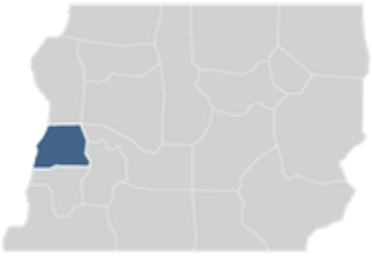
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 2



FLOOD COUNTY, STATE

AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
COASTLAND, CITY OF	123456
FLOOD COUNTY, UNINCORPORATED AREAS	123457
FLOODVILLE, TOWN OF	123458
METROPOLIS, CITY OF	123459
UPLAND, VILLAGE OF*	123460

*No Special Flood Hazard Areas Identified

FEMA

EFFECTIVE:

DECEMBER 31, 2011

FLOOD INSURANCE STUDY NUMBER

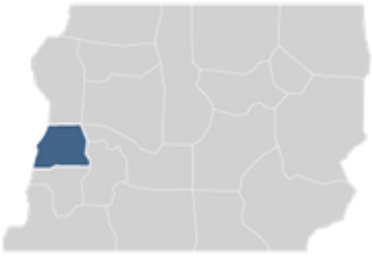
12345CV000X

Version Number 2.3.3.2

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 2



FLOOD COUNTY, STATE

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
COASTLAND, CITY OF	123456	WATER O, CITY OF	123475
FLOOD COUNTY, UNINCORPORATED AREAS	123457	WATER P, CITY OF	123476
FLOODVILLE, TOWN OF	123458	WATER Q, CITY OF	123477
METROPOLIS, CITY OF	123459	WATER R, CITY OF	123478
UPLAND, VILLAGE OF*	123460	WATER S, CITY OF	123479
WATER A, CITY OF	123461	WATER T, CITY OF	123480
WATER B, CITY OF	123462	WATER U, CITY OF	123481
WATER C, CITY OF	123463	WATER V, CITY OF	123482
WATER D, CITY OF	123464	WATER W, CITY OF	123483
WATER E, CITY OF	123465	WATER X, CITY OF	123484
WATER F, CITY OF	123466	WATER Y, CITY OF	123485
WATER G, CITY OF	123467	WATER Z, CITY OF	123486
WATER H, CITY OF	123468	WATER Z1, CITY OF	123487
WATER I, CITY OF	123469	WATER Z2, CITY OF	123488
WATER J, CITY OF	123470	WATER Z3, CITY OF	123489
WATER K, CITY OF	123471	WATER Z4, CITY OF	123490
WATER L, CITY OF	123472	WATER Z5, CITY OF	123491
WATER M, CITY OF	123473	WATER Z6, CITY OF	123492
WATER N, CITY OF	123474	WATER Z7, CITY OF	123493

*No Special Flood Hazard Areas Identified

EFFECTIVE:

DECEMBER 31, 2011

FLOOD INSURANCE STUDY NUMBER
12345CV001A
Version Number 2.3.3.2

FEMA

TABLE OF CONTENTS

Volume 1

Figures

Page

Tables

Page

Volume 1

Exhibits

Flood Profiles	Panel	
Flower Creek	**01**	P
Inundation River	**02-03**	P
Petal Creek	**04-07**	P
South Fork Inundation River	**08**	P
Tributary 1 North Fork Creek	**09**	P
Willow Creek	**10**	P

[other profiles up to 100 pages in document]

Volume 2

Exhibits

Flood Profiles	Panel	
Iris Creek	**40**	P
Daffodil Creek	**41**	P
Rose River	**42**	P
Oak River	**42**	P
Locust Creek	**43**	P
Maple River	**44-45**	P

Published Separately

Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT
FLOOD COUNTY, STATE

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

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

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

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

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

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

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

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

1.2 Purpose of this Flood Insurance Study Report

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

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

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of **Flood County, State**.

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

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

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

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Coastland, City of	123457	99999998	12345C0234X	
Flood County, Unincorporated Areas	123470	99999996, 99999997, 99999998	12345C0234X 12345C0235X	
Floodville, Town of	123456	99999998	12345C0200X	
New Metropolis, City of	123458	99999995, 99999996	N/A	Dry County FIS Report, 2006
Summer Beaches, Village of	123459	99999996	12345C0150X[2]	
Upland, Village of[1]	123480	99999997	12345C0100X	

[1] No Special Flood Hazard Areas Identified
[2] Panel Not Printed

1.4 Considerations for using this Flood Insurance Study Report

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

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

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

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 30, "Map Repositories," within this FIS Report.

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

The initial Countywide FIS Report for **Flood County** became effective on **December 31, 9999**. Refer to Table 27 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 (FBFM) panels. In addition, former flood hazard zone designations have been changed as follows:**

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

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

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

- **FEMA does not design, build, inspect, operate, maintain, or certify levees. FEMA is responsible for accurately identifying flood hazards and communicating those hazards and risks to affected stakeholders. FEMA has identified one or more levee systems in this jurisdiction summarized in Table 8 of this FIS Report. For FEMA to accredit the identified levee systems, the levee systems must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."**

  Information on the levee systems in this jurisdiction can be obtained from the USACE National Levee Database (https://levees.sec.usace.army.mil/). For additional information, the user should contact the appropriate jurisdiction floodplain administrator and the levee owner or sponsor.

  [add this paragraph only if Secluded levee] Please also note that FEMA has identified one or more levee systems in this jurisdiction that have not been demonstrated by the community or levee owner to meet the requirements of 44 CFR 65.10, of the NFIP regulations as it relates to the levee system's capacity to provide 1-percent-annual-chance flood hazard reduction. As such, temporary actions are being taken until such time as FEMA is able to

initiate a new flood risk project to apply the levee analysis and mapping procedures for non-accredited levee systems, as appropriate. These temporary actions involve using the flood hazard data shown on the previous effective FIRM exactly as shown on that prior FIRM and identifying the area with bounding lines and special map notes. If a vertical datum conversion was executed for the county, then the Base Flood Elevations shown on the FIRM will now reflect elevations referenced to the North American Vertical Datum of 1988 (NAVD88). These levees are on FIRM panel(s) 12345C0234X, on the Flood County Levee/Inundation River, and are identified on FIRM panels as potential areas of flood hazard data changes based on further review. Please refer to Section 4.4 of this FIS Report for more information.

- 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/flood-maps/tutorials.

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

Figure 1: FIRM Index

[insert 11x17 of FIRM Index into PDF]

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 Flood Insurance Rate Map (FIRM), 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 Mapping and Insurance 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 Mapping and Insurance eXchange.

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

For community and countywide map dates, refer to Table 27 in this FIS Report.

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

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 have reduced flood hazards due to flood control structures. Refer to Section 4.3 "Dams and Other Flood Hazard Reduction 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 **Universal Transverse Mercator (UTM) Zone 10**. The horizontal datum was **the North American Datum of 1983 NAD83, GRS1980 spheroid.** Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

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

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

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by **Flood County GIS Department at a scale of 1:5,000. The following panels used base map information provided by the U.S. Geological Survey at a scale of 1:12,000: 125, 130, and 140.** 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.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within **Flood County, STATE**, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 27 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

Figure 2. FIRM Notes to Users

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for **Flood County, STATE**, effective **December 31, 9999**.

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.

ACCREDITED LEVEE SYSTEM: Check with your local community to obtain more information on the levee system(s) shown as providing flood hazard reduction on this panel. To mitigate flood hazards in residual risk areas, property owners and residents are encouraged to review the community's emergency preparedness plan and to consider flood insurance and floodproofing or other risk reduction measures. For more information on flood insurance, interested parties should visit www.fema.gov/flood-insurance.

PROVISIONALLY ACCREDITED LEVEE SYSTEM: Check with your local community to obtain more information on the levee system(s) shown as providing flood hazard reduction on this panel. To mitigate flood hazard in residual risk areas, property owners and residents are encouraged to review the community's emergency preparedness plan and to consider flood insurance and floodproofing or other risk reduction measures. For more information on flood insurance, interested parties should visit www.fema.gov/flood-insurance.

To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by December 31, 2011. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect the levee system as non-accredited.

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

FLOWAGE EASEMENT AREA: Flowage easement area data was provided by Flood County and is current as of [date]. For information about the delineation of flowage easement areas in this Flood Risk Project, please contact Flood County at [contact information].

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 **Flood County**.

Figure 3: Map Legend for FIRM

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

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

Figure 3: Map Legend for FIRM

FLOOD INSURANCE IS NOT AVAILABLE FOR STRUCTURES NEWLY BUILT OR SUBSTANTIALLY IMPROVED ON OR AFTER APRIL 8, 1987, IN THE DESIGNATED COLORADO RIVER FLOODWAY

Non-encroachment zone (see Section 2.4 of this FIS Report for more information)

The Colorado River Floodway was established by Congress in the Colorado River Floodway Protection Act of 1986, Public Law 99-450 (100 Statute 1129). The Act imposes certain restrictions within the Floodway.

