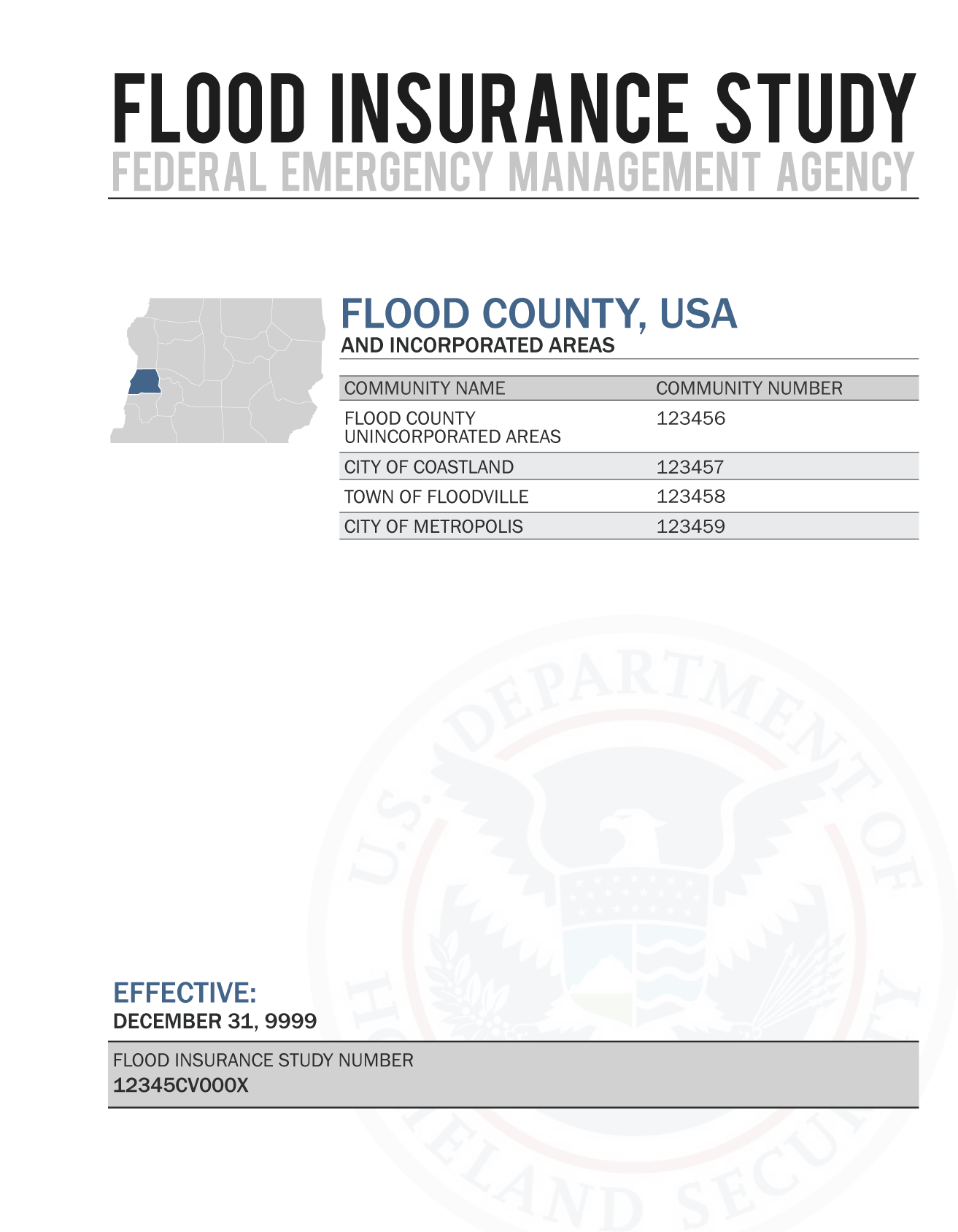
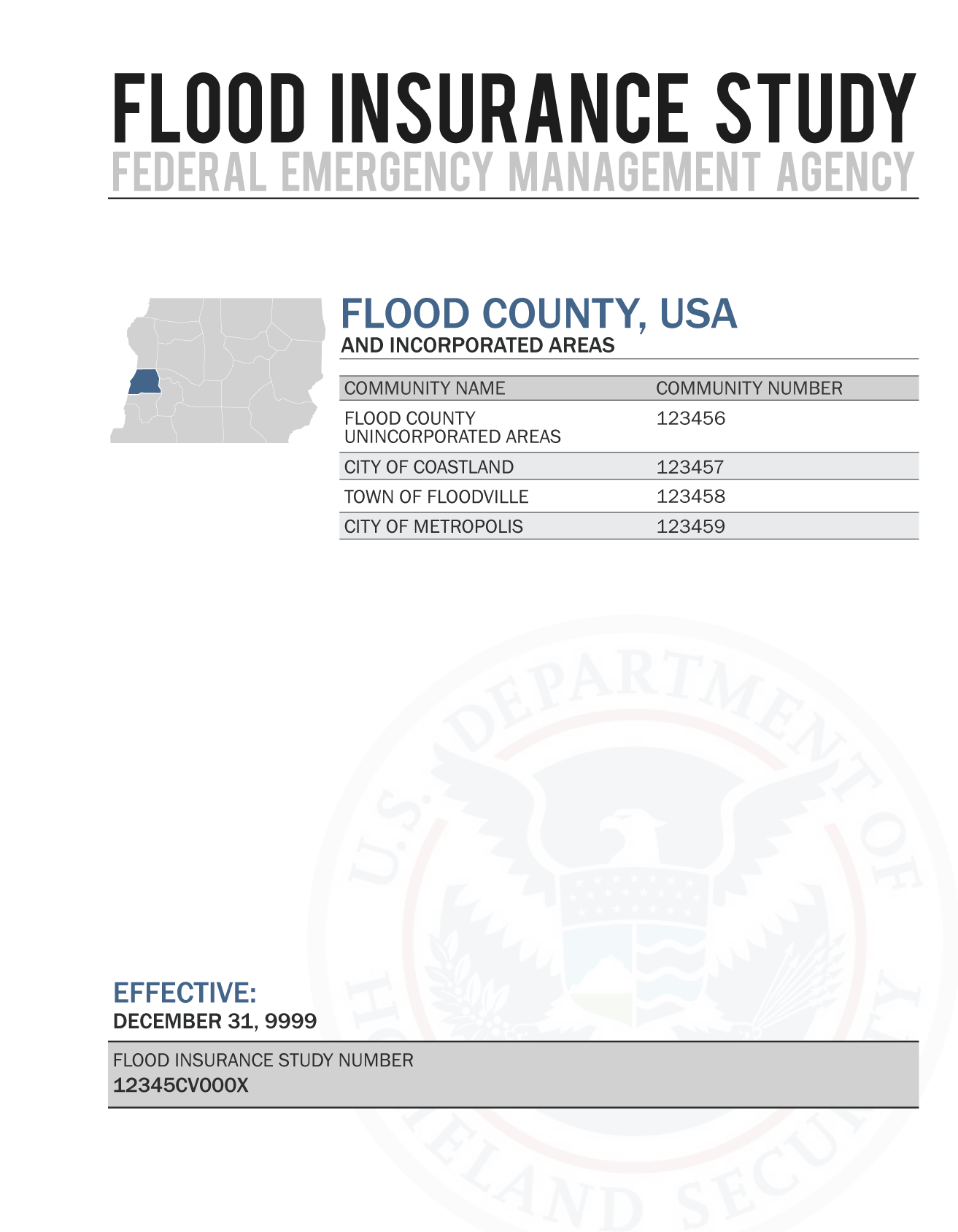
****

