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**Published Separately**

Flood Insurance Rate Map (FIRM)
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 Kauai County, Hawaii.

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

<table>
<thead>
<tr>
<th>Community</th>
<th>CID</th>
<th>Sub-Basin(s)</th>
<th>Located on FIRM Panel(s)</th>
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1 Panel Not Printed
1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages state and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1-percent-annual-chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevation 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 Kauai County became effective on November 4, 1981. Refer to Table 28 for information about subsequent revisions to the FIRMs.

- 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). 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 Local Tidal Datum. These levees are on FIRM panel(s) 1500020256G, 1500020258G, and 1500020259G, on the Waimea River, 1500020204F, on the Moikeha Canal and the Waikaea Canal, and 1500020287G on the Hanapepe 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.

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Kauai 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

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before 2/26/2021.
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**

<table>
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<th>NOTES TO USERS</th>
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<tr>
<td>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 <a href="http://msc.fema.gov">msc.fema.gov</a>. 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.</td>
</tr>
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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’ Local Tidal Datum. Coastal flood elevations are also provided in the Coastal Transect Parameters table in the FIS Report for this jurisdiction. Elevations shown in the Coastal Transect Parameters table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.
Figure 2. FIRM Notes to Users (continued)

**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 HARN State Plane Hawaii 4 FIPS 5104 (US Feet). The horizontal datum was the North American Datum of 1983 (NAD83). 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 Local Tidal Datum. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the Local Tidal Datum and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at [www.ngs.noaa.gov](http://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 the U.S. Department of Agriculture at a scale of 1:6,000 and the Kauai 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: 0130F, and 140F. 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 Kauai County, Hawaii, 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 Kauai County, Hawaii, effective February 26, 2021.
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 Kauai County.

**Figure 3: Map Legend for FIRM**

<table>
<thead>
<tr>
<th>SPECIAL FLOOD HAZARD AREAS:</th>
<th>Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A</td>
<td>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.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>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.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>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.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>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.</td>
</tr>
<tr>
<td>Zone AR</td>
<td>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.</td>
</tr>
<tr>
<td>Zone A99</td>
<td>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.</td>
</tr>
<tr>
<td>Zone V</td>
<td>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.</td>
</tr>
<tr>
<td>Zone VE</td>
<td>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.</td>
</tr>
</tbody>
</table>
Figure 3: Map Legend for FIRM *(continued)*

<table>
<thead>
<tr>
<th>Regulatory Floodway determined in Zone AE.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OTHER AREAS OF FLOOD HAZARD</strong></td>
</tr>
<tr>
<td><img src="https://example.com/shaded-zone-x.png" alt="Shaded Zone X" /></td>
</tr>
<tr>
<td><img src="https://example.com/future-conditions-zone-x.png" alt="Future Conditions 1% Annual Chance Flood Hazard – Zone X" /></td>
</tr>
<tr>
<td><img src="https://example.com/area-reduced-flood-risk-levee.png" alt="Area with Reduced Flood Risk due to Levee" /></td>
</tr>
<tr>
<td><img src="https://example.com/area-flood-risk-levee.png" alt="Area with Flood Risk due to Levee" /></td>
</tr>
</tbody>
</table>

**OTHER AREAS**

| ![Zone D (Areas of Undetermined Flood Hazard)](https://example.com/zone-d.png) | The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible. |

| ![No Screen](https://example.com/no-screen.png) | Unshaded Zone X: Areas of minimal flood hazard. |

**FLOOD HAZARD AND OTHER BOUNDARY LINES**

| ![Flood Zone Boundary](https://example.com/flood-zone-boundary.png) | Flooding Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping) |
| ![Limit of Study](https://example.com/limit-of-study.png) | Limit of Study |
| ![Jurisdiction Boundary](https://example.com/jurisdiction-boundary.png) | Jurisdiction Boundary |
| ![Limit of Moderate Wave Action (LiMWA)](https://example.com/limit-moderate-wave-action.png) | Indicates the inland limit of the area affected by waves greater than 1.5 feet |

**GENERAL STRUCTURES**

| ![Aqueduct](https://example.com/aqueduct.png) | Channel, Culvert, Aqueduct, or Storm Sewer |
| ![Channel](https://example.com/channel.png) | |
| ![Culvert](https://example.com/culvert.png) | |
| ![Storm Sewer](https://example.com/storm-sewer.png) | |
| ![Dam](https://example.com/dam.png) | Dam, Jetty, Weir |
| ![Jetty](https://example.com/jetty.png) | |
| ![Weir](https://example.com/weir.png) | |
**Figure 3: Map Legend for FIRM (continued)**

<table>
<thead>
<tr>
<th>Legend</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image]</td>
<td>Levee, Dike, or Floodwall</td>
</tr>
<tr>
<td>[Image]</td>
<td>Bridge</td>
</tr>
</tbody>
</table>

**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.

- **CBRS AREA**:
  - CBRS Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
  - CBRS AREA 09/30/2009

- **OTHERWISE PROTECTED AREA**:
  - Otherwise Protected Area
  - OTHERWISE PROTECTED AREA 09/30/2009

**REFERENCE MARKERS**

- **22.0**
  - River mile Markers

**CROSS SECTION & TRANSECT INFORMATION**

- **20.2**
  - Lettered Cross Section with Regulatory Water Surface Elevation (BFE)

- **21.1**
  - Numbered Cross Section with Regulatory Water Surface Elevation (BFE)

- **17.5**
  - Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)

- **Coastal Transect**

**Profile Baseline**

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

**Coastal Transect Baseline**

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

**Base Flood Elevation Line**

- [Image]

**ZONE AE (EL 16)**

- Static Base Flood Elevation value (shown under zone label)
**Figure 3: Map Legend for FIRM (continued)**

<table>
<thead>
<tr>
<th>Legend</th>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZONE AO (DEPTH 2)</td>
<td>Zone designation with Depth</td>
<td></td>
</tr>
<tr>
<td>ZONE AO (DEPTH 2) (VEL 15 FPS)</td>
<td>Zone designation with Depth and Velocity</td>
<td></td>
</tr>
<tr>
<td><strong>BASE MAP FEATURES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missouri Creek</td>
<td>River, Stream or Other Hydrographic Feature</td>
<td></td>
</tr>
<tr>
<td>234</td>
<td>Interstate Highway</td>
<td></td>
</tr>
<tr>
<td>234</td>
<td>U.S. Highway</td>
<td></td>
</tr>
<tr>
<td>234</td>
<td>State Highway</td>
<td></td>
</tr>
<tr>
<td>234</td>
<td>County Highway</td>
<td></td>
</tr>
<tr>
<td>MAPLE LANE</td>
<td>Street, Road, Avenue Name, or Private Drive if shown on Flood Profile</td>
<td></td>
</tr>
<tr>
<td>RAILROAD</td>
<td>Railroad</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horizontal Reference Grid Line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horizontal Reference Grid Ticks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Secondary Grid Crosshairs</td>
<td></td>
</tr>
<tr>
<td>Land Grant</td>
<td>Name of Land Grant</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Section Number</td>
<td></td>
</tr>
<tr>
<td>R. 43 W. T. 22 N.</td>
<td>Range, Township Number</td>
<td></td>
</tr>
<tr>
<td>427600mE</td>
<td>Horizontal Reference Grid Coordinates (UTM)</td>
<td></td>
</tr>
<tr>
<td>365000 FT</td>
<td>Horizontal Reference Grid Coordinates (State Plane)</td>
<td></td>
</tr>
<tr>
<td>80° 16’ 52.5”</td>
<td>Corner Coordinates (Latitude, Longitude)</td>
<td></td>
</tr>
</tbody>
</table>
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 Kauai 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 Kauai 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