OTHER AREAS OF FLOOD HAZARD

Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.

Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.

Area with Reduced Flood Hazard due to Accredited or Provisionally Accredited Levee System: Area is shown as reduced flood hazard from the 1-percent-annual-chance or greater flood by a levee system. Overtopping or failure of any levee system is possible. **See Notes to Users for important information.**

Area with Undetermined Flood Hazard due to Non-Accredited Levee System: Analysis and mapping procedures for non-accredited levee systems were applied resulting in a flood insurance rate zone where flood hazards are undetermined, but possible.

OTHER AREAS

Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

NO SCREEN

Unshaded Zone X: Areas of minimal flood hazard.

FLOOD HAZARD AND OTHER BOUNDARY LINES

(ortho) (vector)

Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)

Limit of Study

Jurisdiction Boundary

Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet

Figure 3: Map Legend for FIRM

GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
Bridge	Bridge
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE **(EL 16)**	Static Base Flood Elevation value (shown under zone label)
ZONE AO **(DEPTH 2)**	Zone designation with Depth
ZONE AO **(DEPTH 2)** **(VEL 15 FPS)**	Zone designation with Depth and Velocity

Figure 3: Map Legend for FIRM

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

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

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

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

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

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

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

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

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Big Ocean	Coastland, City of; Flood County, Unincorporated Areas	Entire Coastline	Entire Coastline	N/A	16.3		N	VE, AE, AO	1989
Culvert Creek	Flood County, Unincorporated Areas	Confluence with South Fork Inundation River	2.3 miles upstream of confluence of Ripple Creek	99999998	0.7		N	AE	1997
Inundation River	Flood County, Unincorporated Areas; Metropolis, City of	Confluence with Big Ocean	Approximately 500 feet upstream of State Highway 999	99999998	12.5		Y	AE	2007
Inundation River	Flood County, Unincorporated Areas; Metropolis, City of	Approximately 500 feet upstream of State Highway 999	Confluence of North Fork Inundation River and South Fork Inundation River	99999998	3.8		N	A	1997
Lily Pond	Metropolis, City of	Pear Tree Circle	Westwood Lane	99999997		1.6	N	AE	2002
North Fork Inundation River	Coastland, City of; Flood County, Unincorporated Areas	Confluence with Inundation River	0.7 miles upstream of Lilac Stream	99999998	4.2		Y	AE	2010
South Fork Inundation River	Flood County, Unincorporated Areas	Confluence with Inundation River	3.2 miles upstream of confluence of Culvert Creek	99999998	3.8		Y	AE	2010
West River and Zone A Tributaries	Flood County, Unincorporated Areas	Confluence of West River with Inundation River	1 square mile drainage area of all Zone A streams	99999998	206.8		N	A	2010
Wood Branch and Zone A Tributaries	Flood County, Unincorporated Areas; Floodville, Town of	Confluence of Wood Branch with North Fork Inundation River	1 square mile drainage area of all Zone A streams	99999998	58.7		N	A	2009

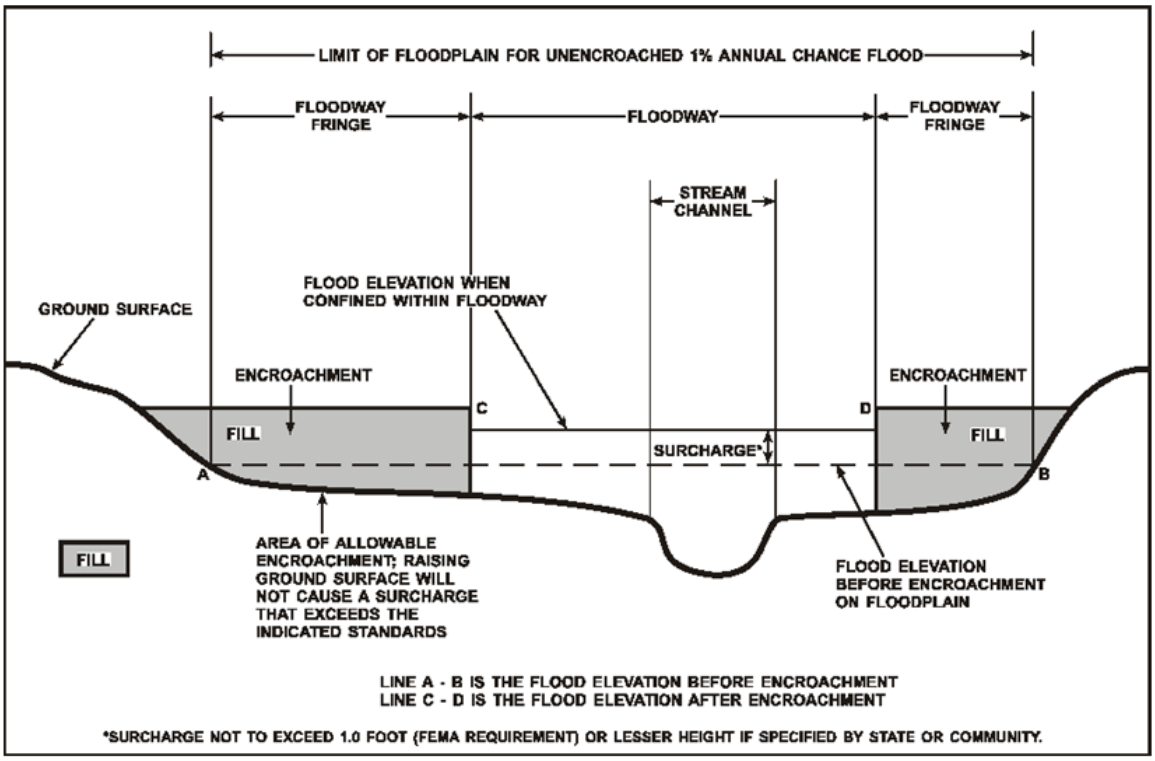
2.2 Floodways

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

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

To participate in the NFIP, Federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. **Regulations for State require communities in Flood County to limit increases caused by encroachment to 0.5 foot and several communities have adopted additional restrictions.** The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic



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

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

All flowage easement areas relevant to this Flood Risk Project are shown on the FIRM using the symbology described in Figure 3. This data was provided by Flood County and is current as of <date>. For information about the delineation of flowage easement areas in this Flood Risk Project, please contact Flood County at <contact information>.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The BFE is the elevation of the 1-percent-annual-chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded

to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

BFEs are primarily intended for flood insurance rating purposes. Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. For example, the user may use the FIRM to determine the stream station of a location of interest and then use the profile to determine the 1-percent annual chance elevation at that location. Because only selected cross sections may be shown on the FIRM for riverine areas, the profile should be used to obtain the flood elevation between mapped cross sections. Additionally, for riverine areas, whole-foot elevations shown on the FIRM may not exactly reflect the elevations derived from the hydraulic analyses; therefore, elevations obtained from the profile may more accurately reflect the results of the hydraulic analysis.

2.4 Non-Encroachment Zones

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-percent-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. Regulations for State require communities in Flood County to limit increases caused by encroachment to 0.5 foot and several communities have adopted additional restrictions for non-encroachment areas.

Non-encroachment determinations may be delineated where it is not possible to delineate floodways because specific channel profiles with bridge and culvert geometry were not developed. Any non-encroachment determinations for this Flood Risk Project have been tabulated for selected cross sections and are shown in Table 24, "Flood Hazard and Non-Encroachment Data for Selected Streams." Areas for which non-encroachment zones are provided show BFEs and the 1-percent-annual-chance floodplain boundaries mapped as zone AE on the FIRM but no floodways.

