary to Belfast Siding	At the confluence with Belfast Siding Creek	Just downstream of Interstate Highway 95/State Highway 405	HEC-RAS	HEC-RAS	2011	AE	

Table 13: Summary of Hydrologic and Hydraulic Analyses - continued

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Unnamed Flooding Source	Seaboard Coastline Railroad	Just downstream of Interstate Highway 95/State Highway 405	HEC-RAS	HEC-RAS	2011	AH	

Table 14: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Black Creek	0.050	0.100-0.120
Miles Branch	0.035-0.060	0.013-0.200
Mill Creek	0.05	0.120
Ogeechee River	0.026-0.065	0.045-0.200
Sterling Creek 1	0.05-0.040	0.035-0.015
Sterling Creek 2	0.050	0.060-0.18
Tivoli River	0.040	0.150

5.3 Coastal Analyses

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

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

Table 15: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Atlantic Ocean	Entire coastline of Bryan County	Entire coastline of Bryan County	Storm Climatology Statistical Analyses	JPM-OS	10/7/2013
Atlantic Ocean	Entire coastline of Bryan County	Entire coastline of Bryan County	Storm Surge including Regional Wave Setup	ADCIRC + SWAN	10/7/2013
Atlantic Ocean	Entire coastline of Bryan County	Entire coastline of Bryan County	Stillwater Frequency Analysis	SURGESTAT (low frequency); Regional Tidal Frequency Analysis (high frequency)	11/21/2013
Atlantic Ocean	Entire coastline of Bryan County	Entire coastline of Bryan County	Dune Erosion	FEMA's Erosion Assessment	1/30/2015

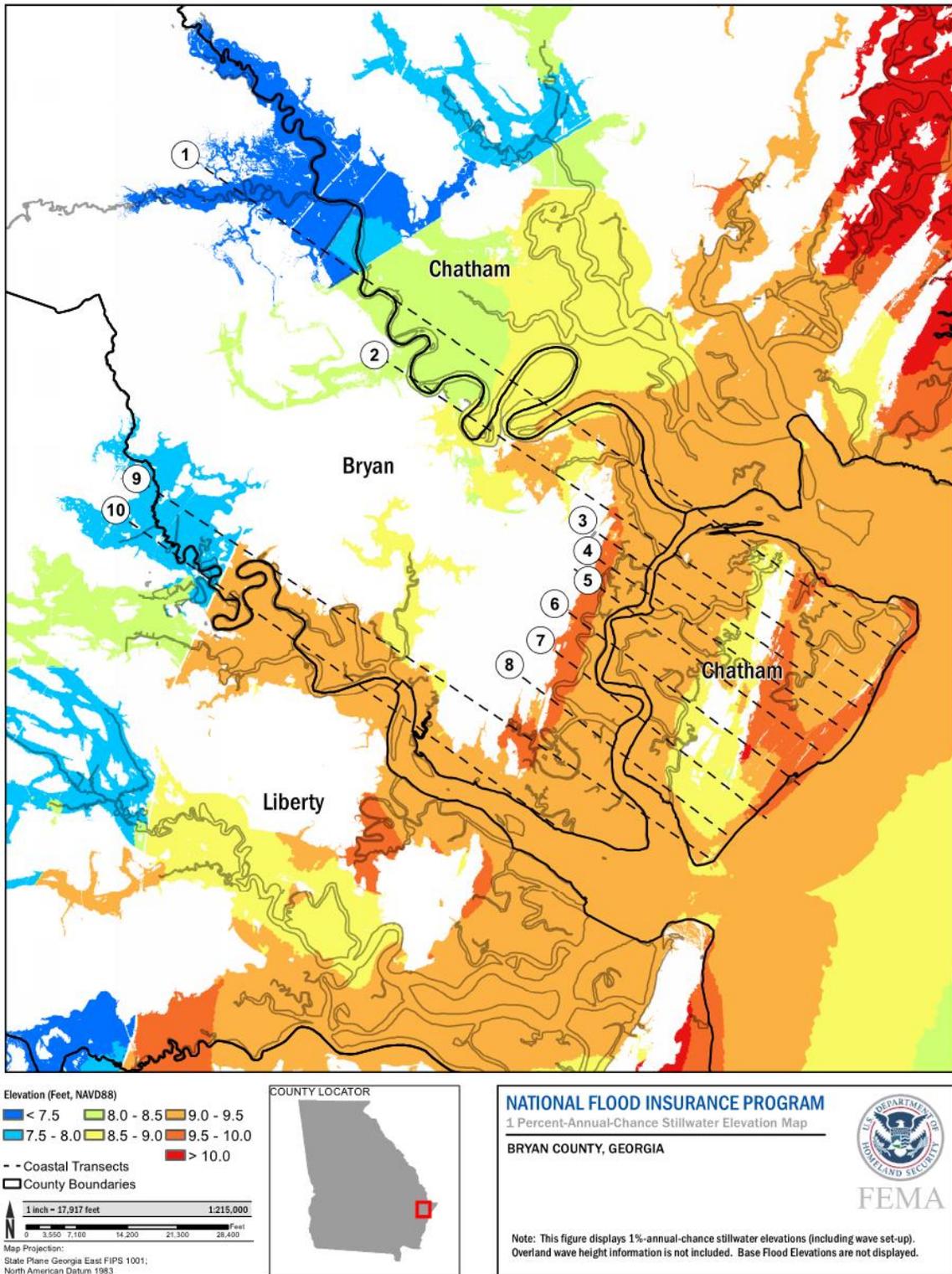
Table15: Summary of Coastal Analyses - continued