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Community</th>
<th>Downstream Limit</th>
<th>Upstream Limit</th>
<th>HUC-8 Sub-Basin(s)</th>
<th>Length (mi) (streams or coastlines)</th>
<th>Area (mi²) (estuaries or ponding)</th>
<th>Floodway (Y/N)</th>
<th>Zone shown on FIRM</th>
<th>Date of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anahola Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.1 miles upstream from Anahola Bay Inlet</td>
<td>Approximately 400 feet upstream from Kuhio Highway</td>
<td>20070000</td>
<td>1.1</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1978</td>
</tr>
<tr>
<td>Hanalei River</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.3 miles upstream from Hanalei Bay Inlet</td>
<td>Approximately 3.1 miles upstream from Kuhio Highway</td>
<td>20070000</td>
<td>5.1</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>2002</td>
</tr>
<tr>
<td>Hanamaulu Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.3 miles upstream from Hanamaulu Bay Inlet</td>
<td>Approximately 0.2 miles upstream of the confluence with Hanamaulu Stream Tributary</td>
<td>20070000</td>
<td>2.3</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1995</td>
</tr>
<tr>
<td>Hanamaulu Stream Tributary</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Hanamaulu Stream</td>
<td>Approximately 472 feet upstream from Maalo Road</td>
<td>20070000</td>
<td>0.1</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1995</td>
</tr>
<tr>
<td>Hanapepe River</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 509 feet upstream of the Hanapepe Bay Inlet</td>
<td>Approximately 1.7 miles upstream from the Hanapepe Road</td>
<td>20070000</td>
<td>2.1</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>2017</td>
</tr>
<tr>
<td>Huleia Stream</td>
<td>Kauai County, Hawaii</td>
<td>At Nawiliwili Bay Inlet</td>
<td>Approximately 0.9 miles upstream from the confluence with Papakolea Stream</td>
<td>20070000</td>
<td>2.7</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1987</td>
</tr>
<tr>
<td>Kalama Stream</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Opaekaa Stream</td>
<td>Approximately 1.3 miles upstream from Puuopae Road</td>
<td>20070000</td>
<td>3.1</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1995</td>
</tr>
<tr>
<td>Kapaa Stream</td>
<td>Kauai County, Hawaii</td>
<td>Just downstream of State Route 56</td>
<td>Approximately 1.4 miles upstream from Hauaala Road</td>
<td>20070000</td>
<td>3.5</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1978</td>
</tr>
<tr>
<td>Kekaha Drainageway</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.3 miles upstream from Kekaha Road</td>
<td>Approximately 0.5 miles upstream from Hukipo Road</td>
<td>20070000</td>
<td>0.9</td>
<td></td>
<td>N</td>
<td>AE, AH</td>
<td>1987</td>
</tr>
<tr>
<td>Flooding Source</td>
<td>Community</td>
<td>Downstream Limit</td>
<td>Upstream Limit</td>
<td>HUC-8 Sub-Basin(s)</td>
<td>Length (mi)</td>
<td>Area (mi$^2$)</td>
<td>Floodway (Y/N)</td>
<td>Zone shown on FIRM</td>
<td>Date of Analysis</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------</td>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------</td>
<td>-------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Lawai Stream</td>
<td>Kauai County, Hawaii</td>
<td>At Lawai Bay Shorline</td>
<td>Approximately 0.7 miles upstream from State Route 50</td>
<td>20070000</td>
<td>4.3</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1987</td>
</tr>
<tr>
<td>Moikeha Canal</td>
<td>Kauai County, Hawaii</td>
<td>At Pacific Ocean Inlet</td>
<td>Just upstream of Apopo Road</td>
<td>20070000</td>
<td>1.3</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1978</td>
</tr>
<tr>
<td>Moloa’a Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.4 miles upstream from the Pacific Ocean Inlet</td>
<td>Approximately 94 feet downstream from Koolau Road</td>
<td>20070000</td>
<td>0.9</td>
<td></td>
<td>N</td>
<td>AE</td>
<td>1994</td>
</tr>
<tr>
<td>Nawiliwili Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 224 feet downstream from Rice Street</td>
<td>Approximately 0.4 miles upstream from State Route 50</td>
<td>20070000</td>
<td>3.3</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1978</td>
</tr>
<tr>
<td>Omao Stream</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Waikomo Stream</td>
<td>Approximately 2.5 miles upstream from Waikomo Stream confluence</td>
<td>20070000</td>
<td>2.5</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1978</td>
</tr>
<tr>
<td>Opaekaa Stream</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Wailua River</td>
<td>Approximately 0.2 miles upstream from Puupilo Road</td>
<td>20070000</td>
<td>4.0</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1987</td>
</tr>
<tr>
<td>Opaekaa Tributary</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Opaekaa Stream</td>
<td>Approximately 0.5 miles upstream from Poo Road</td>
<td>20070000</td>
<td>0.7</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1987</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Kauai County, Hawaii</td>
<td>Open coast north of Molo’a’a Bay</td>
<td>Open coast south of Molo’a’a Bay</td>
<td>20070000</td>
<td>1.0</td>
<td></td>
<td>N</td>
<td>VE</td>
<td>2018</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Kauai County, Hawaii</td>
<td>Entire Coastline of Kauai County</td>
<td>Entire Coastline of Kauai County</td>
<td>20070000</td>
<td>90.0</td>
<td></td>
<td>N</td>
<td>AE, VE</td>
<td>2008</td>
</tr>
<tr>
<td>Papakolea Stream</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Huleia Stream</td>
<td>Approximately 0.4 miles upstream from Huleia Stream confluence</td>
<td>20070000</td>
<td>0.4</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1987</td>
</tr>
<tr>
<td>Puali Stream</td>
<td>Kauai County, Hawaii</td>
<td>At Nawiliwili Bay Inlet</td>
<td>Approximately 0.5 miles upstream from Niumalu Road</td>
<td>20070000</td>
<td>0.7</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1978</td>
</tr>
<tr>
<td>Flooding Source</td>
<td>Community</td>
<td>Downstream Limit</td>
<td>Upstream Limit</td>
<td>HUC-8 Sub-Basin(s)</td>
<td>Length (mi) (streams or coastlines)</td>
<td>Area (mi²) (estuaries or ponding)</td>
<td>Floodway (Y/N)</td>
<td>Zone shown on FIRM</td>
<td>Date of Analysis</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------</td>
<td>----------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------</td>
<td>------------------------------------</td>
<td>----------------------------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Waikaea Canal</td>
<td>Kauai County, Hawaii</td>
<td>At Pacific Ocean Inlet</td>
<td>Approximately 0.4 miles upstream from the confluence with Konohiki Stream</td>
<td>20070000</td>
<td>1.4</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1978</td>
</tr>
<tr>
<td>Waikomo Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 678 feet downstream from Hoonani Road</td>
<td>Approximately 0.2 miles upstream from Wailaa Road</td>
<td>20070000</td>
<td>3.2</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1995</td>
</tr>
<tr>
<td>Waikomo Stream Tributary</td>
<td>Kauai County, Hawaii</td>
<td>At confluence with Waikomo Stream</td>
<td>Approximately 34 feet downstream from Wailaa Road</td>
<td>20070000</td>
<td>0.2</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1995</td>
</tr>
<tr>
<td>Wailua River</td>
<td>Kauai County, Hawaii</td>
<td>At Pacific Ocean Inlet</td>
<td>Approximately 3.1 miles upstream from State Route 56</td>
<td>20070000</td>
<td>3.1</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1978</td>
</tr>
<tr>
<td>Waimea River</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.2 miles upstream of the confluence with Makaweli River</td>
<td>Approximately 2.5 miles upstream of the confluence with Makaweli River</td>
<td>20070000</td>
<td>2.3</td>
<td></td>
<td>N</td>
<td>A</td>
<td>1987</td>
</tr>
<tr>
<td>Waimea River</td>
<td>Kauai County, Hawaii</td>
<td>At Pacific Ocean Inlet</td>
<td>Approximately 0.2 miles upstream of the confluence with Makaweli River</td>
<td>20070000</td>
<td>1.4</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>2017</td>
</tr>
<tr>
<td>Wainiha River</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 0.2 miles upstream from State Route 560</td>
<td>Approximately 2.1 miles upstream from State Route 560</td>
<td>20070000</td>
<td>1.9</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1987</td>
</tr>
<tr>
<td>Waioli Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 39 feet upstream of State Route 560</td>
<td>Approximately 1.2 miles upstream from the State Route 560</td>
<td>20070000</td>
<td>1.2</td>
<td></td>
<td>Y</td>
<td>A, AE</td>
<td>1978</td>
</tr>
<tr>
<td>Waipa Stream</td>
<td>Kauai County, Hawaii</td>
<td>Approximately 528 feet upstream of State Route 560</td>
<td>Approximately 0.5 miles upstream from State Route 560</td>
<td>20070000</td>
<td>0.4</td>
<td></td>
<td>Y</td>
<td>AE</td>
<td>1978</td>
</tr>
</tbody>
</table>
2.2 Floodways