2.5 Coastal Flood Hazard Areas

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

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

2.5.1 Water Elevations and the Effects of Waves

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

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

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

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

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

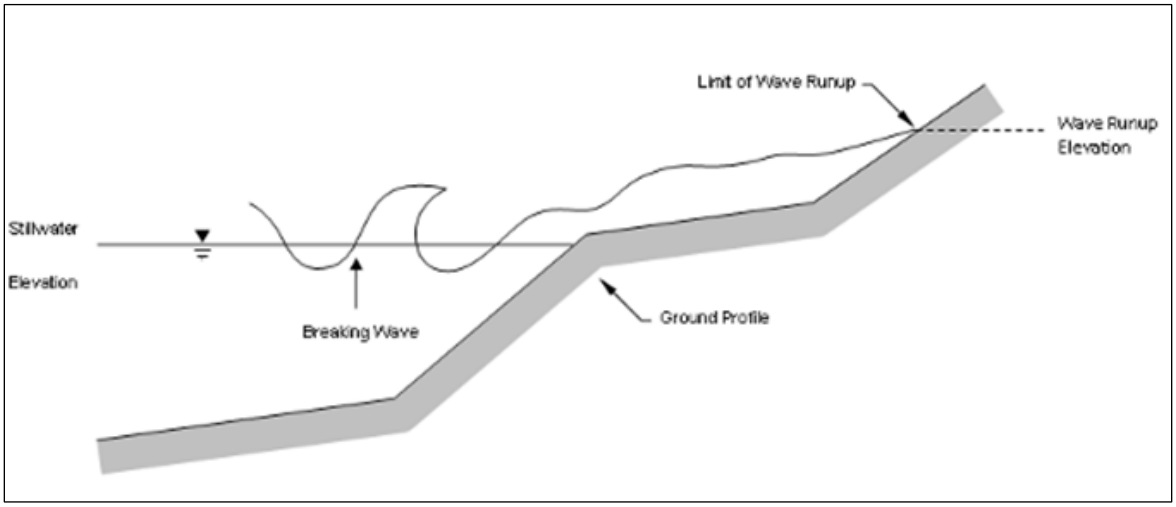
- *Wave setup* is the increase in stillwater elevation at the shoreline caused by the reduction of waves in shallow water. It occurs as breaking wave momentum is transferred to the water column.

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

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

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

Figure 5: Wave Runup Transect Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

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

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

Floodplain Boundaries

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

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

Table 25 presents the types of coastal analyses that were used in mapping the 1-percent-annual-chance floodplain in coastal areas.

Coastal BFEs

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

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

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

2.5.3 Coastal High Hazard Areas

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

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

- ***Primary Frontal Dune (PFD)* is a continuous or nearly continuous mound or ridge of sand with relatively steep slopes immediately landward and adjacent**

to the beach. The PFD is subject to erosion and overtopping from high tides and waves during major coastal storms.

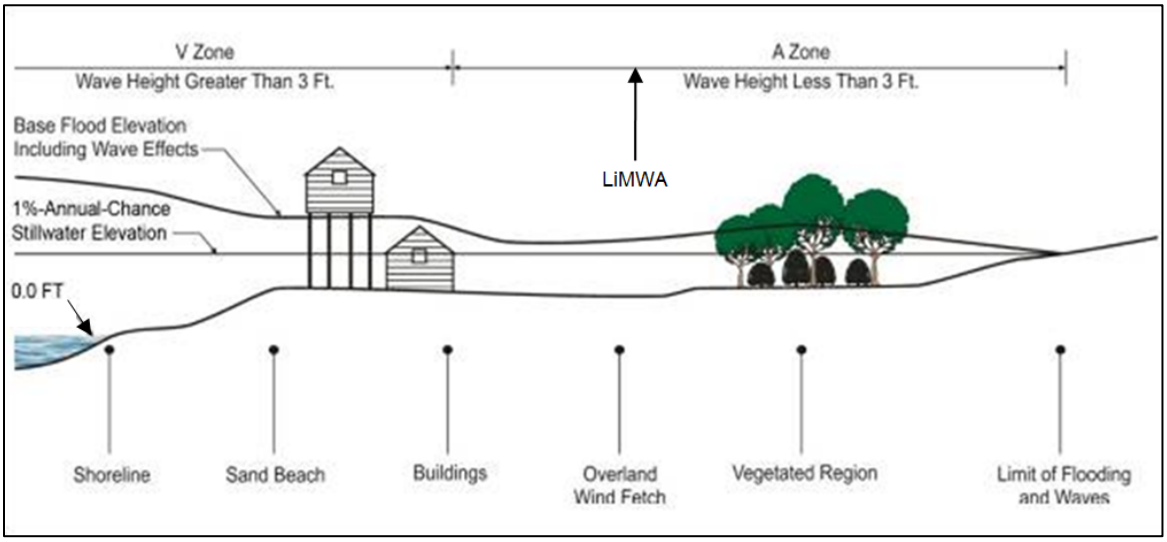
CHHAs are designated as "V" zones (for "velocity wave zones") and are subject to more stringent regulatory requirements and a different flood insurance rate structure. The areas of greatest risk are shown as VE on the FIRM. Zone VE is further subdivided into elevation zones and shown with BFEs on the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

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

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

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

Figure 6: Coastal Transect Schematic



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

Coastal floodplains are shown on the FIRM using the symbology described in Figure 3, "Map Legend for FIRM." In many cases, the BFE on the FIRM is higher than the stillwater elevations shown in Table 16 due to the presence of wave effects. The higher elevation should be used for construction and/or floodplain management purposes.

2.5.4 Limit of Moderate Wave Action

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

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

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

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

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

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

Table 3 lists the flood insurance zones in **Flood County**.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Coastland, City of	**A, AE, AO, VE, X**
Flood County, Unincorporated Areas	**A, AE, AO, AH, V, VE, X**
Floodville, Town of	**A, X**
Metropolis, City of	**A, AE, X**

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 4 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 4: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (**square miles**)
Great-Red River	**99999997**	**Great River**	**Begins at confluence with Inundation River, extends northwest, affecting one third of Flood County**	**598**
Inundation River	**99999998**	**Inundation River**	**Largest watershed within Flood County, encompassing the southeastern half of the county**	**1,058**

4.2 Principal Flood Problems

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

Table 5: Principal Flood Problems

Flooding Source	Description of Flood Problems
Inundation River	**The Inundation River at Metropolis typically exceeds flood stage at least once each winter. In the lower reaches of the Inundation River, higher than normal tides combining with high runoff can cause extensive flooding. Storm runoff is high because of moderately steep to steep terrain and the characteristic low soil permeability in the upper Inundation River valley. A natural constriction in the Inundation River valley downstream of Coastland and tidal influences control the flood elevations at the City of Metropolis. The river valley at Metropolis is flooded an average of three months each year. The worst flooding occurs when high tides combine with high runoff and onshore winds during major winter storms.**

Flooding Source	Description of Flood Problems
South Fork Inundation River	**The South Fork Inundation River at Floodville typically exceeds flood stage at least once each winter. Flood stage in the Coastland area is higher than in the areas downstream because of a natural constriction in the flood plain immediately downstream of the confluence of the North and South Forks of the Inundation River. In December 1964, the Spruce Street Bridge staff gage at Coastland, indicated that the South Fork Inundation River crested at approximately 11 feet above flood stage (bankfull discharge) with an estimated discharge of 100,000 cfs. This flow has a return period greater than 500 years. Stream gage No. 19999999 on the South Fork Inundation River at Floodville recorded a peak flow of 48,900 cfs. This flow has a return period of about 500 years.**

Table 6 contains information about historic flood elevations in the communities within **Flood County**.

Table 6: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (**Feet NAVD88**)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Inundation River	**Outlet of Inundation River at Big Ocean**	**19.8**	**1986**	**80**	**USGS gage**
South Fork Inundation River	**700 feet upstream of Fulton Road**	**18.8**	**2007**	**50**	**NRCS high water marks**

4.3 Dams and Other Flood Hazard Reduction Measures

Table 7 contains information about non-levee flood hazard reduction measures within **Flood County** such as dams or jetties. Levee systems are addressed in Section 4.4 of this FIS Report.

Table 7: Dams and Other Flood Hazard Reduction Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Inundation River	**N/A**	**Dam**	**1.5 miles upstream of Rockhampton Circle**	**Maintained by Floodville Waterworks**
Big Ocean	**A.B. Smith Jetty**	**Jetties**	**At entrance channel**	**Constructed by USACE in 1929**
Big Ocean	**N/A**	**Tidal flooding warnings**	**Low-lying coastal areas**	**Flood Weather Forecast Office issues storm tide warnings**

4.4 Levee Systems

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

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

[only use if Freeboard Deficient approach was used] Please note that the Levee System Name meets the structural standards of 44 CFR 65.10 except lacking adequate freeboard. The flood hazard area landward for the levee system is mapped as Zone D per the freeboard deficient approach under FEMA's analysis and mapping procedures for non-accredited levee systems. The Zone D flood hazard area was determined based on a natural valley analysis of the Flooding Source Name.