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Atlantic Ocean	Entire coastline of Bryan County	Entire coastline of Bryan County	Overland Wave Propagation	WHAFIS	1/30/2015
Atlantic Ocean	Entire coastline of Bryan County	Entire coastline of Bryan County	Wave Runup	N/A	N/A

5.3.1 Total Stillwater Elevations

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

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



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 with hydrodynamic models to determine storm surge levels.

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

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

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

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

Table 16: Tide Gage Analysis Specifics

Gage Name	Managing Agency of Tide Gage Record	Gage Type	Start Date	End Date	Statistical Methodology
Charleston - 8665530	NOAA	Tide	1899	Present	L-moments, GEV
Fort Pulaski - 8670870	NOAA	Tide	1935	Present	L-moments, GEV
Fernandina Beach - 8720030	NOAA	Tide	1898	Present	L-moments, GEV
Mayport Ferry Depot - 8720220	NOAA	Tide	1928	2008	L-moments, GEV
St Augustine - 8720587	NOAA	Tide	1992	2004	L-moments, GEV
Daytona Beach Shores - 8721120	NOAA	Tide	1966	1984	L-moments, GEV
Trident Pier - 8721604	NOAA	Tide	1994	Present	L-moments, GEV
Lake Worth Pier - 8722670	NOAA	Tide	1970	Present	L-moments, GEV
Miami Beach - 8723170	NOAA	Tide	1931	1981	L-moments, GEV
Virginiaia Key - 8713214	NOAA	Tide	1994	Present	L-moments, GEV

Combined Riverine and Tidal Effects

A combined probability 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 Bryan County, combined probability calculations were performed for Sterling Creek 2.

Wave Setup Analysis

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

5.3.2 Waves

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

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated to determine the modification to existing topography that is expected to be associated with flooding events. Erosion was evaluated using the methods listed in Table 15. The post-event eroded profile was used for the subsequent 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 runoff. These analyses were performed at representative transects along all shorelines for which waves were expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1% annual chance flood.