**VOLUME 1 OF 2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Graphic showing where Flood County is located within the State.** | **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** | | |

|  |
| --- |
| **This is the DHS-FEMA logo placed on the traditional FIS Report cover, located in the lower left corner.** |
| **EFFECTIVE:** |
| **DECEMBER 31, 2011** |
| FLOOD INSURANCE STUDY NUMBER |
| **12345CV000X**  Version Number 2.3.3.2 |

****

**VOLUME 1 OF 2**

|  |  |
| --- | --- |
| **Graphic showing where Flood County is located within the State.** | **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:** | This is the DHS-FEMA logo placed on an FIS Report cover that contains a large number of community listings.  The logo is located in the lower right corner. |
| **DECEMBER 31, 2011** |
| FLOOD INSURANCE STUDY NUMBER |
| **12345CV001A**  Version Number 2.3.3.2 |

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| **Willow Creek** | **10** | P |

**[other profiles up to 100 pages in document]**

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**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** | **12345C0150X2** |  |
| **Upland, Village of1** | **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 31, “Map Repositories,” within this FIS Report.

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

The initial Countywide FIS Report for **Flood County** became effective on **December 31, 9999**. Refer to Table 28 for information about subsequent revisions to the FIRMs.

* **Selected FIRM panels for the community may contain information (such as floodways and cross sections) that was previously shown separately on the corresponding Flood Boundary and Floodway Map (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**  **B** | **VE**  **X (shaded)** |
| **C** | **X (unshaded)** |

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

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

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

**Since the status of levees is subject to change at any time, the user should contact the appropriate agency for the latest information regarding levees presented in Table 9 of this FIS Report. For levees owned or operated by the U.S. Army Corps of Engineers (USACE), information may be obtained from the USACE National Levee Database (**[**nld.usace.army.mil**](http://nld.usace.army.mil)**). For all other levees, the user is encouraged to contact the appropriate local community.**

**Please also note that FEMA has identified one or more levees 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’s capacity to provide 1-percent-annual-chance flood protection. As such, temporary actions are being taken until such time as FEMA is able to initiate a new flood risk project to apply new levee analysis and mapping procedures to leveed areas. 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/online-tutorials](https://www.fema.gov/online-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 map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at [msc.fema.gov](https://msc.fema.gov/). Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

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

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

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

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

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

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

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

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

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

PROJECTION INFORMATION: The projection used in the preparation of the map was **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](https://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 31 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 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

**SPECIAL NOTES FOR SPECIFIC FIRM PANELS**

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

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

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

**Accredited Levee: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit** [**www.fema.gov/national-flood-insurance-program**](https://www.fema.gov/national-flood-insurance-program)**.**

**Provisionally Accredited Levee: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. 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 de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit** [**www.fema.gov/national-flood-insurance-program**](https://www.fema.gov/national-flood-insurance-program)**.**