[only use if Zone D from an analysis and mapping procedure] In Zone D areas, floodplain management requirements are applied at the discretion of local officials as long as the community complies with the minimum standards of the National Flood Insurance Program (NFIP) regulations cited at 44 CFR 60.3(a). FEMA will depict the Zone D area landward of the levee system on the FIRM with a different symbology than the traditional Zone D area. The differentiation between Zone D symbology will allow various stakeholders to identify Zone D areas landward of the levee system for use in determining flood insurance requirements, enforcing floodplain management and mitigation, and communicating risk. For additional information regarding floodplain management requirements within Zone D areas, please consult with the local floodplain administrator for these communities. There is water surface elevation information available for these Zone D areas for communities use, as referenced in the Zone D Fact Sheets:

- **Understanding Zone D for Levees: "Areas of Undetermined Flood Hazards" www.fema.gov/sites/default/files/2020-08/fema_understanding-zone-D-levees.pdf**

- **Modeling and Mapping Non-Accredited Levees: Understanding the Zone D Designation www.fema.gov/media-library-data/5b0ef91fd61d29eb3d4be72a47d6f140/508_LAMP_FS_ZoneD.pdf**

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

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

[only use for Secluded levee systems] Please note that FEMA has identified levee systems in this jurisdiction that have not been demonstrated by the community or levee owner to meet the requirements of 44 CFR 65.10 of the NFIP regulations as it relates to the levee system's capacity to provide 1-percent-annual-chance flood hazard reduction. As such, the existing flood hazard analysis in the affected areas has been carried forward from the previously-printed effective FIRM panel(s) and the area has been clearly identified on the FIRM panel with notes and bounding lines. This has been done to inform users that a temporary mapping action has been put in place until such time as FEMA is able to initiate a new flood risk project to apply new flood hazard mapping procedures for leveed areas. These levees occur on FIRM panel(s) 12345C0234X, on the Flood County Levee/Inundation River, and are identified on the FIRM panel(s) as potential areas of flood hazard data changes based on further review. Levees and their accreditation status are listed in Table 8 of this FIS Report.

Table 8: Levee Systems

Community	Flooding Source(s)	NLD Levee System ID	NLD Levee System Name	Levee System Status on Effective FIRM	FIRM Panel(s)	Levee Owner(s) / Sponsor(s)
Flood County, Unincorporated Areas	Inundation River; Muddy Creek	1234545362	IR-123LB	Accredited	12345C0234X	Flood County Drainage District No.1; Inundation River Drainage District No.3
Flood County, Unincorporated Areas	Inundation River	1354212346	Inundation River RB Unit	Provisionally Accredited	12345C0234X	Flood County Water Supply
Floodville, Town of	Inundation River	1901990990	Floodville Levee System	Non-Accredited	12345C0245X	Floodville Waterworks

SECTION 5.0 – ENGINEERING METHODS

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

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

In addition to these flood events, the "1-percent-plus", or "1%+", annual chance flood elevation has been modeled and included on the flood profile for certain flooding sources in this FIS Report. While not used for regulatory or insurance purposes, this flood event has been calculated to help illustrate the variability range that exists between the regulatory 1-percent-annual-chance flood elevation and a 1-percent-annual-chance elevation that has taken into account an additional amount of uncertainty in the flood discharges (thus, the 1% "plus"). For flooding sources whose discharges were estimated using regression equations, the 1%+ flood elevations are derived by taking the 1-percent-annual-chance flood discharges and increasing the modeled discharges by a percentage equal to the average predictive error for the regression equation. For flooding sources with gage- or rainfall-runoff-based discharge estimates, the upper 84-percent confidence limit of the discharges is used to compute the 1%+ flood elevations.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 26, "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 12. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 9. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 10. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 16.) Stream gage information is provided in Table 11.

Table 9: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Culvert Creek	Just downstream of Smith Lane	1.0	130	*	170	190	*	240
Inundation River	Confluence with Big Ocean	1,058	77,200	*	107,000	122,000	132,000	143,000
Inundation River	1.2 miles downstream of US Highway 27	980	73,100	86,800	101,000	116,000	119,000	136,000
Inundation River	2,000 feet downstream of 3rd Avenue	930	70,500	82,360	97,100	111,000	115,000	130,000
Inundation River	500 feet upstream of Main Street	902	69,000	81,100	95,000	109,000	113,000	128,000
Inundation River	Confluence with North Fork Inundation River and South Fork Inundation River	879	67,700	*	93,200	107,000	114,00	125,000
North Fork Inundation River	Just upstream of State Highway 42	137	18,100	*	24,000	27,000	*	31,600
South Fork Inundation River	Confluence with North Fork	598	51,100	*	69,700	79,600	*	93,300

*Not calculated for this Flood Risk Project

Figure 7: Frequency Discharge-Drainage Area Curves

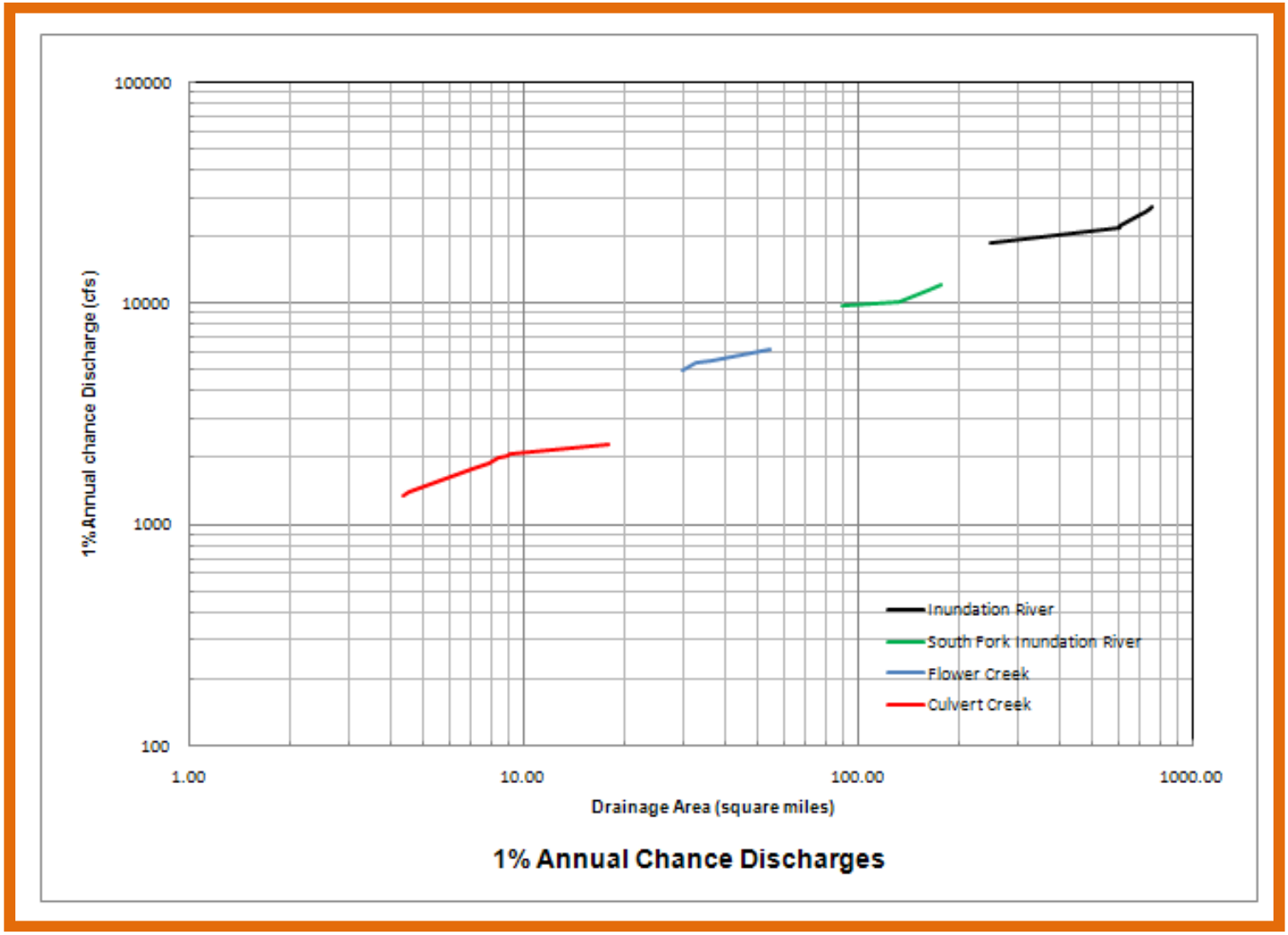


Table 10: Summary of Non-Coastal Stillwater Elevations

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Central Reservoir	Flood County Unincorporated Areas	12.6	*	14.5	15.2	17.0
Lily Pond	Metropolis	8.6	*	11.6	12.6	13.3

*Not calculated for this Flood Risk Project

Table 11: Stream Gage Information used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
North Fork Inundation River	**19999998**	USGS	**North Fork Inundation River near Floodville**	161	01/14/1915	01/08/2009