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

Wave Height Analysis

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

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

Wave Runup Analysis

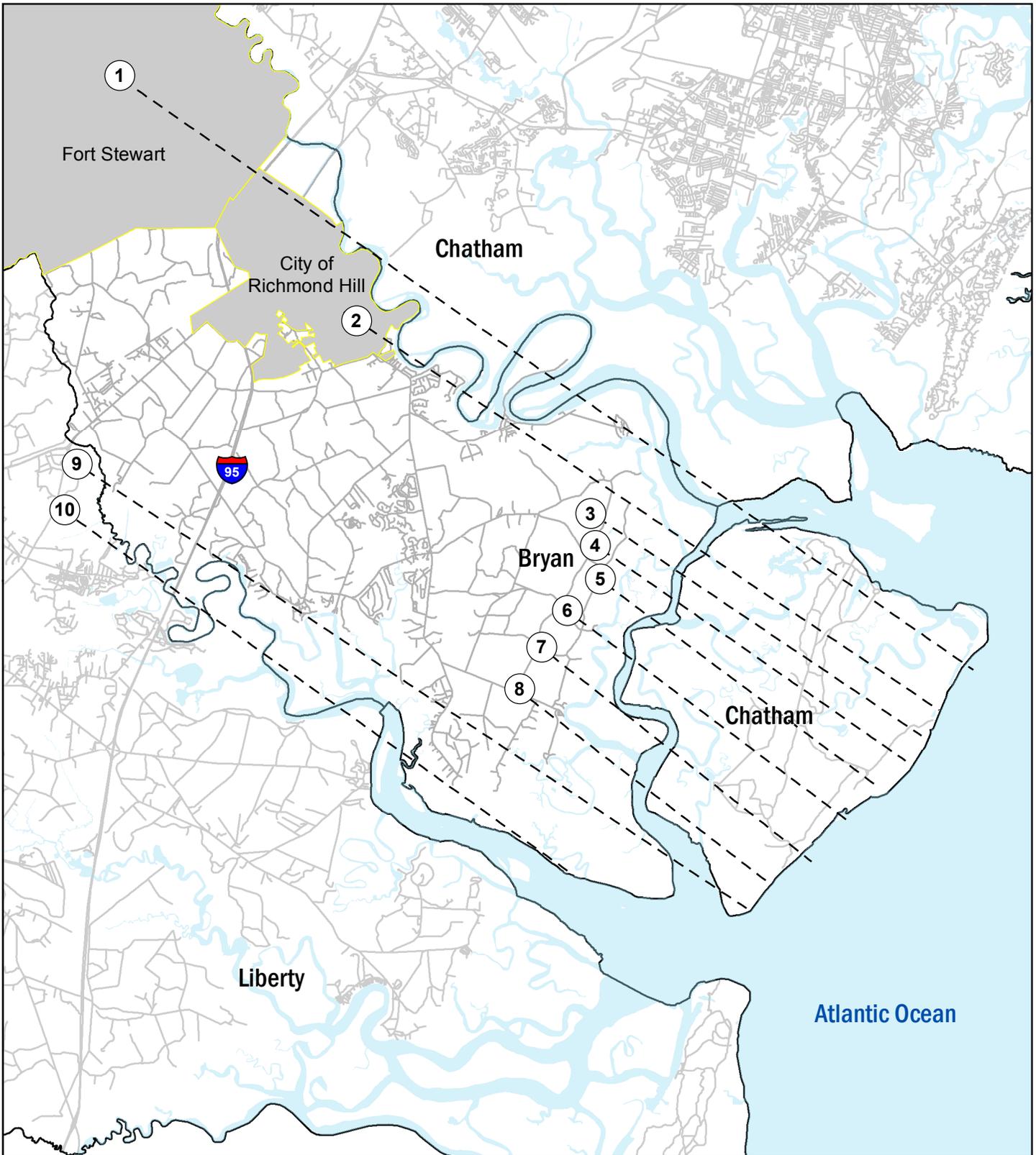
Wave runup analyses were performed to determine the height and extent of runup beyond the limit of stillwater inundation for the 1% annual chance flood. Wave runup elevations were modeled using the methods and models listed in Table 15.

Table 17: Coastal Transect Parameters

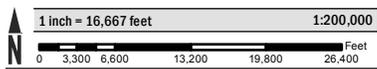
Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H _s (ft)	Peak Wave Period T _p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	1	17.5	11.4	6.2 3.6 - 6.5	6.7 3.9 - 6.9	8.3 4.8 - 8.6	9.5 6.6 - 9.9	13.8 8.8 - 14.1
Atlantic Ocean	2	17.1	11.4	6.1 4.8 - 6.4	6.6 5.2 - 6.9	8.4 6.4 - 8.5	9.7 8.3 - 9.8	14.0 12.6 - 14.6
Atlantic Ocean	3	16.8	12.3	6.1 5.7 - 6.4	6.6 6.1 - 6.9	8.3 7.6 - 8.5	9.6 8.9 - 9.8	14.1 12.8 - 14.9
Atlantic Ocean	4	16.5	11.4	6.1 5.4 - 6.5	6.6 5.8 - 6.9	8.3 7.2 - 8.6	9.5 8.9 - 9.8	14.0 12.6 - 15.0
Atlantic Ocean	5	16.9	11.6	6.1 5.9 - 6.4	6.6 6.2 - 6.9	8.2 7.7 - 8.5	9.5 9.0 - 9.9	14.0 12.5 - 15.1
Atlantic Ocean	6	17.6	11.7	6.1 5.8 - 6.5	6.6 6.2 - 6.9	8.2 7.4 - 8.6	9.6 8.8 - 10.1	14.0 12.7 - 15.2
Atlantic Ocean	7	17.6	11.4	6.1 5.7 - 6.3	6.5 6.0 - 6.8	8.2 7.5 - 8.4	9.3 8.7 - 9.7	13.5 13.1 - 15.2