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

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

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

Figure 4: Floodway Schematic
Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 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

This section is not applicable to this Flood Risk Project
2.5 Coastal Flood Hazard Areas

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

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

2.5.1 Water Elevations and the Effects of Waves

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

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

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

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

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

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

Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1-percent-annual-chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since tidal gages are often sited in areas sheltered from wave action and do not capture this information.
Coastal analyses may examine the effects of overland waves by analyzing storm-induced erosion, overland wave propagation, wave runup, and/or wave overtopping.

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

**Figure 5: Wave Runup Transect Schematic**

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### 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.

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

This section is not applicable to this Flood Risk Project.
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 Kauai County.

Table 3: Flood Zone Designations by Community

<table>
<thead>
<tr>
<th>Community</th>
<th>Flood Zone(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauai County</td>
<td>A, AE, AH, AO, D, VE, X</td>
</tr>
</tbody>
</table>

3.2 Coastal Barrier Resources System

This section is not applicable to this Flood Risk Project

Table 4: Coastal Barrier Resources System Information

[Not applicable to this Flood Risk Project]

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

<table>
<thead>
<tr>
<th>HUC-8 Sub-Basin Name</th>
<th>HUC-8 Sub-Basin Number</th>
<th>Primary Flooding Source</th>
<th>Description of Affected Area</th>
<th>Drainage Area (square miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauai</td>
<td>2007000</td>
<td>Pacific Ocean</td>
<td>Kauai County</td>
<td>555</td>
</tr>
</tbody>
</table>
4.2 Principal Flood Problems

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

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Description of Flood Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Ocean</td>
<td>The island of Kauai is subject to flooding from stream overflow, tsunamis, and hurricanes. In some areas along the coast, all three types of flooding may occur. Tsunamis, which are a series of waves generated by submarine earth movements, travel at high velocities and have had a devastating effect on the developed areas of Kauai County. Sources of these tsunamis are varied and are located in North and South America, the Aleutian Islands, Japan, Kamchatka, the islands lying between the Philippines and Samoa, and even Hawaii itself. Within the Hawaiian Islands, the City of Hilo on Hawaii has been most severely damaged from Tsunami impacts. Based on 1970 figures, Hilo had suffered losses of approximately $62 million over the past 50 years.</td>
</tr>
<tr>
<td>Hanalei Watershed</td>
<td>In Hanalei, the worst flood on record occurred on November 11 and 12, 1955, and inundated the entire Hanalei Valley lowlands. An approximately 0.5-mile section of Kuhio Highway was under 6 feet of water; the lowest highway segment was under 8 feet of water. The Hanalei River stream-gaging station, situated at the same location since 1915, was destroyed. Besides riverine flooding, Hanalei is also exposed to tsunami flooding.</td>
</tr>
<tr>
<td>Anahola Watershed</td>
<td>The largest flood recorded in the Anahola area occurred on January 25, 1956, when more than 13 inches of rain fell in the watershed within a 24-hour period. A U.S. Geological Survey (USGS) stream gage located approximately 3 miles above the mouth of Anahola Stream recorded a peak of 19,600 cfs, the highest in 57 years of stream gage records. The flood exceeded the expected 100-year and approached the 200-year flood discharge of the stream gage record. On December 14, 1991, over 20 inches of rain fell during a 12-hour period, resulting in flash floods which recorded five deaths, severe flooding, erosions, and slides, as well as numerous property damages. Other major floods occurred in April 1948, August 1959, May 1965, November 1968, and January 1975.</td>
</tr>
<tr>
<td>Kanaa Watershed</td>
<td>The flood history in the Kapaa area is not well documented. Before construction of Moikeha and Waikaea Canals, flooding occurred periodically from sheet runoff, but since completion of the canals, there has been no extensive flood damage. Several factors aggravate flooding in the area. Debris buildup at the highway bridges over Kapaa Stream and siltation and plant growth within Moikeha and Waikaea Canals are the main problems.</td>
</tr>
</tbody>
</table>
### Table 6: Principal Flood Problems (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Description of Flood Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wailua Watershed</strong></td>
<td>Flood problems from Opaekaa Stream have mostly occurred upstream of Kamalu Road, where, before 1976, a 6-foot-square box culvert restricted flood discharges. The box culvert has since been replaced by a bridge. The largest recorded flood in the watershed, measured at a gaging station with 15 years of records, located in the left branch of Opaekaa Stream, occurred on January 31, 1975. It had a peak discharge of 724 cfs, which is equivalent to approximately a 28-year recurrence interval. Flood problems caused by Opaekaa Tributary and the upstream study reach of Opaekaa Stream have not been documented.</td>
</tr>
<tr>
<td><strong>Lihue Watershed</strong></td>
<td>The lowlands of the Puali and Nawiliwili Streams are particularly vulnerable to inundation. Sand buildup at the mouth of Nawiliwili Stream causes backwater in the lower portions. To add to the problem, debris accumulation at the bridge openings has aggravated floods in the upstream areas, especially upstream of the Rice Street bridge. In the past, the lawns, parking lots, and roads near Puali Stream have been inundated by sheet runoff and stream overflow. Low spots in residential areas have been covered with standing water to depths of 1 to 2 feet.</td>
</tr>
<tr>
<td><strong>Koloa Watershed</strong></td>
<td>Properties in Koloa in the vicinity of Waikomo Stream and Waikomo Road are particularly flood prone. Debris and vegetation growth in the stream channel aggravate the flood problem in this area. Although Waikomo Stream has caused flooding in Koloa, the major flood problem area is the coastal region of Koloa Poipu, where shallow flooding caused by low-lying topography and inadequate drainage facilities frequently occurs. From six storms that caused flooding in the low-lying Koloa-Poipu area from 1954 to 1965, no flood damages were reported in areas adjacent to Waikomo Stream.</td>
</tr>
<tr>
<td><strong>Hanapepe Watershed</strong></td>
<td>The largest recorded flood in the Hanapepe area occurred on April 15, 1963. During the storm, the Hanapepe River gaging station recorded its highest discharge (39,000 cfs) in 47 years of record. The discharge approximated the magnitude of the 0.5% annual chance flood frequency. The flood destroyed several homes and severely damaged many more in the Hanapepe Valley area. A USACE flood-control levee project under construction at the time was also severely damaged. Since the completion of the levee project, the low-lying areas have been beset with interior drainage problems. In December 1968, several homes and lawns behind the levees were flooded to depths of 3 to 4 feet by floodwater discharged from nearby Hikiula Gulch.</td>
</tr>
</tbody>
</table>
Table 6: Principal Flood Problems (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Description of Flood Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moloa’a Stream</td>
<td>From Ko’ola Road and continuing downstream for about 2,100 feet, stream discharges start to overflow the stream banks. Shallower channel slopes and the additional discharge from Tributary “B” contribute to this condition. From this point and continuing downstream until the coastline, the floodplain widens with the majority the flood flows spilling over the left overbank (looking downstream). Most of the residences within the area are situated on the right overbank. A sandbar at the stream mouth increases the flooding potential. This sandbar builds up over time from the surf and unless cleared regularly causes a severe obstruction to flow. No recorded data of any flooding events are available since no gaging station exists along Moloa’a Stream. However, historical records show major flooding events having occurred in the Anahola area, the nearest town to Moloa’a Stream, located in the adjoining drainage basin 3.8 miles to the south. Intense rainfall between the evening of the 13th and the morning of the 14th of December 1991 caused record heavy stream flows in the northeast portion of Kauai. Several USGS stream gaging stations lie within relatively close proximity of Moloa’a Stream. The two closest stream gages are: 0890 along Anahola Stream and 0975 along Halaulani Stream, located approximately 3.4 miles due south and 5.6 miles due west, respectively, of the Moloa’a Stream mouth. On December 14, 1991 gages 0890, with a drainage area of 4.27 square miles, and 0975, with a drainage area of 1.90 square miles, recorded peak discharges of 21,000 cfs and 4,500 cfs, respectively. Both floods exceeded the probable 100-year discharges of the stream gage record. The record rainfall intensities and volume during the early morning hours of December 14, 1991 caused flash floods which resulted in estimated total damage loss of about seven million dollars to public property, private residences and businesses. Further, three lives were lost due to flooding adjacent to Anahola Stream and on life lost along Moloa’a Stream. The largest flooding event prior December 14, 1991 was recorded at USGS stream gage number 0890. A Peak discharge of 19,600 cfs was recorded in January 25, 1956. This flood exceeded the probable 100-year flood discharge of the stream gage record. Other major floods in the Anahola area occurred in April 1948, August 1959, May 1965, November 1968, and January 1975.</td>
</tr>
<tr>
<td>West Kauai Watershed</td>
<td>The largest recorded storm in the Kekaha area occurred on December 1973. Intense rainfall (7 inches of rain within 2 hours) floodwater throughout Kekaha, inundating the Hawaiian Homes area and damaging Coxs Ditch. County and State roads about 50 homes sustained damage. Also flooded were sugarcane fields, which sustained damage from rock and debris deposition and topsoil erosion. According to several local residents, the flood was aggravated by nonnatural sand plugs in the drainageways near Kekaha. The flood was estimated by the SCS to have 15-year recurrence intervals.</td>
</tr>
</tbody>
</table>
Table 6: Principal Flood Problems (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Description of Flood Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wainiha Watershed</td>
<td>Three severe floods have occurred on the Wainiha River. On February 17, 1956, more than 20 inches of rain fell in the valley during a 24-hour period. The Wainiha River stream gage, located 6.8 miles from the mouth with a drainage area of 10.2 square miles, was destroyed. From flood marks at the stream gage, a peak discharge of 40,000 cfs was calculated.</td>
</tr>
<tr>
<td>Waimea Watershed</td>
<td>On several occasions, Waimea River flooded the Waimea Town area. Severe floods dating back to 1916, 1921, 1927, and 1942 were recorded. On February 7, 1949, the most destructive flood occurred; two lives were lost and five houses were destroyed. The entire town was flooded; the business center was flooded to depths of 3 to 8 feet. Several commercial structures were shoved off their foundations. During the flood, the Waimea River gaging station (Station 380) recorded its highest stage height of 11.4 feet. (Peak discharges are not determined for this stream gage.) The stream gage has a 39-year record (1944 to 1983) and is located 150 feet upstream of the Kaeualii Highway bridge. Based on the river-stage data, the 1949 flood was equal to a 55-year flood.</td>
</tr>
</tbody>
</table>