5.2 Hydraulic Analyses

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

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

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 12. Roughness coefficients are provided in Table 13. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Culvert Creek	**Confluence with South Fork Inundation River**	**2.3 miles upstream of confluence of Ripple Creek**	**1994 State Regression Equations – Region 3**	**HEC-2 4.6**	**03/22/1997**	**AE**	**Ice jam analysis evaluated by Modified Indirect Method (CRREL 2004). Flood Profile reflects results of ice jam analysis.**
Inundation River	**Confluence with Big Ocean**	**Approximately 500 feet upstream of State Highway 999**	**2004 State Regression Equations – Region 3**	**HEC-RAS 3.1**	**06/30/2007**	**AE w/ Floodway**	**[Natural Valley, Structural Based Inundation, or etc.] levee analysis and mapping procedure was applied to NLD Levee System IDs 1354212346 and 1234545362.**
Inundation River	**Approximately 500 feet upstream of State Highway 999**	**Confluence of N. Fork Inundation River and S. Fork Inundation River**	**2004 State Regression Equations – Region 3**	**HEC-RAS 3.1**	**06/30/2007**	**A**	**Effects of hydraulic structures were not considered in the model.**
Lily Pond	**Pear Tree Circle**	**Westwood Lane**	**ICPR 2.20**	**ICPR 2.20**	**05/28/2002**	**AE**	**Elevations determined using ICPR. Survey data utilized in model was based on county information collected in 2008.**
North Fork Inundation River	**Confluence with Inundation River**	**0.7 miles upstream of confluence of Lilac Stream**	**Log Pearson Type III Frequency Analysis**	**HEC-RAS 4.0**	**12/12/2010**	**AE**	**Gage No. 19999998 was used in hydrologic analysis. Hydraulic models incorporated field measured bridge and culvert data.**
South Fork Inundation River	**Confluence with Inundation River**	**3.2 miles upstream of confluence of Culvert Creek**	**HEC-HMS 3.4**	**Unsteady HEC-RAS 4.0**	**12/12/2010**	**AE w/ Floodway**	**Hydraulic model was calibrated to high water marks collected for flood of 2007, which was estimated to be the 2-percent-annual-chance flood.**

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Culvert Creek	0.040-0.060	0.040-0.080
Inundation River	0.040-0.060	0.040-0.080
North Fork Inundation River	0.080-0.100	0.040-0.080
South Fork Inundation River	0.030	0.030-0.035

5.3 Coastal Analyses

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

The following subsections provide summaries of how each coastal process was considered for this FIS Report. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation. Table 14 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.

Table 14: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Big Ocean	Entire coastline of Flood County	Entire coastline of Flood County	Overland Wave Propagation	WHAFIS	99/99/9999
Big Ocean	Entire coastline of Flood County	Entire coastline of Flood County	Statistical Analyses	JPM	99/99/9999
Big Ocean	Entire coastline of Flood County	Entire coastline of Flood County	Storm Surge	ADCIRC	99/99/9999
Big Ocean	Entire coastline of Flood County	Entire coastline of Flood County	Wave Generation	ACES	99/99/9999
Big Ocean	Entire coastline of Flood County	Entire coastline of Flood County	Wave Runup	TAW	99/99/9999
Big Ocean	Entire coastline of Flood County	Entire coastline of Flood County	Wave Setup	Direct Integration Method (DIM)	99/99/9999

5.3.1 Total Stillwater Elevations

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

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

Astronomical Tide

Astronomical tidal statistics were generated directly from local tidal constituents

by sampling the predicted tide at random times throughout the tidal epoch.

Storm Surge Statistics

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

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

Tidal gages can be used instead of historic records of storms when the available tidal gage record for the area represents both the astronomical tide component and the storm surge component. Table 15 provides the gage name, managing agency, gage type, gage identifier, start date, end date, and statistical methodology applied to each gage used to determine the stillwater elevations. For areas between gages, peak stillwater elevations for selected recurrence intervals were estimated by combining interpolation between gages and observed high water marks during major storms. A regionalized statistical approach was applied to the gage data so that stillwater elevations in areas between gages could be identified.

Table 15: Tide Gage Analysis Specifics

Gage Name	Managing Agency of Tide Gage Record	Gage Type	Start Date	End Date	Statistical Methodology
N-408	NOAA	Tide	1968	2003	GEV
N-422	NOAA	Tide	1985	2010	GEV

Combined Riverine and Tidal Effects

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

Riverine and surge rates for the lower reaches of the Inundation River were combined by developing curves for rate of occurrence vs. flood level for each flood source.

Wave Setup Analysis

Wave setup was computed during the storm surge modeling through the methods and models listed in Table 14 and included in the frequency analysis for the determination of the total stillwater elevations. The oscillating component of wave setup, *dynamic wave setup*, was calculated for areas subject to wave runup hazards.

5.3.2 Waves

A coastal wave model (Coastal State University 2007) was used to calculate the nearshore wave fields required for the addition of wave setup effects. Three nested grids were used to obtain sufficient nearshore resolution to represent the radiation stress gradients required as ADCIRC inputs. Radiation stress fields output from the inner grids are used by ADCIRC to estimate the contribution of breaking waves (wave setup effects) to the total stillwater elevation.

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated to determine the modification to existing topography that is expected to be associated with flooding events. Erosion was evaluated using the methods listed in Table 14. The post-event eroded profile was used for the subsequent transect-based onshore wave hazard analyses.

5.3.4 Wave Hazard Analyses

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

Transect locations were chosen with consideration given to the physical land characteristics as well as development type and density so that they would closely represent conditions in their locality. Additional consideration was given to changes in the total stillwater elevation. Transects were spaced close together in areas of complex topography and dense development or where total stillwater elevations varied. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects shown in Figure 9, "Transect Location Map," are also depicted on the FIRM. Table 16 provides the location, stillwater elevations, and starting wave conditions for each transect evaluated for overland wave hazards. In this table, "starting" indicates the parameter value at the beginning of the transect.

Wave Height Analysis

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

schematic of a coastal transect evaluated for overland wave propagation hazards.

Wave heights and wave crest elevations were modeled using the methods and models listed in Table 14, "Summary of Coastal Analyses". For the 0.2-percent-annual-chance event, wave profiles were created to indicate the results of the wave height analysis at each transect. Such wave profiles may show greater detail than the mapping product, due to limitations of the map scale and smoothing tolerances applied during boundary cleanup. Wave runup analysis for the 0.2-percent-annual-chance event was not performed for this study and is not included in the profiles.

Wave Runup Analysis

Wave runup analyses were performed to determine the height and extent of runup beyond the limit of stillwater inundation for the 1-percent-annual-chance flood. Wave runup elevations were modeled using the methods and models listed in Table 14.

Table 16: 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
Big Ocean	1	27.2	13	5.6 5.6-5.6	* *	10.6 10.1-10.9	15.7 15.2-15.8	19.6 18.6-19.8

*Not calculated for this Flood Risk Project

Figure 9: Transect Location Map

Note to producer: insert 11x17 inch transect location map into PDF and remove this yellow highlighted text.

If there is no transect location map, delete this yellow highlighted text and include the following text below the Figure 9 caption, per the FIS Report Technical Reference.

[Not applicable to this Flood Risk Project]

5.4 Alluvial Fan Analyses

Alluvial fan flooding can pose significant risk to communities due to uncertain flow paths and the potential for mud and debris flows. Alluvial fans and flooding on alluvial fans show great diversity because of variations in climate, fan history, rates and styles of tectonism, source area lithology, vegetation, and land use. Acknowledging this diversity, FEMA developed an approach that considers site-specific conditions in the identification and mapping of flood hazards on alluvial fans. The FEMA alluvial fan methodology was used to determine the flood depths and velocities on the alluvial fans described in Table 17.

A summary of the peak discharge at the fan apex and results for the 1-percent-annual-chance determinations for all the streams studied by alluvial fan analyses is shown in Table 18, "Results of Alluvial Fan Analyses."

Table 17: Summary of Alluvial Fan Analyses

Flooding Source	Location From (apex)	Location To (toe)	Drainage Area above Apex (sq mi)	Model(s) Used	Date Analysis was Completed	Method Description
Culvert Creek Fan	From apex of fan	Highway I-10	24.2	N/A	2005	Geomorphic Data, Post Flood Hazard Verification, and Historical Information
Mountain Wash Fan	Apex of fan	Stan Road	54.5	FLO-2D, version 2006.07	2006	Risk-Based Analysis
Petal Creek fan	From apex of fan	Tangerine Road	15.8	FLO-2D version 2007.06	2009	Composite Methods
Valley Creek Fan	Apex of N. Fork Inundation River Fan	Maple Lane	44.7	FAN Computer Program	1993	Areas identified with historical aerial photos. FAN analysis used for 1-percent-annual-chance flood in active areas. HEC-2 4.6 was used in inactive areas, where incised networks and little risk of avulsion observed.