Table 17: Coastal Transect Parameters - continued

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H _s (ft)	Peak Wave Period T _p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean	8	17.8	11.6	6.1 5.8 - 6.2	6.5 6.2 - 6.7	8.2 7.7 - 8.3	9.4 9.0 - 9.7	13.8 13.0 - 15.2
Atlantic Ocean	9	17.6	11.4	6.1 4.7 - 6.2	6.5 5.0 - 6.7	7.9 6.4 - 8.3	9.1 7.8 - 9.7	13.1 10.8 - 15.2
Atlantic Ocean	10	17.5	12.0	6.1 4.5 - 6.1	6.5 4.8 - 6.5	8.0 6.1 - 8.1	9.2 7.7 - 9.3	13.9 10.6 - 14.2



Elevation (Feet, NAVD88)



Map Projection:
State Plane Georgia East FIPS 1001;
North American Datum 1983



NATIONAL FLOOD INSURANCE PROGRAM

Transect Location Map

BRYAN COUNTY, GEORGIA



FEMA

Figure 9: Transect Location Map

5.4 Alluvial Fan Analyses

This section is not applicable to this Flood Risk Project.

Table 18: Summary of Alluvial Fan Analyses

[Not Applicable to this Flood Risk Project]

Table 19: Results of Alluvial Fan Analyses

[Not Applicable to this Flood Risk Project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

All FIS Reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS Reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS Reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

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

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

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

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

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

Table 20: Countywide Vertical Datum Conversion

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from NGVD29 to NAVD88 (feet)
Daisy	SE	32.125	81.750	-0.778
Groveland	SE	32.125	81.625	-0.820
Lanier	SE	32.125	81.500	-0.833
Eden	SE	32.125	81.375	-0.853
Willie	SE	32.000	81.625	-0.886
Letford	SE	32.000	81.500	-0.912
Meldrim SW	SE	32.000	81.375	-0.922
Limerick NW	SE	31.875	81.375	-0.981
Richmond Hill	SE	31.875	81.250	-0.928
Burroughs	SE	31.875	81.125	-0.928
Limerick SE	SE	31.750	81.250	-0.955
Oak Level	SE	31.750	81.125	-0.955
Stilson	SE	32.250	81.500	-0.794
Average Conversion from NGVD29 to NAVD88 = -0.888 feet				

Table 21: Stream-Based Vertical Datum Conversion

[Not Applicable to this Flood Risk Project]

6.2 Base Map

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

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

Table 22: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
Digital Orthophoto	USDA NAIP	2013	1 meter	Color orthoimagery for Bryan County
Digital Orthophoto	USDA NAIP	2010	1 meter	Color orthoimagery for Bryan County
Political boundaries	Georgia Department of Transportation	2007	1:100,000	Municipal and county boundaries
Transportation Features	Georgia Department of Transportation	2011	1:100,000	Roads
Hydrography	Georgia Department of Transportation	1996	1:100,000	Water bodies
Stream Centerlines	GA DNR	February 2008 or later	1"=6,000'	Developed using 2-foot contours and aerial photographs

6.3 Floodplain and Floodway Delineation

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

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

In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The floodway widths presented in this FIS Report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 24, "Floodway Data."

Certain flooding sources may have been studied that do not have published BFEs on the FIRMs, or for which there is a need to report the 1% annual chance flood elevations at selected cross sections

because a published Flood Profile does not exist in this FIS Report. These streams may have also been studied using methods to determine non-encroachment zones rather than floodways. For these flooding sources, the 1% annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23. All topographic data used for modeling or mapping has been converted as necessary to NAVD88. The 1% annual chance elevations for selected cross sections along these flooding sources, along with their non-encroachment widths, if calculated, are shown in Table 25, “Flood Hazard and Non-Encroachment Data for Selected Streams.”