Table 7: Historic Flooding Elevations

[Not applicable to this Flood Risk Project]

4.3 Non-Levee Flood Protection Measures

A tsunami warning system has been developed for the entire State of Hawaii. This warning system was designed to provide sufficient time for evacuation from tsunami danger zones.

Table 8: Non-Levee Flood Protection Measures

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Structure Name</th>
<th>Type of Measure</th>
<th>Location</th>
<th>Description of Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanapepe Bay</td>
<td>Hanapepe Jetty</td>
<td>Jetty</td>
<td>Eastern Hanapepe Bay shoreline</td>
<td>Jetty constructed of rip-rap and concrete approximately 1189 feet long, forming a man-made harbor.</td>
</tr>
<tr>
<td>Hanamaulu Bay</td>
<td>Hanamaulu Jetty</td>
<td>Jetty</td>
<td>At the southern bay outlet</td>
<td>Rock jetty approximately 328 feet long providing protection for the southern shoreline of Hanamaulu Bay</td>
</tr>
<tr>
<td>Nawiliwili Bay</td>
<td>Nawiliwili Seawall</td>
<td>Seawall</td>
<td>Along the eastern facing north bank of the Pacific Ocean Inlet from Nawiliwili Bay</td>
<td>Concrete coastal armoring structure approximately 2495 feet long, providing erosion control at the Nawiliwili Bay Outlet</td>
</tr>
</tbody>
</table>
4.4 Levees

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, new flood hazard analyses in the affected areas have been developed and reflected on the revised FIRM panels and the area has been clearly identified on the FIRM panel with notes and bounding lines. These levees occur on FIRM panel(s) 1500020204F, 1500020256G, 1500020258G, 1500020259G, and 1500020287G, on the Moikeha Canal, Waikae Canal, Waimea River and the Hanapepe 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

<table>
<thead>
<tr>
<th>Community</th>
<th>Flooding Source</th>
<th>Levee Location</th>
<th>Levee Owner</th>
<th>USACE Levee</th>
<th>Levee ID</th>
<th>Covered Under PL84-99 Program?</th>
<th>FIRM Panel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauai County</td>
<td>Hanapepe River</td>
<td>Right Bank</td>
<td>County of Kauai, Department of Public Works</td>
<td>Yes</td>
<td>15007C_21</td>
<td>Yes</td>
<td>1500020287G</td>
</tr>
<tr>
<td></td>
<td>Hanapepe River</td>
<td>Left Bank</td>
<td>County of Kauai, Department of Public Works</td>
<td>Yes</td>
<td>15007C_147</td>
<td>Yes</td>
<td>1500020287G</td>
</tr>
<tr>
<td></td>
<td>Waimea River</td>
<td>Right Bank</td>
<td>County of Kauai, Department of Public Works</td>
<td>Yes</td>
<td>15007C_124</td>
<td>Yes</td>
<td>1500020256G, 1500020258G, 1500020259G</td>
</tr>
<tr>
<td></td>
<td>Waikaeo Canal</td>
<td>Left Bank</td>
<td>Kauai County</td>
<td>*</td>
<td>150002_191</td>
<td>*</td>
<td>1500020204F</td>
</tr>
<tr>
<td></td>
<td>Moikeha Canal</td>
<td>Left Bank</td>
<td>Kauai County</td>
<td>*</td>
<td>150002_179</td>
<td>*</td>
<td>1500020204F</td>
</tr>
</tbody>
</table>

*Data not available
SECTION 5.0 – ENGINEERING METHODS

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

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 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.