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.* | |
| Light Blue Rectangle | 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. |
| Screen for Regulatory Floodway determined in Zone AE.  Light blue rectangle with diagonal red hatching. | Regulatory Floodway determined in Zone AE. |
| Light Blue Rectangle | **Non-encroachment zone (see Section 2.4 of this FIS Report for more information)** |
| Screen for Colorado River Floodway.  Light blue rectangle with diagonal red cross-hatching.  FLOOD INSURANCE IS NOT AVAILABLE FOR STRUCTURES NEWLY BUILT OR SUBSTANTIALLY IMPROVED ON OR AFTER APRIL 8, 1987, IN THE DESIGNATED COLORADO RIVER FLOODWAY | **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** | |
| Solid light orange rectangle | 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. |
| Screen for Future Conditions 1% Annual Chance Flood Hazard.  Light grey rectangle with diagonal darker grey hatching. | 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. |
| Screen for Area with Reduced Flood Risk due to Levee.  Light orange rectangle with diagonal grey hatching. | Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood. **See Notes to Users for important information.** |
| Screen for Area with Flood Risk due to Levee.  Light yellow rectangle with diagonal grey hatching. | Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1% annual chance flood. |
| **OTHER AREAS** | |
| Solid light orange color rectangle | 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** | |
| Flood Zone Boundary symbology for ortho-based maps Flood Zone Boundary symbology for vector-based maps  (ortho) (vector) | Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping) |
| Red line with a white line through the middle | Limit of Study |
| Yellow line with a black line through the middle | Jurisdiction Boundary |
| LiMWA symbology | Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet |
| **GENERAL STRUCTURES** | |
| Black dash lines  *Aqueduct*  *Channel*  *Culvert*  *Storm Sewer* | Channel, Culvert, Aqueduct, or Storm Sewer |
| \_\_\_\_\_\_\_\_\_\_  *Dam*  *Jetty*  *Weir* | Dam, Jetty, Weir |
| PALevee | Levee, Dike, or Floodwall |
| Bridge symbology  *Bridge* | Bridge |
| **COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA):** *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.* ***See Notes to Users for important information.*** | |
| Black diagonal lines  **CBRS AREA 09/30/2009** | Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway. |
| Diagonal black dash lines**OTHERWISE PROTECTED AREA 09/30/2009** | Otherwise Protected Area |
| **REFERENCE MARKERS** | |
| A number above a dot | River mile Markers |
| **CROSS SECTION & TRANSECT INFORMATION** | |
| Lettered Cross Section symbology | Lettered Cross Section with Regulatory Water Surface Elevation (BFE) |
| Numbered cross section symbology | Numbered Cross Section with Regulatory Water Surface Elevation (BFE) |
| Unlettered cross section symbology | Unlettered Cross Section with Regulatory Water Surface Elevation (BFE) |
| Coastal transect symbology | Coastal Transect |
| ProfileBaseline | 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. |
| CoastBaseline | 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. |
| BFE | 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 |
| **BASE MAP FEATURES** | |
| *HydroFeature (Solid Blue Line)Missouri Creek* | River, Stream or Other Hydrographic Feature |
| Interstate highway symbology | Interstate Highway |
| us highway symbol | U.S. Highway |
| state highway symbol | State Highway |
| county highway symbol | County Highway |
| MAPLE LANE  road symbology | Street, Road, Avenue Name, or Private Drive if shown on Flood Profile |
| *railroad symbology RAILROAD* | Railroad |
|  | Horizontal Reference Grid Line |
|  | Horizontal Reference Grid Ticks |
| A cross figure | Secondary Grid Crosshairs |
| Land Grant | Name of Land Grant |
| 7 | Section Number |
| R. 43 W. T. 22 N. | Range, Township Number |
| **4276000mE** | Horizontal Reference Grid Coordinates (UTM) |
| **365000 FT** | Horizontal Reference Grid Coordinates (State Plane) |
| **80° 16’ 52.5”** | Corner Coordinates (Latitude, Longitude) |

# SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

## 2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-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 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1- 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- 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 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1-percent-annual-chance floodplain corresponds to the SFHAs. The 0.2-percent-annual-chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

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

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

Table 2: Flooding Sources Included in this FIS Report

| Flooding Source | Community | Downstream Limit | Upstream Limit | HUC-8 Sub-Basin(s) | Length (mi) (streams or coastlines) | Area (mi2) (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** |

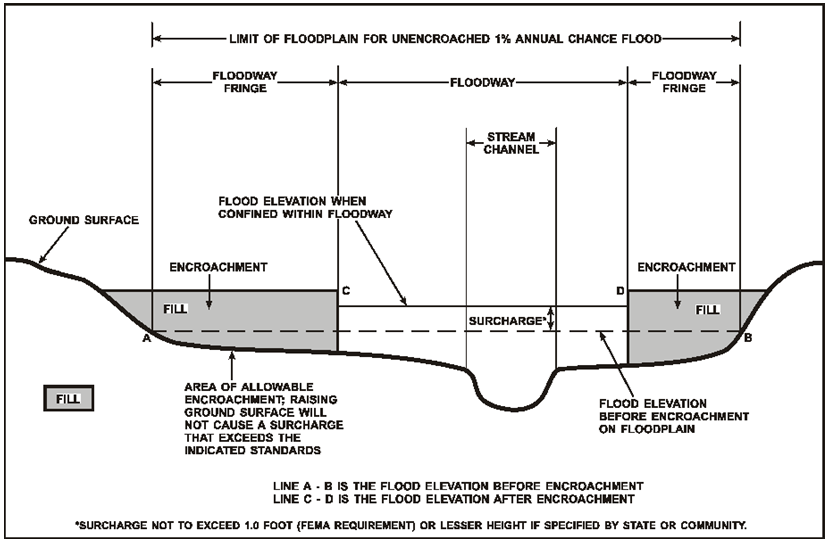
## 2.2 Floodways

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 24, “Floodway Data.”**

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

## 2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (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 25, “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.**

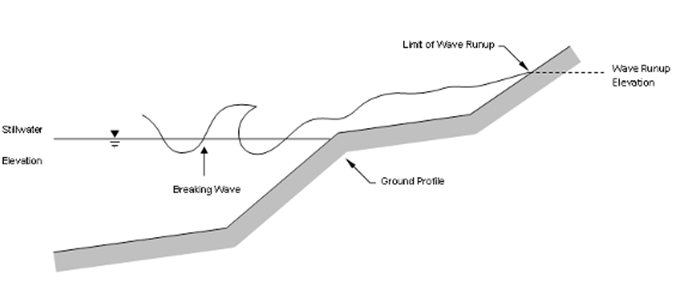
* ***Wave setup* is the increase in stillwater elevation at the shoreline caused by the reduction of waves in shallow water. It occurs as breaking wave momentum is transferred to the water column.**

**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-Percent-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 26 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 17, “Coastal Transect Parameters.” The locations of transects are shown in Figure 9, “Transect Location Map.” More detailed information about the methods used in coastal analyses and the results of intermediate steps in the coastal analyses are presented in Section 5.3 of this FIS Report. Additional information on specific mapping methods is provided in Section 6.4 of this FIS Report.**

### 2.5.3 Coastal High Hazard Areas

**Certain areas along the open coast and other areas may have higher risk of experiencing structural damage caused by wave action and/or high-velocity water during the 1-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.**