Table 23: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data					
		Description	Scale	Contour Interval	RMSE _z	Accuracy _z	Citation
Bryan County, Unincorporated Areas	Approximate Streams	Topographic Maps	1:24,000	10 ft	N/A	N/A	USGS 2000
Entire Coastline of Bryan County	Atlantic Ocean	LiDAR	N/A	N/A	18 cm	35.28 cm	PhotoScience & Fugro EarthData 2010
Bryan County, Unincorporated Areas	Black Creek	Quadrangle Maps	Enlarged to 1:12,000 and 1:24,000	10 ft	N/A	N/A	USGS various dates (b)
Bryan County, Unincorporated Areas	Black Creek	Aerial Photographs	1:9,600	2 ft	N/A	N/A	Abrams Aerial Survey Corporation 1979
Bryan County, Unincorporated Areas	Miles Branch	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Bryan County, Unincorporated Areas	Mill Creek	Aerial Surveys	1:9,600	2 ft	N/A	N/A	Abrams Aerial Survey Corporation 1979
Bryan County, Unincorporated Areas	Ogeechee River	Quadrangle Maps	Enlarged to 1:12,000 and 1:24,000	10 ft	N/A	N/A	USGS various dates (b)

Table 23: Summary of Topographic Elevation Data used in Mapping - continued

Community	Flooding Source	Source for Topographic Elevation Data					
		Description	Scale	Contour Interval	RMSE _z	Accuracy _z	Citation
Bryan County, Unincorporated Areas	Sterling Creek 1	Topographic Maps	1:3,600	1 ft	N/A	N/A	Stevenson & Palmer Engineering, Inc., updated
Bryan County, Unincorporated Areas	Sterling Creek 2	Aerial Surveys	1:9,600	2 ft	N/A	N/A	Abrams Aerial Survey Corporation 1979
Bryan County, Unincorporated Areas	Tivoli River	Aerial Surveys	1:9,600	2 ft	N/A	N/A	Abrams Aerial Survey Corporation 1979
Bryan County, Unincorporated Areas	Tributary 1 to Elbow Swamp	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Bryan County, Unincorporated Areas	Tributary 2 to Elbow Swamp	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Bryan County, Unincorporated Areas	Tributary to Belfast Siding	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Bryan County, Unincorporated Areas	Unnamed Flooding Source	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available

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

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BLACK CREEK								
A	600	2,722	19,686	0.6	27.2	26.1 ²	27.1	1.0
B	3,040	1,960	16,538	0.7	28.4	26.6 ²	27.6	1.0
C	5,040	2,300	16,816	0.7	28.8	27.0 ³	28.0	1.0
D	7,170	2,560	19,673	0.6	28.8	27.6 ³	28.6	1.0
E	10,540	2,516	22,858	0.5	28.8	28.0 ³	29.0	1.0
F	12,550	3,060	15,708	0.8	28.8	28.4 ³	29.4	1.0
G	12,770	2,987	21,559	0.6	30.8	30.8	31.4	0.6
H	15,080	2,002	16,930	0.7	31.3	31.3	32.0	0.7
I	21,460	1,543	13,014	0.9	33.0	33.0	33.8	0.8
J	24,500	1,621	17,793	0.7	33.8	33.8	34.7	0.9
K	27,250	1,197	13,344	0.8	34.3	34.3	35.2	0.9
L	29,320	1,301	11,822	0.9	34.7	34.7	35.6	0.9
M	32,070	1,539	11,030	1.0	36.1	36.1	37.1	1.0
N	35,680	981	8,350	1.3	37.7	37.7	38.7	1.0
O	40,200	916	12,341	0.9	38.1	38.1	39.1	1.0
P	42,590	864	6,204	1.7	38.2	38.2	39.2	1.0
Q	46,060	1,519	12,573	0.8	41.5	41.5	42.4	0.9
R	46,310	1,701	13,089	0.8	42.2	42.2	43.1	0.9

¹ Feet above confluence with Ogeechee River

² Elevation computed without consideration of flooding controlled by Ogeechee River

³ Elevation computed without consideration of backwater effects from Ogeechee River

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BRYAN COUNTY, GA
AND INCORPORATED AREAS**

FLOODWAY DATA

BLACK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BLACK CREEK (Continued)								
V	63,485	2,350	11,626	0.8	47.5	47.5	48.5	1.0
W	68,738	2,079	10,118	0.9	49.6	49.6	50.5	0.9
X	73,221	649	11,988	2.1	51.8	51.8	52.8	0.9
Y	73,556	689	11,971	1.8	52.8	52.8	53.5	0.7
Z	75,007	1,418	8,837	1.1	53.5	53.5	54.1	0.6

¹ Feet above confluence with Ogeechee River

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY
**BRYAN COUNTY, GA
AND INCORPORATED AREAS**

FLOODWAY DATA

BLACK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MILL CREEK								
A	3,323	595	2,628	1.7	32.4	32.4	32.9	0.6
B	9,647	625	2,696	1.6	37.8	37.8	38.8	1.0
C	15,290	670	3,328	1.3	43.1	43.1	44.1	1.0
D	20,193	245	1,413	2.2	47.8	47.8	48.6	0.9