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.
Table 10: Summary of Discharges

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Location</th>
<th>Drainage Area (Square Miles)</th>
<th>Peak Discharge (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>10% Annual Chance</td>
</tr>
<tr>
<td>Anahola Stream</td>
<td>At mouth</td>
<td>10.3</td>
<td>15,000</td>
</tr>
<tr>
<td>Hanalei River</td>
<td>At mouth</td>
<td>23.8</td>
<td>37,000</td>
</tr>
<tr>
<td>Hanamalulu Stream</td>
<td>At mouth</td>
<td>8.9</td>
<td>*</td>
</tr>
<tr>
<td>Hanamalulu Stream Tributary</td>
<td>At mouth</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Hanapepe River</td>
<td>At mouth</td>
<td>27.0</td>
<td>21,000</td>
</tr>
<tr>
<td></td>
<td>At Gage No. 16049000</td>
<td>18.5</td>
<td>17,000</td>
</tr>
<tr>
<td>Huleia Stream</td>
<td>At mouth</td>
<td>26.07</td>
<td>21,270</td>
</tr>
<tr>
<td></td>
<td>At a point approx. 13,800 feet inland</td>
<td>19.82</td>
<td>16,800</td>
</tr>
<tr>
<td>Kalama Stream</td>
<td>At confluence with Opaekaa Stream</td>
<td>2.4</td>
<td>3,800</td>
</tr>
<tr>
<td>Kapaa Stream</td>
<td>At mouth</td>
<td>13.6</td>
<td>21,000</td>
</tr>
<tr>
<td>Kekaha Drainageway</td>
<td>Kapilimao-Waimea Basin</td>
<td>5.79</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Waipao-Waika Basin</td>
<td>5.54</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Drainageway between basins</td>
<td>5.54</td>
<td>*</td>
</tr>
<tr>
<td>Flooding Source</td>
<td>Location</td>
<td>Drainage Area (Square Miles)</td>
<td>10% Annual Chance</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Lawai Stream</td>
<td>At Lauoho Road</td>
<td>3.62</td>
<td>3,090</td>
</tr>
<tr>
<td></td>
<td>At upstream Access Road crossing</td>
<td>3.32</td>
<td>2,870</td>
</tr>
<tr>
<td>Moikeha Canal</td>
<td>At mouth</td>
<td>2.0</td>
<td>900</td>
</tr>
<tr>
<td>Molo'a Stream</td>
<td>At mouth</td>
<td>3.3</td>
<td>3,630</td>
</tr>
<tr>
<td></td>
<td>Upstream of Tributary &quot;A&quot;</td>
<td>3.1</td>
<td>3,410</td>
</tr>
<tr>
<td></td>
<td>Downstream of Tributary &quot;B&quot;</td>
<td>2.6</td>
<td>2,950</td>
</tr>
<tr>
<td></td>
<td>Upstream of Tributary &quot;B&quot;</td>
<td>2.2</td>
<td>2,530</td>
</tr>
<tr>
<td>Nawiliwili Stream</td>
<td>At mouth</td>
<td>4.7</td>
<td>2,400</td>
</tr>
<tr>
<td></td>
<td>At Lihue Mill Access Road</td>
<td>4.0</td>
<td>2,250</td>
</tr>
<tr>
<td>Omao Stream</td>
<td>At confluence with Waikomo Stream</td>
<td>4.1</td>
<td>2,700</td>
</tr>
<tr>
<td>Opaekaa Tributary</td>
<td>At confluence with Wailua River</td>
<td>6.4</td>
<td>9,000</td>
</tr>
<tr>
<td>Opaekaa Tributary</td>
<td>Downstream of confluence of Kalama Stream</td>
<td>5.1</td>
<td>7,300</td>
</tr>
</tbody>
</table>
### Table 10: Summary of Discharges (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Location</th>
<th>Drainage Area (Square Miles)</th>
<th>10% Annual Chance</th>
<th>4% Annual Chance</th>
<th>2% Annual Chance</th>
<th>1% Annual Chance Existing</th>
<th>1% Annual Chance Future</th>
<th>0.2% Annual Chance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opaekaa Tributary (continued)</strong></td>
<td>Upstream of confluence of Kalama Stream</td>
<td>2.7</td>
<td>4,300</td>
<td>*</td>
<td>7,600</td>
<td>9,400</td>
<td>*</td>
<td>14,000</td>
</tr>
<tr>
<td></td>
<td>At Access Road crossing</td>
<td>2.44</td>
<td>1,810</td>
<td>*</td>
<td>3,440</td>
<td>4,390</td>
<td>*</td>
<td>7,230</td>
</tr>
<tr>
<td></td>
<td>Upstream of confluence of Opaekaa Tributary</td>
<td>2.05</td>
<td>1,560</td>
<td>*</td>
<td>2,960</td>
<td>3,775</td>
<td>*</td>
<td>6,200</td>
</tr>
<tr>
<td></td>
<td>At confluence of Opaekaa Stream</td>
<td>1.80</td>
<td>370</td>
<td>*</td>
<td>710</td>
<td>900</td>
<td>*</td>
<td>1,480</td>
</tr>
<tr>
<td></td>
<td>At Poo Road</td>
<td>0.39</td>
<td>350</td>
<td>*</td>
<td>660</td>
<td>840</td>
<td>*</td>
<td>1,380</td>
</tr>
<tr>
<td><strong>Papakolea Stream</strong></td>
<td>At confluence with Huleai Stream</td>
<td>3.48</td>
<td>3,760</td>
<td>*</td>
<td>6,000</td>
<td>7,060</td>
<td>*</td>
<td>9,830</td>
</tr>
<tr>
<td><strong>Puali Stream</strong></td>
<td>At mouth</td>
<td>2.0</td>
<td>3,000</td>
<td>*</td>
<td>5,400</td>
<td>6,600</td>
<td>*</td>
<td>9,700</td>
</tr>
<tr>
<td><strong>Waikaea Canal</strong></td>
<td>At mouth</td>
<td>6.7</td>
<td>3,300</td>
<td>*</td>
<td>4,700</td>
<td>5,400</td>
<td>*</td>
<td>6,900</td>
</tr>
<tr>
<td><strong>Waikomo Stream</strong></td>
<td>Downstream of confluence of Omao Stream</td>
<td>10.4</td>
<td>5,600</td>
<td>*</td>
<td>7,900</td>
<td>9,000</td>
<td>*</td>
<td>11,600</td>
</tr>
<tr>
<td></td>
<td>At mouth</td>
<td>7.9</td>
<td>4,200</td>
<td>*</td>
<td>6,000</td>
<td>6,900</td>
<td>*</td>
<td>8,900</td>
</tr>
<tr>
<td></td>
<td>Upstream of confluence of Omao Stream</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>2,500</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td><strong>Waikomo Stream Tributary</strong></td>
<td>At confluence with Waikomo Stream</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>670</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td><strong>Wailua River</strong></td>
<td>At mouth</td>
<td>53.1</td>
<td>40,000</td>
<td>*</td>
<td>64,000</td>
<td>76,000</td>
<td>*</td>
<td>105,000</td>
</tr>
<tr>
<td>Flooding Source</td>
<td>Location</td>
<td>Drainage Area (Square Miles)</td>
<td>Peak Discharge (cfs)</td>
<td>10% Annual Chance</td>
<td>4% Annual Chance</td>
<td>2% Annual Chance</td>
<td>1% Annual Chance Existing</td>
<td>1% Annual Chance Future</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------</td>
<td>----------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Waimea River</td>
<td>At mouth</td>
<td>86.5</td>
<td></td>
<td>35,500</td>
<td>*</td>
<td>54,500</td>
<td>64,000</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Upstream of confluence with Makaweli River</td>
<td>58.4</td>
<td></td>
<td>28,900</td>
<td>*</td>
<td>45,300</td>
<td>53,300</td>
<td>*</td>
</tr>
<tr>
<td>Wainiha River</td>
<td>At mouth</td>
<td>22.57</td>
<td></td>
<td>29,700</td>
<td>*</td>
<td>46,600</td>
<td>55,590</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>At a point approx. 8,800 feet inland</td>
<td>20.68</td>
<td></td>
<td>27,550</td>
<td>*</td>
<td>43,220</td>
<td>51,540</td>
<td>*</td>
</tr>
<tr>
<td>Waipa Stream</td>
<td>At mouth</td>
<td>3.2</td>
<td></td>
<td>5,000</td>
<td>*</td>
<td>8,800</td>
<td>10,500</td>
<td>*</td>
</tr>
<tr>
<td>Waioli Stream</td>
<td>At mouth</td>
<td>5.1</td>
<td></td>
<td>7,400</td>
<td>*</td>
<td>12,500</td>
<td>16,000</td>
<td>*</td>
</tr>
</tbody>
</table>