Table 18: Results of Alluvial Fan Analyses

Flooding Source	Location From (apex)	Location To (toe)	1% Annual Chance Peak Flow at Fan Apex (cfs)	Flood Zones and Depths (ft)	Minimum Velocity (fps)	Maximum Velocity (fps)
Culvert Creek Fan	From apex of fan	Highway I-10	1,750	AO 1-2', AE	1	6
Mountain Wash Fan	From apex of fan	Stan Rd	2,140	AO 1-3'	2	6
Petal Creek Fan	From apex of Petal Creek fan	Tangerine Rd	880	AO 1-3', A	1	7
Valley Creek Fan	From apex of N. Fork Inundation River Fan	Maple Ln	1,500	AO	N/A	N/A

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.

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 visit the NGS website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for **Flood County** are provided in Table 19.

Table 19: Countywide Vertical Datum Conversion

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from **NGVD29** to **NAVD88** (**feet**)
Flood Forest	**SE**	**44.500**	**-83.625**	**-0.620**
Flood Lake	**SE**	**44.500**	**-83.500**	**-0.665**
Flood Point	**SE**	**44.500**	**-83.875**	**-0.658**
Flood Pond	**SE**	**44.500**	**-83.750**	**-0.594**
Flood SE	**SE**	**44.250**	**-83.750**	**-0.647**
Flood SW	**SW**	**44.250**	**-83.625**	**-0.682**
Floodland	**SE**	**44.250**	**-83.500**	**-0.705**
Metropolis SE	**SE**	**44.375**	**-83.875**	**-0.554**
Metropolis SW	**SW**	**44.500**	**-83.375**	**-0.722**
Average Conversion from **NGVD29** to **NAVD88** = **-0.650 feet**				

A countywide conversion factor could not be generated for Flood County because the maximum variance from average exceeds 0.25 feet. Calculations for the vertical offsets on a stream by stream basis are depicted in Table 20.

Table 20: Stream-Based Vertical Datum Conversion

Flooding Source	Average Vertical Datum Conversion Factor (feet)
Flower Creek	-0.604
Inundation River	-0.681
Little Creek	-0.545
North Fork Inundation River	-0.627
Petal Creek	-0.513
South Fork Inundation River	-0.592
Spring Creek	-0.447
Summer Creek, Winter Creek	-0.463

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/flood-maps/guidance-partners/guidelines-standards.

Base map information shown on the FIRM was derived from the sources described in Table 21.

Table 21: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
Digital Orthophoto	Flood County & USGS	2005	1 foot GSD	Color orthoimagery was provided for urban areas of the county
Digital Orthophoto	USGS	1998	1:12,000	Digital Orthophoto Quadrangles were used in rural areas of the county
Political boundaries	Flood County	2005	1:5,000	Municipal and county boundaries
Public Land Survey System (PLSS)	State Center for Geographic Information	2005	1:24,000	PLSS data were digitized from USGS quadrangles

Data Type	Data Provider	Data Date	Data Scale	Data Description
Transportation Features	**State Center for Geographic Information**	**2003**	**1:10,000**	**Roads and railroads, were delineated from 2005 orthoimagery**
Surface Water Features	**State Center for Geographic Information**	**2003**	**1:5,000**	**Streams, rivers, and lakes were derived from NHD data**

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 22. **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 22, 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 22.**

In cases where the 1-percent and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary 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 23, “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-percent-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-percent-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 22. All topographic data used for modeling or mapping has been converted as necessary to NAVD88. The 1-percent-annual-chance elevations for selected cross sections along these flooding sources, along with their non-

encroachment widths, if calculated, are shown in Table 24, "Flood Hazard and Non-Encroachment Data for Selected Streams."

Table 22: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data			
		Description	Vertical Accuracy	Horizontal Accuracy	Citation
Flood County	**All within HUC 99999998**	**Light Detection and Ranging data (LiDAR)**	**9.25 cm RMSEz**	**1 meter at 95% confidence level**	**USGS 2008**
Metropolis, City of	**Lily Pond**	**Contour Lines**	**92.7 cm RMSEz**	**+/- 40 ft at 90% confidence level**	**USGS 1988**

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

Table 23: Floodway Data

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	60	46	262	5.8	20.1	20.1	20.2	0.1
B	160	51	353	4.3	21.5	21.5	22.5	1.0
C	680	170	1,253	1.2	22.0	22.0	22.9	0.9

[1] Feet above mouth

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: CULVERT CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
009	920	34	219	4.4	22.0	14.2[2]	15.2	1.0
026	2,560	38	188	4.6	22.0	18.0[2]	18.1	0.1
036	3,560	34	187	4.7	22.0	20.0[2]	20.1	0.1
043	4,280	38	169	2.5	22.0	20.1[2]	20.2	0.1
044	4,390	38	169	2.5	22.1	20.1[2]	20.2	0.1
048	4,830	26	102	4.2	22.3	20.6[2]	20.7	0.1
053	5,270	26	109	3.9	22.6	21.5[2]	21.7	0.2
054	5,360	26	109	3.9	22.7	21.5[2]	21.7	0.2
055	5,530	36	167	2.6	22.8	22.0[2]	23.0	1.0

[1] Feet above mouth
[2] Computed without consideration of backwater effects from Inundation River

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: FLOWER CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	82,440	1,395	23,879	4.9	22.2	22.2	23.2	1.0
B	84,620	2,208	42,275	2.7	22.8	22.8	23.8	1.0
C	86,800	2,500	45,371	2.6	23.1	23.1	24.1	1.0
D	89,600	3,921	72,926	1.6	23.3	23.3	24.3	1.0
E	121,600	5,548	88,146	1.3	24.0	24.0	25.0	1.0
F	123,550	6,965	129,249	0.9	24.0	24.0	25.0	1.0
G	126,250	7,598	138,886	0.8	24.0	24.0	25.0	1.0
H	128,400	6,440	125,613	0.9	24.1	24.1	25.1	1.0
I	130,300	7,170	133,927	0.8	24.1	24.1[2]/ 21.3[3]/ 22.1[4]	25.1	1.0
J	132,250	6,701	128,508	0.9	24.1	24.1	25.1	1.0
K	133,050	7,198	131,137	0.8	24.1	24.1	25.1	1.0
L	135,700	6,116	113,706	1.0	24.1	24.1	25.1	1.0
M	137,800	5,938	103,284	1.1	24.1	24.1	25.1	1.0
N	139,600	6,274	115,736	1.0	24.2	24.2	25.2	1.0
O	141,500	6,398	111,041	1.0	24.2	24.2	25.2	1.0
P	143,150	6,551	101,204	1.1	24.2	24.2	25.2	1.0
Q	145,200	5,993	88,563	1.2	24.3	24.3	25.3	1.0
R	168,350	5,616	49,712	2.2	30.4	30.4	31.4	1.0
S	171,350	5,868	47,885	2.3	31.2	31.2	32.2	1.0
T	174,250	7,466	62,370	1.7	31.9	31.9	32.8	0.9
U	191,520	1,091	16,630	6.4	38.0	38.0	39.0	1.0

[1] Feet above mouth
[2] Elevation riverward of levee systems
[3] Elevation landward of right bank levee system
[4] Elevation landward of left bank levee system

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: INUNDATION RIVER

LOCATION		FLOODWAY[1]			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION[2]	DISTANCE[3]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	82,440	1,395	23,879	4.9	22.2	22.2	23.2	1.0
B	84,620	2,208	42,275	2.7	22.8	22.8	23.8	1.0
C	86,800	2,500	45,371	2.6	23.1	23.1	24.1	1.0
D	89,600	3,921	72,926	1.6	23.3	23.3	24.3	1.0
E	121,600	5,548	88,146	1.3	24.0	24.0	25.0	1.0
F	123,550	6,965	129,249	0.9	24.0	24.0	25.0	1.0
G	126,250	7,598	138,886	0.8	24.0	24.0	25.0	1.0
H	128,400	6,440	125,613	0.9	24.1	24.1	25.1	1.0
I	130,300	7,170	133,927	0.8	24.1	24.1	25.1	1.0
J	132,250	6,701	128,508	0.9	24.1	24.1	25.1	1.0
K	133,050	7,198	131,137	0.8	24.1	24.1	25.1	1.0
L	135,700	6,116	113,706	1.0	24.1	24.1	25.1	1.0

[1] Values reported are based on averages calculated across evaluation lines. Refer to model result grids for modeled variability in elevation and surcharge across the floodway.
[2] Floodway computed by 2-D or hybrid 1-D 2-D model at this location
[3] Feet above mouth