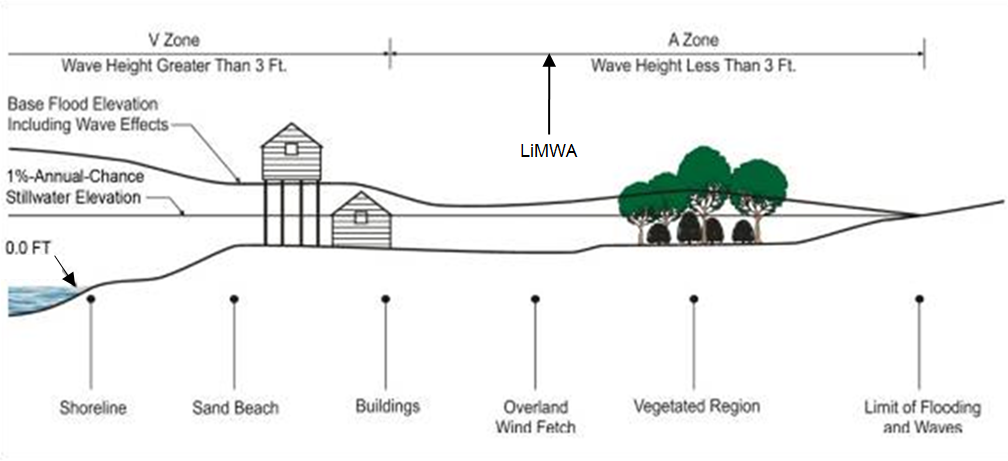
**CHHAs are designated as “V” zones (for “velocity wave zones”) and are subject to more stringent regulatory requirements and a different flood insurance rate structure. The areas of greatest risk are shown as VE on the FIRM. Zone VE is further subdivided into elevation zones and shown with BFEs on the 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 17 due to the presence of wave effects. The higher elevation should be used for construction and/or floodplain management purposes.**

### 2.5.4 Limit of Moderate Wave Action

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

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

**The effects of wave hazards in Zone AE between Zone VE (or the shoreline where Zone VE is not identified) and the limit of the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot or greater breaking waves are projected to occur during the 1-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** |

## 3.2 Coastal Barrier Resources System

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

Table 4: Coastal Barrier Resources System Information

| Primary Flooding Source | CBRS/OPA Type | Date CBRS Area Established | FIRM Panel Number(s) |
| --- | --- | --- | --- |
| **Big Ocean** | **CBRS** | **1/1/1999** | **12345C0235X** |

# SECTION 4.0 – AREA STUDIED

## 4.1 Basin Description

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

Table 5: Basin Characteristics

| HUC-8 Sub-Basin Name | HUC-8  Sub-Basin Number | Primary Flooding Source | Description of Affected Area | Drainage Area (**square miles**) |
| --- | --- | --- | --- | --- |
| **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 6 contains a description of the principal flood problems that have been noted for **Flood County** by flooding source.

Table 6: 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 3 months each year. The worst flooding occurs when high tides combine with high runoff and onshore winds during major winter storms.** |
| **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 7 contains information about historic flood elevations in the communities within **Flood County**.

Table 7: 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 Non-Levee Flood Protection Measures

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

Table 8: Non-Levee Flood Protection Measures

| Flooding Source | Structure Name | Type of Measure | Location | Description of Measure |
| --- | --- | --- | --- | --- |
| **Big Ocean** | **A.B. Smith Jetty** | **Jetties** | **At entrance channel** | **Constructed by USACE in 1929** |
| **Big Ocean** | **N/A** | **Berms and riprap** | **Floodville, along the coast of the Big Ocean** | **Several property owners in this city have placed berms and riprap to protect homes** |
| **Big Ocean** | **N/A** | **Tidal flooding warnings** | **Low-lying coastal areas** | **Flood Weather Forecast Office issues storm tide warnings** |
| **Inundation River** | **N/A** | **Dam** | **1.5 miles upstream of Rockhampton Circle** | **Maintained by Floodville Waterworks** |
| **Inundation River** | **N/A** | **Dike** | **Various locations** | **Not high enough to completely prevent flooding** |

## 4.4 Levees

**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 risk 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 FIRM flood zone.**

**Levee systems that are determined to reduce the risk 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 Section 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’s certification status. Accredited levee systems and PALs are shown on the FIRM using the symbology shown in Figure 3 and in Table 9. If the required information for a PAL is not submitted within the required timeframe, or if information indicates that a levee system not longer meets Section 65.10, FEMA will de-accredit the levee system and issue an effective FIRM showing the levee-impacted area as a SFHA.**

**FEMA coordinates its programs with USACE, who may inspect, maintain, and repair levee systems. The USACE has authority under Public Law 84-99 to supplement local efforts to repair flood control projects that are damaged by floods. Like FEMA, the USACE provides a program to allow public sponsors or operators to address levee system maintenance deficiencies. Failure to do so within the required timeframe results in the levee system being placed in an inactive status in the USACE Rehabilitation and Inspection Program. Levee systems in an inactive status are ineligible for rehabilitation assistance under Public Law 84-99.**

**FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levees that exist within Flood County. Table 9, “Levees,” lists all accredited levees, PALs, and de-accredited levees 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. Levees identified as PALs in the table are labeled on the FIRM to indicate their provisional status.**

**Please note that the information presented in Table 9 is subject to change at any time. For that reason, the latest information regarding any USACE structure presented in the table should be obtained by contacting USACE and accessing the USACE National Levee Database. For levees owned and/or operated by someone other than the USACE, contact the local community shown in Table 31.**

**Please note that FEMA has identified levees 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’s capacity to provide 1-percent-annual-chance flood protection. 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 9 of this FIS Report.**