*Not calculated for this Flood Risk Project

Table 10: Summary of Discharges (continued)

Figure 7: Frequency Discharge-Drainage Area Curves
[Not applicable to this Flood Risk Project]

Table 11: Summary of Non-Coastal Stillwater Elevations
[Not applicable to this Flood Risk Project]

Table 12: Stream Gage Information used to Determine Discharges
[Not applicable to this Flood Risk Project]
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>
<thead>
<tr>
<th>Flooding Source</th>
<th>Study Limits Downstream Limit</th>
<th>Study Limits Upstream Limit</th>
<th>Hydrologic Model or Method Used</th>
<th>Hydraulic Model or Method Used</th>
<th>Date Analyses Completed</th>
<th>Flood Zone on FIRM</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anahola Stream</td>
<td>Approximately 0.1 miles upstream from Anahola Bay Inlet</td>
<td>Approximately 400 feet upstream from Kuhio Highway</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Hanalei River</td>
<td>Approximately 0.3 miles upstream from Hanalei Bay Inlet</td>
<td>Approximately 3.1 miles upstream from Kuhio Highway</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>October 18, 2002</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Hanamaulu Stream</td>
<td>Approximately 0.3 miles upstream from Hanamaulu Bay Inlet</td>
<td>Approximately 0.2 miles upstream of the confluence with Hanamaulu Stream Tributary</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>September 30, 1995</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Hanamaulu Stream Tributary</td>
<td>At confluence with Hanamaulu Stream</td>
<td>Approximately 472 feet upstream from Maalo Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>September 30, 1995</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Hanapepe River</td>
<td>Approximately 509 feet upstream of the Hanapepe Bay Inlet</td>
<td>Approximately 1.7 miles upstream from the Hanapepe Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-RAS 5.0 and up</td>
<td>October 24, 2017</td>
<td>AE</td>
<td>The Natural Valley method was used for both levees removed</td>
</tr>
<tr>
<td>Flooding Source</td>
<td>Study Limits Downstream Limit</td>
<td>Study Limits Upstream Limit</td>
<td>Hydrologic Model or Method Used</td>
<td>Hydraulic Model or Method Used</td>
<td>Date Analyses Completed</td>
<td>Flood Zone on FIRM</td>
<td>Special Considerations</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Huleia Stream</td>
<td>At Nawiliwili Bay Inlet</td>
<td>Approximately 0.9 miles upstream from the confluence with Papakolea Stream</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Kalama Stream</td>
<td>At confluence with Opaekaa Stream</td>
<td>Approximately 1.3 miles upstream from Puuopae Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>September 30, 1995</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Kapaa Stream</td>
<td>Just downstream of State Route 56</td>
<td>Approximately 1.4 miles upstream from Hauaala Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Kekaha Drainageway</td>
<td>Approximately 0.3 miles upstream from Kekaha Road</td>
<td>Approximately 0.5 miles upstream from Hukipo Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>AE, AH</td>
<td></td>
</tr>
<tr>
<td>Lawai Stream</td>
<td>At the Lawai Bay Shoreline</td>
<td>Approximately 0.7 miles upstream from State Route 50</td>
<td>Regional Equations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Moikeha Canal</td>
<td>At Pacific Ocean Inlet</td>
<td>Just upstream of Apopo Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Moloa’a Stream</td>
<td>Approximately 0.4 miles upstream from the Pacific Ocean Inlet</td>
<td>Approximately 94 feet downstream from Koolau Road</td>
<td>Regression Equations</td>
<td>HEC-2</td>
<td>June 1, 1994</td>
<td>AE</td>
<td></td>
</tr>
</tbody>
</table>
Table 13: Summary of Hydrologic and Hydraulic Analyses (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Study Limits Downstream Limit</th>
<th>Study Limits Upstream Limit</th>
<th>Hydrologic Model or Method Used</th>
<th>Hydraulic Model or Method Used</th>
<th>Date Analyses Completed</th>
<th>Flood Zone on FIRM</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nawiliwili Stream</td>
<td>Approximately 224 feet downstream from Rice Street</td>
<td>Approximately 0.4 miles upstream from State Route 50</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A</td>
<td>AE</td>
</tr>
<tr>
<td>Omao Stream</td>
<td>At confluence with Waikomo Stream</td>
<td>Approximately 2.5 miles upstream from Waikomo Stream confluence</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Opaekaa Stream</td>
<td>At confluence with Wailua River</td>
<td>Approximately 0.2 miles upstream from Poo Road</td>
<td>Regional Equations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Opaekaa Tributary</td>
<td>At confluence with Opaekaa Stream</td>
<td>Approximately 0.5 miles upstream from Poo Road</td>
<td>Regional Equations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Papakolea Stream</td>
<td>At confluence with Huleia Stream</td>
<td>Approximately 0.4 miles upstream from Huleia Stream confluence</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Puali Stream</td>
<td>At Nawiliwili Bay Inlet</td>
<td>Approximately 0.5 miles upstream from Niumalu Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A, AE</td>
<td></td>
</tr>
</tbody>
</table>
Table 13: Summary of Hydrologic and Hydraulic Analyses (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Study Limits Downstream Limit</th>
<th>Study Limits Upstream Limit</th>
<th>Hydrologic Model or Method Used</th>
<th>Hydraulic Model or Method Used</th>
<th>Date Analyses Completed</th>
<th>Flood Zone on FIRM</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waikaea Canal</td>
<td>At Pacific Ocean Inlet</td>
<td>Approximately 0.4 miles upstream from the confluence with Konohiki Stream</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Waikomo Stream</td>
<td>Approximately 678 feet downstream from Hoonani Road</td>
<td>Approximately 0.2 miles upstream from Wailaau Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>September 30, 1995</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Waikomo Stream Tributary</td>
<td>At confluence with Waikomo Stream</td>
<td>Approximately 34 feet downstream from Wailaau Road</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>September 30, 1995</td>
<td>AE</td>
<td></td>
</tr>
<tr>
<td>Wailua River</td>
<td>At Pacific Ocean Inlet</td>
<td>Approximately 3.1 miles upstream from State Route 56</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Waimea River</td>
<td>Approximately 0.2 miles upstream of the confluence with Makaweli River</td>
<td>Approximately 2.5 miles upstream of the confluence with Makaweli River</td>
<td>Regional Equations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Waimea River</td>
<td>At Pacific Ocean Inlet</td>
<td>Approximately 0.2 miles upstream of the confluence with Makaweli River</td>
<td>Multiple Linear Correlations</td>
<td>HEC-RAS 5.0 and up</td>
<td>October 24, 2017</td>
<td>AE</td>
<td>Left levee analysis was conducted using the Natural Valley method</td>
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Table 13: Summary of Hydrologic and Hydraulic Analyses *(continued)*