¹ Feet above 18th Street

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BRYAN COUNTY, GA
AND INCORPORATED AREAS**

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
STERLING CREEK 1								
A	55	229	754	0.6	9.8	9.8	9.8	0.0
B	1,378	472	1,182	0.4	9.8	9.8	10.0	0.2
C	3,834	233	822	0.5	10.0	10.0	10.3	0.3
D	5,617	149	590	0.8	10.1	10.1	10.6	0.5
E	7,056	194	833	0.5	10.7	10.7	11.2	0.5
F	9,205	230	1,447	0.3	10.8	10.8	11.4	0.6

¹Feet above Interstate Highway 95

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY
**BRYAN COUNTY, GA
AND INCORPORATED AREAS**

FLOODWAY DATA

STERLING CREEK 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
STERLING CREEK 2								
A	342	455	2,855	0.6	9.0 ²	8.4	9.3	0.9
B	3,593	459	2,658	0.7	9.0 ²	8.6	9.6	1.0
C	3,701	427	2,394	0.8	9.0 ²	8.7	9.7	1.0
D	5,751	295	1,295	1.4	9.6	9.6	10.2	0.5
E	7,738	171	913	2.0	10.4	10.4	11.1	0.7
F	8,623	138	908	0.8	10.9	10.9	11.6	0.6
G	12,922	151	846	0.8	11.4	11.4	12.0	0.7
H	14,605	123	670	0.8	11.7	11.7	12.3	0.6
I	19,237	110	667	0.8	13.0	13.0	13.7	0.7
J	19,297	110	687	0.8	13.0	13.0	13.7	0.7
K	23,099	164	960	0.6	13.2	13.2	14.2	0.9
L	23,375	173	1,106	0.5	16.1	16.1	16.4	0.4

¹ Feet Below Harris Trail

² Flooding controlled by the Atlantic Ocean

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY
**BRYAN COUNTY, GA
AND INCORPORATED AREAS**

FLOODWAY DATA

STERLING CREEK 2

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

[Not applicable to this Flood Risk project]

6.4 Coastal Flood Hazard Mapping

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

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

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

- The *primary frontal dune zone* is defined in 44 CFR Section 59.1 of the NFIP regulations. The primary frontal dune represents a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes that occur immediately landward and adjacent to the beach. The primary frontal dune zone is subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune zone occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.
- The *wave runup zone* occurs where the (eroded) ground profile is 3.0 feet or more below the 2-percent wave runup elevation.
- The *wave overtopping splash zone* is the area landward of the crest of an overtopped barrier, in cases where the potential 2-percent wave runup exceeds the barrier crest elevation by 3.0 feet or more.
- The *breaking wave height zone* occurs where 3-foot or greater wave heights could occur (this is the area where the wave crest profile is 2.1 feet or more above the total stillwater elevation).

The SFHA boundary indicates the limit of SFHAs shown on the FIRM as either “V” zones or “A” zones.

Table 26 indicates the coastal analyses used for floodplain mapping and the criteria used to determine the inland limit of the open-coast Zone VE and the SFHA boundary at each transect.

Table 26: Summary of Coastal Transect Mapping Considerations

Coastal Transect	Primary Frontal Dune (PFD) Identified	Wave Runup Analysis	Wave Height Analysis	Zone VE Limit	SFHA Boundary
		Zone Designation and BFE (ft NAVD88)	Zone Designation and BFE (ft NAVD88)		
1	N/A	N/A	VE 11-12 AE 7-11	Wave Height	SWEL
2	N/A	N/A	VE 12 AE 9-12	Wave Height	SWEL
3	N/A	N/A	VE 12 AE 10-12	Wave Height	SWEL
4	N/A	N/A	VE 11-12 AE 10-11	Wave Height	SWEL
5	N/A	N/A	VE 12 AE 10	Wave Height	SWEL
6	N/A	N/A	VE 12 AE 10-11	Wave Height	SWEL
7	N/A	N/A	VE 11-12 AE 10-11	Wave Height	SWEL
8	N/A	N/A	VE 11 AE 10-11	Wave Height	SWEL
9	N/A	N/A	VE 11-13 AE 9-11	Wave Height	SWEL
10	N/A	N/A	VE 12-14 AE 9-11	Wave Height	SWEL