Table 9: Levees

| Community | Flooding Source | Levee Location | Levee Owner | USACE Levee | Levee ID | Covered Under PL84-99 Program? | FIRM Panel(s) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Flood County, Unincorporated Areas** | **Inundation River** | **Left Bank** | **Flood County Water Supply** | **Yes** | **1234545362** | **Yes** | **12345C0234X** |
| **Flood County, Unincorporated Areas** | **Inundation River** | **Right Bank** | **Flood County Water Supply** | **Yes** | **1354212346** | **Yes** | **123450C234X** |
| **Floodville, Town of** | **Inundation River** | **Left Bank** | **Floodville Waterworks** | **No** | **1901990990** | **No** | **12345C0245X** |

# 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 one 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 27, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, “FIRM Revisions.”**

## 5.1 Hydrologic Analyses

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

**A summary of the discharges is provided in Table 10. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 11. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 17.) Stream gage information is provided in Table 12.**

Table 10: Summary of Discharges

|  |  |  | Peak Discharge (**cfs**) | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Flooding Source | Location | Drainage Area (**Square Miles**) | 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

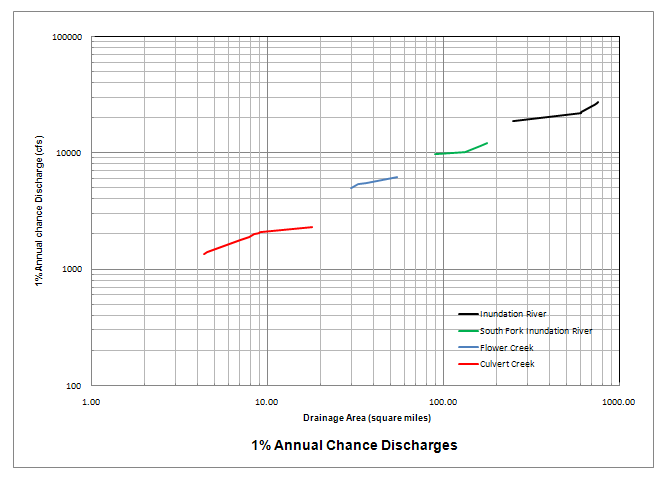


Table 11: Summary of Non-Coastal Stillwater Elevations

|  |  | Elevations (**feet NAVD88**) | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Flooding Source | Location | 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 12: Stream Gage Information used to Determine Discharges

| Flooding Source | Gage Identifier | Agency that Maintains Gage | Site Name | Drainage Area (Square Miles) | Period of Record | |
| --- | --- | --- | --- | --- | --- | --- |
| From | To |
| **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 24, “Floodway Data.”**

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

Table 13: Summary of Hydrologic and Hydraulic Analyses

| Flooding Source | Study Limits  Downstream Limit | Study Limits  Upstream Limit | Hydrologic Model or Method Used | Hydraulic Model or Method Used | Date Analyses Completed | Flood Zone on FIRM | Special Considerations |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | **Levee analysis and mapping procedures were applied to Levee 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% annual chance flood.** |

Table 14: 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 15 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.**

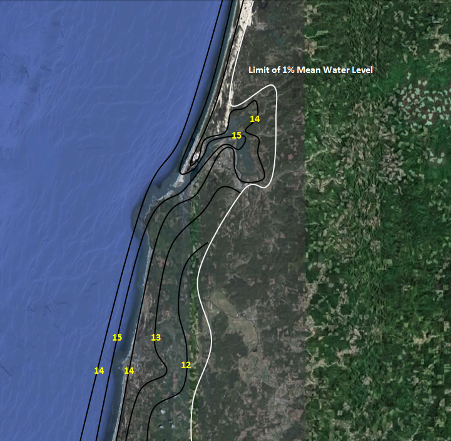
Table 15: Summary of Coastal Analyses

| Flooding  Source | Study Limits  From | | Study Limits  To | Hazard Evaluated | Model or Method Used | Date Analysis was Completed |
| --- | --- | --- | --- | --- | --- | --- |
| **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 15. The stillwater elevation that was used for each transect in coastal analyses is shown in Table 17, “Coastal Transect Parameters.” Figure 8 shows the total stillwater elevations for the 1-percent-annual-chance flood that was determined for this coastal analysis.**

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

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#### 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 16 provides the gage name, managing agency, gage type, gage identifier, start date, end date, and statistical methodology applied to each gage used to determine the stillwater elevations. 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 16: 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 15 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 15**. **The post-event eroded profile was used for the subsequent transect-based onshore wave hazard analyses.**

### 5.3.4 Wave Hazard Analyses

**Overland wave hazards were evaluated to determine the combined effects of ground elevation, vegetation, and physical features on overland wave propagation and wave runup. These analyses were performed at representative transects along all shorelines for which waves were expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1-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 17 provides the location, stillwater elevations, and starting wave conditions for each transect evaluated for overland wave hazards. In this table, “starting” indicates the parameter value at the beginning of the transect.**

#### Wave Height Analysis

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

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

Table 17: Coastal Transect Parameters

| Flood Source | Coastal Transect | Starting Wave Conditions for the 1% Annual Chance | | Starting Stillwater Elevations (ft **NAVD88**)  Range of Stillwater Elevations   (ft **NAVD88**) | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Significant Wave Height  Hs (**ft**) | Peak Wave Period  Tp (**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 18.**

**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 19, “Results of Alluvial Fan Analyses.”**

Table 18: 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 19: Results of Alluvial Fan Analyses

|  | 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**) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Flooding Source |
| **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](https://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](https://www.ngs.noaa.gov/).

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

Table 20: 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 21.**

Table 21: 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/guidelines-and-standards-flood-risk-analysis-and-mapping](https://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping).

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

Table 22: Base Map Sources

| Data Type | Data Provider | Data Date | Data Scale | Data Description |
| --- | --- | --- | --- | --- |
| **Digital Orthophoto** | **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** |
| **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 23. **For each coastal flooding source studied as part of this FIS Report, the mapped floodplain boundaries on the FIRM have been delineated using the flood and wave elevations determined at each transect; between transects, boundaries were delineated using land use and land cover data, the topographic elevation data described in Table 23, and knowledge of coastal flood processes. In ponding areas, flood elevations were determined at each junction of the model; between junctions, boundaries were interpolated using the topographic elevation data described in Table 23.**

In cases where the 1- and 0.2-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 24, “Floodway Data.”