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Study Limits Downstream Limit</th>
<th>Study Limits Upstream Limit</th>
<th>Hydrologic Model or Method Used</th>
<th>Hydraulic Model or Method Used</th>
<th>Date Analyses Completed</th>
<th>Flood Zone on FIRM</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wainiha River</td>
<td>Approximately 0.2 miles upstream from State Route 560</td>
<td>Approximately 2.1 miles upstream from State Route 560</td>
<td>Regional Equations</td>
<td>HEC-2</td>
<td>March 4, 1987</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Waioli Stream</td>
<td>Approximately 39 feet upstream of State Route 560</td>
<td>Approximately 1.2 miles upstream from the State Route 560</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>A, AE</td>
<td></td>
</tr>
<tr>
<td>Waipa Stream</td>
<td>Approximately 528 feet upstream of State Route 560</td>
<td>Approximately 0.5 miles upstream from State Route 560</td>
<td>Multiple Linear Correlations</td>
<td>HEC-2</td>
<td>June 1978</td>
<td>AE</td>
<td></td>
</tr>
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### Table 14: Roughness Coefficients

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Channel &quot;n&quot;</th>
<th>Overbank &quot;n&quot;</th>
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</thead>
<tbody>
<tr>
<td>Anahola Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anahola Stream</td>
<td>0.025 – 0.035</td>
<td>0.040 – 0.070</td>
</tr>
<tr>
<td>Hanalei Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waipa Stream</td>
<td>0.030 – 0.040</td>
<td>0.030 – 0.080</td>
</tr>
<tr>
<td>Waioli Stream</td>
<td>0.030</td>
<td>0.040 – 0.090</td>
</tr>
<tr>
<td>Hanalei Stream</td>
<td>0.030 – 0.150</td>
<td>0.030 – 0.150</td>
</tr>
<tr>
<td>Kapaa Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kapaa Stream</td>
<td>0.028 – 0.038</td>
<td>0.032 – 0.070</td>
</tr>
<tr>
<td>Moikeha Canal</td>
<td>0.017 – 0.030</td>
<td>0.025 – 0.034</td>
</tr>
<tr>
<td>Waikaea Canal</td>
<td>0.023 – 0.036</td>
<td>0.025 – 0.050</td>
</tr>
<tr>
<td>Koloa Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waikomo</td>
<td>0.030 – 0.040</td>
<td>0.040 – 0.100</td>
</tr>
<tr>
<td>Omao Stream</td>
<td>0.040 – 0.050</td>
<td>0.070 – 0.080</td>
</tr>
<tr>
<td>Lawai Stream</td>
<td>0.040 – 0.050</td>
<td>0.040 – 0.080</td>
</tr>
<tr>
<td>Hanapepe Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hanapepe River</td>
<td>0.030-0.040</td>
<td>0.015-0.090</td>
</tr>
<tr>
<td>Lihue Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nawiliwili Stream</td>
<td>0.030 – 0.040</td>
<td>0.035 – 0.300</td>
</tr>
<tr>
<td>Puali Stream</td>
<td>0.030</td>
<td>0.035 – 0.080</td>
</tr>
<tr>
<td>Huleia Stream</td>
<td>0.025 – 0.045</td>
<td>0.025 – 0.070</td>
</tr>
<tr>
<td>Papakolea Stream</td>
<td>0.040</td>
<td>0.040 – 0.060</td>
</tr>
<tr>
<td>Hanamaulu Stream</td>
<td>0.020</td>
<td>0.030 – 0.080</td>
</tr>
<tr>
<td>Hanamaulu Stream Tributary</td>
<td>0.020</td>
<td>0.040</td>
</tr>
<tr>
<td>Moloa’a Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moloa’a Stream</td>
<td>0.020-0.050</td>
<td>0.035-0.100</td>
</tr>
<tr>
<td>Wailua Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wailua River</td>
<td>0.030 – 0.045</td>
<td>0.050 – 0.100</td>
</tr>
<tr>
<td>Opaekaa Stream</td>
<td>0.020 – 0.050</td>
<td>0.040 – 0.100</td>
</tr>
<tr>
<td>Opaekaa Tributary</td>
<td>0.020 – 0.050</td>
<td>0.040 – 0.080</td>
</tr>
<tr>
<td>Kalama Stream</td>
<td>0.035 – 0.040</td>
<td>0.038 – 0.080</td>
</tr>
<tr>
<td>Waimea Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waimea River</td>
<td>0.030 – 0.040</td>
<td>0.050 – 0.100</td>
</tr>
<tr>
<td>Wainiha Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wainiha River</td>
<td>0.025 – 0.045</td>
<td>0.030 – 0.080</td>
</tr>
<tr>
<td>West Kauai Watershed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kekaha Drainageway</td>
<td>0.050 – 0.080</td>
<td>0.060 – 0.100</td>
</tr>
</tbody>
</table>
5.3 **Coastal Analyses**

For the areas of Kauai 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**

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Study Limits From</th>
<th>Study Limits To</th>
<th>Hazard Evaluated</th>
<th>Model or Method Used</th>
<th>Date Analysis was Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Ocean</td>
<td>Open coast north of Moloa’a Bay</td>
<td>Open coast south of Moloa’a Bay</td>
<td>Tsunami</td>
<td>Hybrid Finite Element model</td>
<td>10/30/2018</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Overland Wave Propagation</td>
<td>WHAFIS 4.0</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Erosion</td>
<td>CHAMP</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Statistical Analyses</td>
<td>EST</td>
<td>*</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Storm Surge</td>
<td>ADCIRC</td>
<td>*</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Generation</td>
<td>ACES</td>
<td>*</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Generation</td>
<td>SPM hurricane prediction techniques</td>
<td>12/31/2007</td>
</tr>
</tbody>
</table>
Table 15: Summary of Coastal Analyses (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>Study Limits From</th>
<th>Study Limits To</th>
<th>Hazard Evaluated</th>
<th>Model or Method Used</th>
<th>Date Analysis was Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Runup</td>
<td>TAW</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Runup</td>
<td>SPM</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Runup</td>
<td>RUNUP 2.0</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Setup</td>
<td>Direct Integration Method (DIM)</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Wave Setup</td>
<td>Gourlay</td>
<td>02/28/2008</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>Entire coastline of Kauai County</td>
<td>Entire coastline of Kauai County</td>
<td>Tsunami</td>
<td>Hybrid finite element model</td>
<td>*</td>
</tr>
</tbody>
</table>

*Unconfirmed

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.
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 Empirical Simulation Technique was performed on the storm surge modeling results to determine the stillwater elevations for the 1-percent-annual-chance event.
Table 16: Tide Gage Analysis Specifics
[Not applicable to this Flood Risk Project]

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

5.3.2 Waves
This section is not applicable to this Flood Risk Project

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.

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”.

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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.

Tsunami Analysis
Tsunami wave elevations for the coastal areas of Kauai were calculated using a report prepared by the USACE Waterways Experiment Station (Houston, et al., 1977) in conjunction with Japanese Tsunamis in Hawaii – A Preliminary Report, By D.C. Cox (D.C. Cox, 1980). A hybrid finite-element numerical model was developed to supplement historical data in determining the 10 largest tsunami elevations from 1837 to 1979. The finite-element model provides an accurate, representative response of the island to tsunami activity as a result of rapid bathymetric and/or wave height variations. The numerical model was adjusted and verified by comparing the calculated results of the model with tide gauge recordings of the 1960 and 1964 tsunamis. Use of the model yields starting tsunami elevations for various flood frequencies at a point 200 feet inland from the shoreline.

The procedure used for determining the tsunami runup profile was extracted from a study entitled “Tsunami Inundation Prediction” (Bretschneider and Wybro, 1976) in which a formula was developed for predicting tsunami runup profiles, and the calculated results were compared with the recorded inundation data of the 1946 and 1960 tsunami on the islands of Maui and Hawaii. Good to excellent correlations were obtained between the observed and calculated inundation profiles.