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

6.5 FIRM Revisions

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

6.5.1 Letters of Map Amendment

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

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

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

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

6.5.2 Letters of Map Revision Based on Fill

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

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

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

6.5.3 Letters of Map Revision

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

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

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

Table 27: Incorporated Letters of Map Change

Case Number	Effective Date	Flooding Source	FIRM Panel(s)
10-04-4427P	08/11/2011	Belfast Siding Creek, Tributary to Belfast Siding Creek, Unnamed Flooding Area	13029C0290E 13029C0375E
13-04-1675P	05/15/2014	Tributary 1 to Elbow Swamp, Tributary 2 to Elbow Swamp	13029C0275E 13029C0286E 13029C0290E

6.5.4 Physical Map Revisions

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

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

For more information about the PMR process, please visit www.fema.gov and visit the “Flood Map Revision Processes” section.

6.5.5 Contracted Restudies

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

6.5.6 Community Map History

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

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.
- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.
- *Initial FHBM Effective Date* is the effective date of the first Flood Hazard Boundary Map (FHBM). This date may be the same date as the Initial NFIP Map Date.
- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.
- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community.
- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as Physical Map Revisions (PMR) of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Bryan County FIRMs in countywide format was 07/23/2008.

Table 28: Community Map History

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Bryan County, Unincorporated Areas	07/30/1976	07/30/1976	N/A	11/16/1983	10/16/1992 03/02/2009 05/05/2014
Pembroke, City of	05/10/1974	05/10/1974	03/05/1976	08/01/1986	03/02/2009 05/05/2014
Richmond Hill, City of	06/07/1974	06/07/1974	01/30/1976	04/17/1984	03/02/2009 05/05/2014

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

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

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

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Approximate Study Streams	05/05/2014	Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Atlantic Ocean (Flooding controlled by Atlantic Ocean)		BakerAECOM, LLC	HSFEHQ-09-D-0368 Task Order: HSFE04-10-J-0075	April 2015	Bryan County, Unincorporated Areas; Richmond Hill, City of
Belfast Siding Creek		Dewberry	LOMR 4427P	March 2011	Bryan County, Unincorporated Areas
Black Creek	05/16/1983	PBS&J	H-4778	April 1980	Bryan County, Unincorporated Areas
Black Creek	05/05/2014	Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas

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

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Georges Branch	05/05/2014	Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Miles Branch	05/05/2014	Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Mill Creek	05/05/2014	Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Ogeechee River		Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Ogeechee River	05/05/2014	Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Sterling Creek 1		Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Sterling Creek 2		Dewberry	FEMA-2010-CA-5087	May 2014	Bryan County, Unincorporated Areas
Tivoli River	05/05/2014	Dewberry	LOMR 233P	September 2003	Bryan County, Unincorporated Areas
Tributary 1 to Elbow Swamp		Dewberry	LOMR 1675P	December 2013	Bryan County, Unincorporated Areas
Tributary 2 to Elbow Swamp		Dewberry	LOMR 1675P	December 2013	Bryan County, Unincorporated Areas
Tributary to Belfast Siding		Dewberry	LOMR 4427P	March 2011	Bryan County, Unincorporated Areas
Unnamed Flooding Source		Dewberry	LOMR 4427P	March 2011	Bryan County, Unincorporated Areas

7.2 Community Meetings

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

Table 30: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Bryan County and Incorporated Areas		08/20/2015	Work Map	FEMA, Georgia DNR, Dewberry, BakerAECOM, LLC, and community officials
		TBD	CCO Meeting	FEMA, Georgia DNR, Dewberry, BakerAECOM, LLC, and community officials
Bryan County and Incorporated Areas	05/05/2014	11/09/2010	CCO Meeting	FEMA, the community, Georgia Coastal Regional Commission, the study contractor, and other various agencies and affected groups
		11/16/2010	Scoping	FEMA, the community, and the study contractor
Bryan County and Incorporated Areas	03/02/2009	12/07/2005	CCO Meeting	FEMA, Georgia DNR, City of Pembroke and Bryan County
		05/14/2008	CCO Meeting	FEMA, Georgia DNR, PBS&J, Cities of Pembroke and Richmond Hill, and Bryan County
Bryan County Unincorporated Areas	05/16/1983	May 1978	CCO Meeting	FEMA and community officials
		12/16/1982	CCO Meeting	FEMA and community officials
Richmond Hill, City of	10/17/1983	May 1978	CCO Meeting	FEMA and community officials
		05/25/1983	CCO Meeting	FEMA and community officials

SECTION 8.0 – ADDITIONAL INFORMATION

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

The additional data that was used for this project includes the FIS Report and FIRM that were previously prepared for Bryan County (FEMA 2014).