**Certain flooding sources may have been studied that do not have published BFEs on the FIRMs, or for which there is a need to report the 1-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 23. 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 25, “Flood Hazard and Non-Encroachment Data for Selected Streams.”**

Table 23: Summary of Topographic Elevation Data used in Mapping

|  |  | Source for Topographic Elevation Data | | | |
| --- | --- | --- | --- | --- | --- |
| Community | Flooding Source | 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 24: Floodway Data

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | **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** | | | | |  |
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|  | **1Feet above mouth** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | | | | | |
| **FLOODING SOURCE: CULVERT CREEK** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | | | | | |
|  |  |  | | | | | |  | |  | | | | |  | | | | | | |  |  | | | | |  | | | | | |  | | | | | |  | | |
|  | **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** | | | | **14.22** | | | | | | **15.2** | | | | | | **1.0** | |  | | |  |
|  | **026** | | | **2,560** | | | | **38** | | | **188** | | | | | | **4.6** | | | | | **22.0** | | | | **18.02** | | | | | | **18.1** | | | | | | **0.1** | |  | | |  |
|  | **036** | | | **3,560** | | | | **34** | | | **187** | | | | | | **4.7** | | | | | **22.0** | | | | **20.02** | | | | | | **20.1** | | | | | | **0.1** | |  | | |  |
|  | **043** | | | **4,280** | | | | **38** | | | **169** | | | | | | **2.5** | | | | | **22.0** | | | | **20.12** | | | | | | **20.2** | | | | | | **0.1** | |  | | |  |
|  | **044** | | | **4,390** | | | | **38** | | | **169** | | | | | | **2.5** | | | | | **22.1** | | | | **20.12** | | | | | | **20.2** | | | | | | **0.1** | |  | | |  |
|  | **048** | | | **4,830** | | | | **26** | | | **102** | | | | | | **4.2** | | | | | **22.3** | | | | **20.62** | | | | | | **20.7** | | | | | | **0.1** | |  | | |  |
|  | **053** | | | **5,270** | | | | **26** | | | **109** | | | | | | **3.9** | | | | | **22.6** | | | | **21.52** | | | | | | **21.7** | | | | | | **0.2** | |  | | |  |
|  | **054** | | | **5,360** | | | | **26** | | | **109** | | | | | | **3.9** | | | | | **22.7** | | | | **21.52** | | | | | | **21.7** | | | | | | **0.2** | |  | | |  |
|  | **055** | | | **5,530** | | | | **36** | | | **167** | | | | | | **2.6** | | | | | **22.8** | | | | **22.02** | | | | | | **23.0** | | | | | | **1.0** | |  | | |  |
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|  |  | | |  | | | |  | | |  | | | | | |  | | | | |  | | | |  | | | | | |  | | | | | |  | |  | | |
| **1Feet above mouth**  **2Computed without consideration of backwater effects from Inundation River** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  |  | | | |  | | | | | | | | | |  | | | |  | | | |  | | | | |  | | | | | |  | | | | | |  | | |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | | | | |
| **FLOODING SOURCE: FLOWER CREEK** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | | | | |
|  |  |  | | | | | |  |  | | | | |  | | | | | | | |  |  | | | |  | | | | | |  | | | | | |  | | | |
|  | **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** | | | | **24.12/ 21.33/ 22.14** | | | | | | **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** |  | | | |
|  |  |  | | | | | |  | | |  | | | | | |  | | | | |  | | | |  | | | | | |  | | | | | |  |  | | | |
| **1Feet above mouth** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **2Elevation riverward of levees** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **3Elevation landward of right bank levee** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **4Elevation landward of left bank levee** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  |  | | | |  | | | | | | | | | |  | | | |  | | | |  | | | | |  | | | | | |  | | | | | |  | | |
| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | | | | |
| **FLOODING SOURCE: INUNDATION RIVER** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | | | | |
|  |  |  | | | | | |  |  | | | | |  | | | | | | | |  |  | | | |  | | | | | |  | | | | | | | |  | |
|  | **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 / 2082** | | | **6,885** | | | | | | | **2.6** | | | | **37.7** | | | | **37.7** | | | | | | **38.7** | | | | | | **1.0** | | |  | |
|  | **G** | | | **50,670** | | | | **297 / 1842** | | | **5,233** | | | | | | | **3.2** | | | | **37.8** | | | | **37.8** | | | | | | **38.8** | | | | | | **1.0** | | |  | |
|  | **H** | | | **50,760** | | | | **300 / 1772** | | | **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** | | |  | |
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|  | **1Feet above mouth** | | | | | | |  | | | | | | | | | | | | | |  | | | |  | | | | | |  | | | | | |  | | |  | |
|  | **2Total floodway width / width within jurisdiction** | | | | | | | | | | | | | | | | | | | | |  | | | |  | | | | | |  | | | | | |  | | |  | |
|  |  | | |  | | | |  | | | | |  | | | | |  | | | |  | | | |  | | | | | |  | | | | | |  | | |  | |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | | | |
| **FLOODING SOURCE: NORTH FORK INUNDATION RIVER** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | | | |
|  |  | | |  | | | |  | | | | |  | | | | |  | | | |  | |  | | | | | |  | | | | | |  | | | | |  | |
|  | **LOCATION** | | | | | | | **FLOODWAY** | | | | | | | | | | | | | | **1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)** | | | | | | | | | | | | | | | | | | |  | |
|  | CROSS SECTION | | | DISTANCE**2** | | | | WIDTH (**FEET**) | | | SECTION AREA  (**SQ. FEET**) | | | | | | | MEAN VELOCITY (**FEET/SEC**) | | | | REGULATORY | | | | WITHOUT FLOODWAY | | | | | | WITH FLOODWAY | | | | | | INCREASE | | |  | |
|  |  | | |  | | | |  | | |  | | | | | | |  | | | |  | | | |  | | | | | |  | | | | | |  | | |  | |
|  | **A1** | | | **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** | | |  | |
|  | **F1** | | | **14,425** | | | | **\*** | | | **\*** | | | | | | | **\*** | | | | **14.6** | | | | **14.6** | | | | | | **\*** | | | | | | **\*** | | |  | |
|  | **G1** | | | **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** | | |  | |
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|  | **1Floodway not computed/shown for this cross section** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  | |
|  | **2Feet above mouth** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  | |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | | | | | | | |
| **FLOODING SOURCE: PETAL CREEK** | | | | | | | | | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | | | | | | | |
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|  | **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** | | | **17,700** | | | | **90** | | | **1,273** | | | | | | | **3.1** | | | | **21.5** | | | | **21.5** | | | | | | **22.5** | | | | | | **1.0** | | |  | |
|  | **B** | | | **19,180** | | | | **339** | | | **3,260** | | | | | | | **1.2** | | | | **22.3** | | | | **22.3** | | | | | | **23.3** | | | | | | **1.0** | | |  | |
|  | **C** | | | **21,380** | | | | **237** | | | **2,389** | | | | | | | **1.6** | | | | **22.9** | | | | **22.9** | | | | | | **23.9** | | | | | | **1.0** | | |  | |
|  | **D** | | | **22,900** | | | | **809** | | | **7,235** | | | | | | | **0.5** | | | | **23.1** | | | | **23.1** | | | | | | **24.1** | | | | | | **1.0** | | |  | |
|  | **E** | | | **24,680** | | | | **973** | | | **6,866** | | | | | | | **0.6** | | | | **23.2** | | | | **23.2** | | | | | | **24.2** | | | | | | **1.0** | | |  | |
|  | **F** | | | **26,200** | | | | **107** | | | **1,577** | | | | | | | **2.5** | | | | **23.4** | | | | **23.4** | | | | | | **24.4** | | | | | | **1.0** | | |  | |
|  | **G** | | | **26,570** | | | | **107** | | | **1,602** | | | | | | | **2.4** | | | | **23.6** | | | | **23.6** | | | | | | **24.6** | | | | | | **1.0** | | |  | |
|  | **H** | | | **26,597** | | | | **107** | | | **1,602** | | | | | | | **2.4** | | | | **23.7** | | | | **23.7** | | | | | | **24.7** | | | | | | **1.0** | | |  | |
|  | **I** | | | **26,807** | | | | **114** | | | **1,680** | | | | | | | **2.3** | | | | **23.8** | | | | **23.8** | | | | | | **24.8** | | | | | | **1.0** | | |  | |
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|  | **1Feet above mouth** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  | |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | | | | | | | |
| **FLOODING SOURCE: WOOD BRANCH** | | | | | | | | | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | | | | | | | |