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: INUNDATION RIVER

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	39,950	611	16,224	1.7	36.7	36.7	37.7	1.0
B	43,630	284	7,306	3.7	36.7	36.7	37.7	1.0
C	45,630	282	7,335	3.7	37.0	37.0	38.0	1.0
D	46,590	431	7,137	2.5	37.2	37.2	38.2	1.0
E	48,910	332	6,198	2.9	37.5	37.5	38.5	1.0
F	50,070	439 / 208[2]	6,885	2.6	37.7	37.7	38.7	1.0
G	50,670	297 / 184[2]	5,233	3.2	37.8	37.8	38.8	1.0
H	50,760	300 / 177[2]	5,330	3.2	38.1	38.1	39.1	1.0
I	50,860	297	5,335	3.1	38.2	38.2	39.2	1.0
J	52,260	247	4,812	3.5	38.4	38.4	39.3	0.9
K	53,700	251	4,275	3.9	38.7	38.7	39.6	0.9
L	54,080	175	3,835	4.4	38.8	38.8	39.7	0.9
M	54,130	175	3,835	4.4	38.8	38.8	39.7	0.9
N	54,350	173	3,784	4.4	39.0	39.0	39.8	0.8
O	55,190	173	3,605	4.7	39.2	39.2	40.1	0.9
P	57,150	139	3,352	5.0	39.9	39.9	40.9	1.0

[1] Feet above mouth
[2] Total floodway width / width within jurisdiction

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: NORTH FORK INUNDATION RIVER

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A[2]	12,930	*	*	*	11.4	11.4	*	*
B	13,165	25	98	4.5	12.2	12.2	13.2	1.0
C	13,315	47	210	2.1	12.8	12.8	13.5	0.7
D	13,835	71	279	1.6	12.9	12.9	13.7	0.8
E	14,345	29	85	4.7	14.1	14.1	14.4	0.3
F[2]	14,425	*	*	*	14.6	14.6	*	*
G[2]	14,695	*	*	*	15.5	15.5	*	*
H	14,985	53	144	2.8	16.2	16.2	16.3	0.1
I	15,785	28	98	2.2	17.2	17.2	17.4	0.2
J	16,465	22	80	2.7	18.4	18.4	19.3	0.9
K	17,965	19	69	3.2	19.8	19.8	20.3	0.5

[1] Feet above mouth
[2] Floodway not computed/shown for this cross section

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: PETAL CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)				
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY (EXISTING CONDITIONS)	FUTURE CONDITIONS	EXISTING CONDITIONS WITHOUT FLOODWAY	EXISTING CONDITIONS WITH FLOODWAY	INCREASE
A	500	350	7,466	1.8	37.2	37.7	37.2	38.2	1.0
B	620	350	7,221	1.8	37.2	37.7	37.2	38.2	1.0
C	1,020	350	7,632	1.8	37.3	37.8	37.3	38.3	1.0
D	2,620	404	9,307	1.5	37.4	37.9	37.4	38.4	1.0
E	4,580	321	6,278	2.2	37.4	37.9	37.4	38.4	1.0
F	7,020	347	6,501	2.1	37.6	38.1	37.6	38.6	1.0
G	7,940	223	3,395	4.0	37.6	38.1	37.6	38.6	1.0
H	8,140	219	3,346	4.1	37.7	38.2	37.7	38.7	1.0
I	8,190	219	3,337	4.1	37.7	38.2	37.7	38.7	1.0
J	8,420	201	3,175	4.3	37.8	38.3	37.8	38.8	1.0
K	10,700	194	3,745	3.7	38.6	38.4	38.6	39.6	1.0

[1] Feet above mouth

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: WOOD BRANCH

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	8,600	265	2,464	3.9	*	8.5[3]	8.9	0.4
B	9,250	320	3,014	2.9	*	8.9[3]	9.6	0.7
C	9,830	250	1,977	3.6	9.8[2]	9.2[3]	10.1	0.9
D	11,680	135	1,024	4.8	10.5[2]	10.4[3]	10.7	0.3
E	12,690	80	739	7.0	12.8	12.8	13.3	0.5
F	13,470	71	746	6.9	15.6	15.6	16.5	0.9
G	16,030	33	318	14.4	18.0	18.0	18.8	0.8
H	16,765	75	357	12.8	23.0	23.0	23.6	0.6
I	17,059	125	797	5.7	26.4	26.4	27.1	0.7
J	17,559	325	1,296	5.4	29.1	29.1	29.5	0.4
K	17,860	154	1,512	4.7	30.7	30.7	31.6	0.9
L	18,239	88	1,098	6.4	32.3	32.3	33.2	0.9
M	18,730	190	1,977	3.6	36.7	36.7	37.6	0.9

[1] Feet above U.S. Highway 101
[2] Combined coastal and riverine effects from University Bay and College Creek
[3] Elevation computed without consideration of backwater effects from University Bay
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: COLLEGE CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	82,440	1,395	23,879	4.9	22.5	22.2[2]	23.2	1.0
B	84,620	2,208	42,275	2.7	22.8	22.8	23.8	1.0
C	86,800	2,500	45,371	2.6	23.1	23.1	24.1	1.0
D	89,600	3,921	72,926	1.6	23.3	23.3	24.3	1.0
E	121,600	5,548	88,146	1.3	24.0	24.0	25.0	1.0
F	123,550	6,965	129,249	0.9	24.0	24.0	25.0	1.0
G	126,250	7,598	138,886	0.8	24.0	24.0	25.0	1.0
H	128,400	6,440	125,613	0.9	24.1	24.1	25.1	1.0
H[3]	128,400	6,440	125,613	0.9	24.1	24.1	25.1	1.0
I[3]	130,300	7,170	133,927	0.8	24.1	24.1	25.1	1.0
J[3]	132,250	6,701	128,508	0.9	24.1	24.1	25.1	1.0
K[3]	133,050	7,198	131,137	0.8	24.1	24.1	25.1	1.0
L[3]	135,700	6,116	113,706	1.0	24.1	24.1	25.1	1.0

[1] Feet above mouth

[2] Elevation computed without consideration of backwater effects from University Bay

[3] This cross section lies within an area that has not been updated on the FIRM at this time due to the presence of levees that have not been demonstrated to meet the requirements of NFIP Regulation Section 65.10. Please refer to Section 4.4 of this FIS for more information.

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: INUNDATION RIVER

Non-encroachment areas may be delineated where it is not possible to delineate floodways because specific channel profiles with bridge and culvert geometry were not developed. Any non-encroachment determinations for this Flood Risk Project have been tabulated for selected cross sections and are shown in Table 24. The non-encroachment width indicates the measured distance left and right (looking downstream) from the mapped center of the stream to the non-encroachment boundary based on a surcharge of 1.0 foot or less.

Table 24: Flood Hazard and Non-Encroachment Data for Selected Streams

Flooding Source	Cross Section	Stream Station[1]	1% Annual Chance Flood Discharge (cfs)	1% Annual Chance Water Surface Elevation (feet NAVD88)	Non-Encroachment Width (feet)	
					Left	Right
Culvert Creek	179	17,857	850	22.3	50	60
Culvert Creek	195	19,499	780	23.6	60	80
Culvert Creek	210	20,993	780	24.3	20	200
Spring Branch	025	2,487	1,230	32.4	N/A	N/A
Spring Branch	056	5,612	1,090	37.5	N/A	N/A
Spring Branch	077	7,659	860	40.1	N/A	N/A

[1] Feet above mouth

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 22.

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-percent-annual-chance flood condition):

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

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

- **The *wave overtopping splash zone* is the area landward of the crest of an overtopped barrier, in cases where the potential 2-percent wave runup exceeds the barrier crest elevation by 3.0 feet or more.**
- **The *breaking wave height zone* occurs where 3-foot or greater wave heights could occur (this is the area where the wave crest profile is 2.1 feet or more above the total stillwater elevation).**
- **The *high-velocity flow zone* is landward of the overtopping splash zone (or area on a sloping beach or other shore type), where the product of depth of flow times the flow velocity squared (hv^2) is greater than or equal to 200 ft^3/sec^2. This zone may only be used on the Pacific Coast.**

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

Table 25 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 25: Summary of Coastal Transect Mapping Considerations

Coastal Transect	Primary Frontal Dune (PFD) Identified	Wave Runup Analysis: Zone Designation and BFE (ft NAVD88)	Wave Height Analysis: Zone Designation and BFE (ft NAVD88)	Zone VE Limit	SFHA Boundary
1	✓	VE 12	VE 14-16	PFD	PFD
2		N/A	VE 14-16 AE 9-12	Wave Height	SWEL
3		VE 16	N/A	Runup	Overtopping

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 30, "Map Repositories").

6.5.1 Letters of Map Amendment

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

To obtain an application for a LOMA, visit www.fema.gov/flood-maps/change-your-flood-zone 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/flood-maps/tutorials.