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

Table 31: Map Repositories

Community	Address	City	State	Zip Code
Bryan County, Unincorporated Areas	Engineering and Inspections, 66 Captain Matthew Freeman Dr., Suite: 201	Richmond Hill	GA	31324
Pembroke, City of	City Hall, 160 N Main St	Pembroke	GA	31321
Richmond Hill, City of	City of Richmond Hill, Planning & Zoning Department, P.O. Box 250	Richmond Hill	GA	31324

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

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

Table 32: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/engineering-library
NFIP website	www.fema.gov/national-flood-insurance-program
NFHL Dataset	msc.fema.gov
FEMA Region IV	Federal Emergency Management Agency, 3003 Chamblee Tucker Road, Atlanta, Georgia 30341
Other Federal Agencies	
USGS website	www.usgs.gov
Hydraulic Engineering Center website	www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Tom Shillock, CFM Dept. of Natural Resources Environmental Protection Division 2 Martin Luther King Jr. Drive Atlanta, Georgia 30334
State GIS Coordinator	Not Applicable

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

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

Table 33: Bibliography and References

Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
Abrams Aerial Survey Corporation, 1979	Abrams Aerial Survey Corporation	<i>Aerial Surveys, Scale 1:9,600, Contour Interval 2 feet; Jericho, three maps, Black Creek, Ogeechee River, three maps, Black Creek/Mill Creek</i>	Abrams Aerial Survey Corporation		June 1979	
BakerAECOM 2012	BakerAECOM	<i>Task Order 75: Georgia-Northeast Florida Flood Insurance Study, IDS1</i>	BakerAECOM		2012	
BakerAECOM 2013	BakerAECOM	<i>Task Order 75: Georgia-Northeast Florida Flood Insurance Study, IDS2</i>	BakerAECOM		2013	
BakerAECOM 2014	BakerAECOM	<i>Task Order 75: Georgia-Northeast Florida Flood Insurance Study, IDS3</i>	BakerAECOM		2014	
BakerAECOM 2015	BakerAECOM	<i>Task Order 75: Georgia-Northeast Florida Flood Insurance Study, IDS 4 & 5: Camden County, Georgia, Coastal Hazard Analysis and Floodplain Mapping Report</i>	BakerAECOM		2015	
BakerAECOM 2015	BakerAECOM	<i>FEMA Region IV, Coastal Hazard Analysis TSDN, Bryan County, Georgia</i>	BakerAECOM		April 2015	
Dewberry	Dewberry	<i>LOMR 10-04-4427P</i>	Dewberry		2011	
Dewberry	Dewberry	<i>LOMR 13-04-1675P</i>	Dewberry		2013	

Table 33: Bibliography and References - continued

Citation in this FIS	Publisher/ Issuer	<i>Publication Title, "Article," Volume, Number, etc.</i>	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 2014	Federal Emergency Management Agency	<i>Byran County and Incorporated Areas, Flood Insurance Study</i>	Federal Emergency Management Agency	Washington, D.C.	05/05/2014	
PhotoScience & Fugro EarthData 2010		LiDAR	PhotoScience & Fugro EarthData		2010	
Stamey and Hess 1993	USGS	<i>USGS Water Resources Investigations Report 93-4016, Techniques for Estimating Magnitude and Frequency of Floods in Rural Basins of Georgia</i>	Stamey T.C., and C.W. Hess		1993	
Stevenson & Palmer Engineering, Inc.	Stevenson & Palmer Engineering, Inc.	<i>Post Development Drainage Map, Scale 1:3,600, Contour Interval 1 foot</i>	Stevenson & Palmer Engineering, Inc.		undated	
USGS 2000	USGS	<i>Digital Raster Graphic Mosaic of Bryan County, Georgia, Scale 1:24,000, Contour Interval 10 feet, US Department of Interior</i>	Geotechnologies, Inc.		2000	

Table 33: Bibliography and References - continued

Citation in this FIS	Publisher/ Issuer	<i>Publication Title, "Article," Volume, Number, etc.</i>	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USGS various dates	USGS	<i>7.5-Minute Series Topographic Maps, enlarged scale 1:1,000, Contour Interval 10 feet, Medrim SE, Medrim SW, 1958, photorevised 1976; enlarged scale 1:24,000, Contour Interval 10 feet: Eden, 1958, photorevised 1976; US Department of Interior</i>	USGS		vaious dates	