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|  | **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** | | | |  |
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| **1Feet above mouth** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| TABLE 24 | | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | |
| **FLOODING SOURCE: WOOD BRANCH** | | | | | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | |

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|  | **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** | **\*** | | **8.53** | | **8.9** | | **0.4** |  |
|  | **B** | | **9,250** | **320** | | **3,014** | | | **2.9** | **\*** | | **8.93** | | **9.6** | | **0.7** |  |
|  | **C** | | **9,830** | **250** | | **1,977** | | | **3.6** | **9.82** | | **9.23** | | **10.1** | | **0.9** |  |
|  | **D** | | **11,680** | **135** | | **1,024** | | | **4.8** | **10.52** | | **10.43** | | **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** |  |
|  |  | |  |  | |  | | |  |  | |  | |  | |  |  |
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|  | **1Feet above U.S. Highway 101** | | |  | | | | | |  | |  | |  | |  |  |
|  | **2Combined coastal and riverine effects from University Bay and College Creek** | | | | | | | | | | |  | |  | |  |  |
|  | **3Elevation computed without consideration of backwater effects from University Bay** | | | | | | | | | | |  | |  | |  |  |
|  | **\* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation** | | | | | | | | | | | | |  | |  |  |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | **FLOODWAY DATA** | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | |
| **FLOODING SOURCE: COLLEGE CREEK** | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | |

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|  | **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** | | **22.22** | | **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** |  |
|  | **H3** | | | **128,400** | | **6,440** | | **125,613** | | | | | **0.9** | | | | **24.1** | | **24.1** | | **25.1** | | **1.0** |  |
|  | **I3** | | | **130,300** | | **7,170** | | **133,927** | | | | | **0.8** | | | | **24.1** | | **24.1** | | **25.1** | | **1.0** |  |
|  | **J3** | | | **132,250** | | **6,701** | | **128,508** | | | | | **0.9** | | | | **24.1** | | **24.1** | | **25.1** | | **1.0** |  |
|  | **K3** | | | **133,050** | | **7,198** | | **131,137** | | | | | **0.8** | | | | **24.1** | | **24.1** | | **25.1** | | **1.0** |  |
|  | **L3** | | | **135,700** | | **6,116** | | **113,706** | | | | | **1.0** | | | | **24.1** | | **24.1** | | **25.1** | | **1.0** |  |
|  |  | | |  | |  | |  | | | | |  | | | |  | |  | |  | |  |  |
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|  | **1Feet above mouth** | | | | |  | | | | |  | | | |  | **3This 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.** | | | | | | | |  |
|  | **2Elevation computed without consideration of backwater effects from University Bay** | | | | | | | | | | | | | | |  |
|  |  | | | | | | | | | | | | | | |  |
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| TABLE 24 | **FEDERAL EMERGENCY MANAGEMENT AGENCY** | | | | | | | | | | | **FLOODWAY DATA** | | | | | | | | | | | | |
| **FLOOD COUNTY, STATE** | | | | | | | | | | |
| **FLOODING SOURCE: INUNDATION RIVER** | | | | | | | | | | | | |
| **AND INCORPORATED AREAS** | | | | | | | | | | |