For more information about how to apply for a LOMA, call the FEMA Mapping and Insurance 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/flood-maps/change-your-flood-zone 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 Mapping and Insurance 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/flood-maps/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/flood-maps/change-your-flood-zone 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 Mapping and Insurance 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 **Flood County** FIRM are listed in Table 26. **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 26: Incorporated Letters of Map Change

Case Number	Effective Date	Flooding Source	FIRM Panel(s)
10-10-0012P	**01-01-2010**	**Inundation River**	**1234C0234E** **1234C0244D**[1]
10-10-0014P	**01-01-2005**	**North Fork Inundation River**	**1234C0234E**

[1] **Although a portion of LOMR 10-10-0012P falls within the scope of this map revision, panel 1234C0244D was not revised. Therefore, users must continue to refer to the annotated FIRM attachment for this LOMR for FIRM panel 1234C0244D.**

6.5.4 Physical Map Revisions

A Physical Map Revisions (PMR) is 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 Floods & Maps "Change Your Flood Zone Designation" 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 **Flood**

County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 27, "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 27 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 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 PMRs 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 Flood County FIRMs in countywide format was 07/23/2008.

Table 27: Community Map History

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Coastland, City of	02/15/1973	02/15/1973	10/10/1980 06/23/1975	09/28/1984	12/31/2011 07/23/2008 02/14/2005 09/02/1998
Flood County, Unincorporated Areas	11/01/1974	11/01/1974	09/06/1977	08/15/1984	12/31/2011 07/23/2008 10/26/2002 02/18/1998
Floodville, Town of	04/15/1974	04/15/1975	N/A	12/15/1984	07/23/2008 01/05/2003 05/26/1998
Metropolis, City of[1]	11/01/1974	11/01/1974	09/06/1977	08/15/1984	12/31/2011 07/23/2008 10/26/2002 02/18/1998
Upland, Village of[2, 3]	07/23/2008	N/A	N/A	07/23/2008	12/31/2011
Water, City of[3]	07/23/2008	N/A	N/A	07/23/2008	N/A

[1] Dates for this community were taken from Flood County, Unincorporated Areas
[2] No Special Flood Hazard Areas Identified
[3] This community did not have a FIRM prior to the first countywide FIRM for Flood County

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 28 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 28: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Big Ocean	02/18/1998	ABC Engineers, Inc.	EMW-B-8888	September 1989	Coastland, City of; Flood County, Unincorporated Areas
Culvert Creek	02/18/1998	ABC Engineers, Inc.	EMW-C-9999	April 1997	Flood County, Unincorporated Areas

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Inundation River (Zone AE)	07/23/2008	State DNR	MAS-B-1234	March 2007	Flood County, Unincorporated Areas; Metropolis, City of
Inundation River (Zone A)	02/18/1998	ABC Engineers, Inc.	EMW-C-9999	March 1997	Flood County, Unincorporated Areas; Metropolis, City of
Lily Pond	10/26/2002	State DNR	HSF-J-7654	January 2002	Metropolis, City of
North Fork Inundation River	12/31/2011	State DNR	HSF-J-7654	May 2010	Coastland, City of; Flood County, Unincorporated Areas
South Fork Inundation River	12/31/2011	State DNR	HSF-J-7654	June 2010	Flood County, Unincorporated Areas
West River and Zone A Tributaries	12/31/2011	State DNR	HSF-J-7654	February 2010	Flood County, Unincorporated Areas; Metropolis, City of
Wood Branch and Zone A Tributaries	12/31/2011	State DNR	HSF-J-7654	December 2009	Flood County, Unincorporated Areas; Floodville, Town of

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 29. 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 29: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Coastland, City of	12/31/2011	11/30/2010	CCO Meeting	FEMA, the community, and the study contractor
		02/08/2010	Resilience	FEMA, the community, the study contractor, and the State Hazard Mitigation office
		03/16/2008	Discovery	FEMA, the community, the study contractor, and USACE
Flood County Unincorporated Areas	12/31/2011	11/30/2010	CCO Meeting	FEMA, the community, and the study contractor
		02/08/2010	Resilience	FEMA, the community, the study contractor, and the State Hazard Mitigation office
		03/16/2008	Discovery	FEMA, the community, the study contractor, and USACE
Floodville, Town of	07/23/2008	08/15/2006	CCO Meeting	FEMA, the community, and the study contractor
		01/08/2004	Scoping	FEMA, the community, and the study contractor
Metropolis, City of	12/31/2011	12/01/2010	Open House	FEMA, the community, and the study contractor
		11/30/2010	CCO Meeting	FEMA, the community, and the study contractor
		02/08/2010	Resilience	FEMA, the community, and the study contractor
		03/16/2008	Discovery	FEMA, the community, the study contractor, and USACE
Upland, Village of	12/31/2011	11/28/2010	CCO Meeting	FEMA, the community, and the study contractor
		03/17/2008	Discovery	FEMA, the community, the study contractor, and USACE
Water, City of	07/23/2008	08/15/2006	CCO Meeting	FEMA, the community, and the study contractor
		01/07/2004	Scoping	FEMA, the community, and the study contractor

SECTION 8.0 – ADDITIONAL INFORMATION

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

The additional data that was used for this project includes the FIS Report and FIRM that were previously prepared for Dry County and the City of New Metropolis, (FEMA 2006). In addition, the USACE prepared a Tsunami Prediction Study for Flood County in 1967 in response to the destruction caused by the March 1964 tsunami (USACE 1964).

Table 30 is a list of the locations where FIRMs for **Flood 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 30: Map Repositories

Community	Address	City	State	Zip Code
Coastland, City of	**456 Sump Pump Boulevard**	**Coastland**	**ST**	**99999**
Flood County, Unincorporated Areas	**123 Noah's Ark Drive**	**Floodville**	**ST**	**99999**
Floodville, Town of	**789 Highwaters Street**	**Floodville**	**ST**	**99999**
Metropolis, City of	**1234 Stilts Avenue**	**Metropolis**	**ST**	**99999**
Upland, Village of[1]	**800 River Road**	**Upland**	**ST**	**99999**

[1] **No Special Flood Hazard Areas Identified**

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 31.

Table 31 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 31: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	www.fema.gov/flood-maps/products-tools/know-your-risk/engineers-surveyors-architects
NFIP website	www.fema.gov/flood-insurance
NFHL Dataset	msc.fema.gov
FEMA Region X	**Federal Regional Center** **130 228th Street SW** **Bothell, WA 98021-9796** **(425) 487-4657**
Other Federal Agencies	
USGS website	www.usgs.gov
Hydraulic Engineering Center website	www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	**Chris Harris, CFM** **Dept. of Land Conservation & Development** **1234 Stilts Avenue** **Metropolis, State 99999** **(111) 999-0050 x111** **chris.harris@state.gov.us**
State GIS Coordinator	**Julio Gonzales, GISP** **Statewide GIS Coordinator** **1234 Stilts Avenue** **Metropolis, State 99999** **Phone: (111) 999-6066** **julie.gonzales@state.gov.us**

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 32 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 32: 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
ABC Eng, 1978	**ABC Engineers, Inc.**	***Flower Creek Water Supply, Coastland Water Board, City of Coastland, State, C10933.00***		**City of Coastland, State**	**April 1978**	**City of Coastland Water Board**
Coastland 1977	**City of Coastland**	***Inventory of Coastal Resources for the 1990 Comprehensive Plan***			**December 1977**	**City of Coastland library**
Coastland 1978	**City of Coastland**	***1990 Comprehensive Plan***			**September 1978**	**City of Coastland library**
FEMA 1989	**Federal Emergency Management Agency**	***Flood Insurance Study, Flood County, State, and Unincorporated Areas***		**Washington, D.C.**	**1989**	**FEMA Flood Map Service Center msc.fema.gov**
FEMA 1996	**Federal Emergency Management Agency**	***Flood Insurance Study, City of Floodville, Flood County, State***		**Washington, D.C.**	**1996**	**FEMA Flood Map Service Center msc.fema.gov**
FIA 1977	**U.S. Department of Housing and Urban Development, Federal Insurance Administration**	***Flood Hazard Boundary Map, Flood County, USA, Community-Panel Numbers 410042 0001 through 0021***	**Sidney McFlood**	**Washington, D.C.**	**September 1977**	**FEMA Flood Map Service Center msc.fema.gov**

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
State CES 1967	**State University, Resource Development Section, Cooperative Extension Service**	***Resources Analysis, Flood County, State***	**Dave Waters and Gary Mapper**	**City of Coastland, State**	**December 1967**	**extension.state.edu/catalog/**
USGS 1988	**U.S. Department of Interior, Geological Survey**	***7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet.* Coastland, ST (1984, revised 1988)**		**Washington, D.C.**	**Various**	**topomaps.usgs.gov**
USGS 2008	**U.S. Department of Interior, Geological Survey**	***LiDAR Data, Scale 1:4,800, Contour Interval 2 Feet.***		**Washington, D.C.**	**2008**	**lidar.cr.usgs.gov/**