**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 25. 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 25: 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 23.**

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

**The limit of Zone VE shown on the FIRM is defined as the farthest inland extent of any of these criteria (determined for the 1-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 (hv2) is greater than or equal to 200 ft3/sec2. This zone may only be used on the Pacific Coast.**

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

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

Table 26: Summary of Coastal Transect Mapping Considerations

| Coastal Transect | Primary Frontal Dune (PFD) Identified | Wave Runup Analysis | Wave Height Analysis | Zone VE Limit | SFHA Boundary |
| --- | --- | --- | --- | --- | --- |
| Zone Designation and BFE  (ft **NAVD88**) | Zone Designation and BFE  (ft **NAVD88**) |
| **1** | **✓** | **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 31, “Map Repositories”).

### 6.5.1 Letters of Map Amendment

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

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

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

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

### 6.5.2 Letters of Map Revision Based on Fill

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

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

A tutorial for LOMR-F is available at [www.fema.gov/online-tutorials](https://www.fema.gov/online-tutorials).

### 6.5.3 Letters of Map Revision

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

To obtain an application for a LOMR, visit [www.fema.gov/media-library/assets/documents/1343](https://www.fema.gov/media-library/assets/documents/1343) and download the form “MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision”. Visit the “Flood Map-Related Fees” section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

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

Table 27: Incorporated Letters of Map Change

| Case Number | Effective Date | Flooding Source | FIRM Panel(s) |
| --- | --- | --- | --- |
| **10-10-0012P** | **01-01-2010** | **Inundation River** | **1234C0234E**  **1234C0244D1** |
| **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](https://www.fema.gov) and visit the “Flood Map Revision Processes” section.

### 6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit [www.fema.gov](https://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 28, “Community Map History.” A description of each of the column headings and the source of the date is also listed below.

* *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.
* *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or “pending” (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.

* *Initial FHBM Effective Date* is the effective date of the first 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 28: Community Map History

| Community Name | Initial Identification Date | Initial FHBM Effective Date | FHBM Revision Date(s) | Initial FIRM Effective Date | FIRM Revision Date(s) |
| --- | --- | --- | --- | --- | --- |
| **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 of1** | **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 of2, 3** | **07/23/2008** | **N/A** | **N/A** | **07/23/2008** | **12/31/2011** |
| **Water, City of3** | **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 29 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

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

| Flooding Source | FIS Report Dated | Contractor | Number | Work Completed Date | Affected Communities |
| --- | --- | --- | --- | --- | --- |
| **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** |
| **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, Uninorporated Areas** |
| **West River and Zone A Tributaries** | **12/31/2011** | **State DNR** | **HSF-J-7654** | **February 2010** | **Flood County, Uninorporated 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 30. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 30: Community Meetings

| Community | FIS Report Dated | Date of Meeting | Meeting Type | Attended By |
| --- | --- | --- | --- | --- |
| **Coastland, City of** | **12/31/2011** | **03/16/2008** | **Discovery** | **FEMA, the community, the study contractor, and USACE** |
| **02/08/2010** | **Resilience** | **FEMA, the community, the study contractor, and the State Hazard Mitigation office** |
| **11/30/2010** | **CCO Meeting** | **FEMA, the community, and the study contractor** |
| **Flood County Unincorporated Areas** | **12/31/2011** | **03/16/2008** | **Discovery** | **FEMA, the community, the study contractor, and USACE** |
| **02/08/2010** | **Resilience** | **FEMA, the community, the study contractor, and the State Hazard Mitigation office** |
| **11/30/2010** | **CCO Meeting** | **FEMA, the community, and the study contractor** |
| **Floodville, Town of** | **07/23/2008** | **01/08/2004** | **Scoping** | **FEMA, the community, and the study contractor** |
| **08/15/2006** | **CCO Meeting** | **FEMA, the community, and the study contractor** |
| **Metroplis, City of** | **12/31/2011** | **03/16/2008** | **Discovery** | **FEMA, the community, the study contractor, and USACE** |
| **02/08/2010** | **Resilience** | **FEMA, the community, and the study contractor** |
| **11/30/2010** | **CCO Meeting** | **FEMA, the community, and the study contractor** |
| **12/01/2010** | **Open House** | **FEMA, the community, and the study contractor** |
| **Upland, Village of** | **12/31/2011** | **03/17/2008** | **Discovery** | **FEMA, the community, the study contractor, and USACE** |
| **11/28/2010** | **CCO Meeting** | **FEMA, the community, and the study contractor** |
| **Water, City of** | **07/23/2008** | **01/07/2004** | **Scoping** | **FEMA, the community, and the study contractor** |
| **08/15/2006** | **CCO Meeting** | **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](https://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 31 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 31: 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 of1** | **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 32.

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

Table 32: Additional Information

|  |  |
| --- | --- |
| FEMA and the NFIP | |
| FEMA and FEMA Engineering Library website | [www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/engineering-library](https://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/engineering-library) |
| NFIP website | [www.fema.gov/national-flood-insurance-program](https://www.fema.gov/national-flood-insurance-program) |
| NFHL Dataset | [msc.fema.gov](https://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](https://www.usgs.gov/) |
| Hydraulic Engineering Center website | [www.hec.usace.army.mil](http://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**](mailto:christine.valentine@state.or.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**](mailto:cy.smith@state.or.us) |

# SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

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

Table 33: Bibliography and References

| Citation  in this FIS | Publisher/ Issuer | *Publication Title,* “Article,” Volume, Number, etc. | Author/Editor | Place of  Publication | Publication Date/ Date of Issuance | Link |
| --- | --- | --- | --- | --- | --- | --- |
| **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**](https://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**](https://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**](https://msc.fema.gov/) |
| **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/**](http://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**](http://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/**](http://lidar.cr.usgs.gov/) |