Tsunami elevations, as the wave travels inland, and the maximum inundation limits were determined utilizing a study entitled Tsunami Inundation Prediction (Bretschneider and Wybro, 1976). Runup elevations and inundation limits are dependent on starting tsunami elevations, inland ground elevations, roughness factors (Manning’s “n” values), and the expected type of wave behavior (non-bore or bore formation).

Overland roughness factors used in the hydraulic computations were chosen by engineering judgment and based on field observations of the coastal areas. Most of the coastal areas of Kauai have experienced only the non-bore type of tsunami wave action. The only recorded bore formation in Kauai occurred in 1946 in the Haena area.

Revised coastal tsunami analyses for Moloa’a Bay were completed as a part of this 2018 FIS revision. Detailed study of the Moloa'a Bay area re-mapped the 1-percent annual chance tsunami runup elevations and special flood hazard areas using topographic and bathymetric LiDAR data from the USACE (USACE, 2013). The same methodology for determination of the tsunami bore propagation and inland inundation limits previously used were also applied for this revision.
Table 17: Coastal Transect Parameters†

<table>
<thead>
<tr>
<th>Flood Source</th>
<th>Coastal Transect</th>
<th>Significant Wave Height $H_s$ (ft)</th>
<th>Peak Wave Period $T_p$ (sec)</th>
<th>10% Annual Chance $H_s$</th>
<th>4% Annual Chance $H_s$</th>
<th>2% Annual Chance $H_s$</th>
<th>1% Annual Chance $H_s$</th>
<th>0.2% Annual Chance $H_s$</th>
<th>Zone Designation</th>
<th>1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Ocean</td>
<td>1</td>
<td>*</td>
<td>*</td>
<td>0.7</td>
<td>*</td>
<td>0.9</td>
<td>4.2†</td>
<td>2.3</td>
<td>VE AE</td>
<td>6</td>
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<tr>
<td>Pacific Ocean</td>
<td>2</td>
<td>*</td>
<td>*</td>
<td>0.7</td>
<td>*</td>
<td>0.8</td>
<td>7.0†</td>
<td>2.0</td>
<td>VE AE</td>
<td>9-11 7-9</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>3</td>
<td>*</td>
<td>*</td>
<td>0.7</td>
<td>*</td>
<td>0.8</td>
<td>5.6†</td>
<td>2.0</td>
<td>VE AE</td>
<td>8-9 8 7</td>
</tr>
<tr>
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<td>4</td>
<td>*</td>
<td>*</td>
<td>0.7</td>
<td>*</td>
<td>0.8</td>
<td>1.1</td>
<td>2.0</td>
<td>VE AE</td>
<td>13 13</td>
</tr>
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<td>*</td>
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<td>*</td>
<td>0.9</td>
<td>5.5†</td>
<td>2.2</td>
<td>VE AE</td>
<td>8 7-8 6</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>6</td>
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<td>*</td>
<td>0.7</td>
<td>*</td>
<td>0.9</td>
<td>5.6†</td>
<td>2.1</td>
<td>VE AE</td>
<td>8-9 6-8</td>
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</table>
Table 17: Coastal Transect Parameters† (continued)

<table>
<thead>
<tr>
<th>Flood Source</th>
<th>Coastal Transect</th>
<th>Starting Wave Conditions for the 1% Annual Chance</th>
<th>Starting Stillwater Elevations (ft LOCAL TIDE DATUM)</th>
<th>Zone Designation</th>
<th>1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Ocean</td>
<td>7</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>10-11 10 9²</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>8</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>9-11 7-9</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>9</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>9-11 9²</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>10</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>10-12 8-10</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>11</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>10-12 8-10</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>12</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>12 11² 11²</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>13</td>
<td>* *</td>
<td>0.7 0.7</td>
<td>VE AE</td>
<td>8-9 6-8</td>
</tr>
</tbody>
</table>
Table 17: Coastal Transect Parameters† *(continued)*

<table>
<thead>
<tr>
<th>Flood Source</th>
<th>Coastal Transect</th>
<th>Significant Wave Height $H_s$ (ft)</th>
<th>Peak Wave Period $T_p$ (sec)</th>
<th>10% Annual Chance</th>
<th>4% Annual Chance</th>
<th>2% Annual Chance</th>
<th>1% Annual Chance</th>
<th>0.2% Annual Chance</th>
<th>Zone Designation</th>
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<td>VE</td>
<td>8-9 8</td>
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<td>8-9 6-8</td>
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Table 17: Coastal Transect Parameters† (continued)

<table>
<thead>
<tr>
<th>Flood Source</th>
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<th>Starting Wave Conditions for the 1% Annual Chance</th>
<th>Starting Stillwater Elevations (ft LOCAL TIDE DATUM)</th>
<th>Range of Stillwater Elevations (ft LOCAL TIDE DATUM)</th>
<th>Zone Designation</th>
<th>1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)</th>
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<td>8 8²</td>
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<td>Peak Wave Period $T_p$ (sec)</td>
<td>10% Annual Chance</td>
<td>4% Annual Chance</td>
<td>2% Annual Chance</td>
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Table 17: Coastal Transect Parameters (continued)
## Table 17: Coastal Transect Parameters (continued)

<table>
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<tr>
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<th>Significant Wave Height $H_s$ (ft)</th>
<th>Peak Wave Period $T_p$ (sec)</th>
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<th>4% Annual Chance</th>
<th>2% Annual Chance</th>
<th>1% Annual Chance</th>
<th>0.2% Annual Chance</th>
<th>Zone Designation</th>
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<td>Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)</td>
<td>Zone Designation</td>
<td>1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)</td>
<td></td>
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<tr>
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<td>*    *</td>
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<td>8-9</td>
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<td>*   *   *   *   *   *   *   *   *   VE</td>
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</tr>
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<td>25^1</td>
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### Table 17: Coastal Transect Parameters† (continued)

<table>
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<tr>
<th>Flood Source</th>
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<th>Significant Wave Height $H_s$ (ft)</th>
<th>Peak Wave Period $T_p$ (sec)</th>
<th>Starting Wave Conditions for the 1% Annual Chance</th>
<th>Starting Stillwater Elevations (ft LOCAL TIDE DATUM)</th>
<th>Range of Stillwater Elevations (ft LOCAL TIDE DATUM)</th>
<th>Zone Designation</th>
<th>1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)</th>
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<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
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<td>VE</td>
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<td>VE</td>
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<td>*</td>
<td>*</td>
<td>*</td>
<td>VE</td>
<td>23-26^</td>
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<td>*</td>
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<td>*</td>
<td>VE</td>
<td>25^</td>
</tr>
<tr>
<td>Flood Source</td>
<td>Coastal Transect</td>
<td>Significant Wave Height $H_s$ (ft)</td>
<td>Peak Wave Period $T_p$ (sec)</td>
<td>10% Annual Chance $H_s$</td>
<td>4% Annual Chance $H_s$</td>
<td>2% Annual Chance $H_s$</td>
<td>1% Annual Chance $H_s$</td>
<td>0.2% Annual Chance $H_s$</td>
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<td>*</td>
<td>*</td>
<td>*</td>
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</tr>
</tbody>
</table>

*Not calculated for this Flood Risk Project
†All elevations reflect the hurricane surge hazard only, unless otherwise noted.
^Base Flood Elevation reflects tsunami hazard
1Includes wave setup
2Wave runup elevation

Table 17: Coastal Transect Parameters* (continued)
Figure 9: Transect Location Map
Figure 9: Transect Location Map (continued)
Figure 9: Transect Location Map (continued)
5.4 **Alluvial Fan Analyses**  
This section is not applicable to this Flood Risk Project

Table 18: Summary of Alluvial Fan Analyses  
[Not applicable to this Flood Risk Project]

Table 19: Results of Alluvial Fan Analyses  
[Not applicable to this Flood Risk Project]

### SECTION 6.0 – MAPPING METHODS

#### 6.1 Vertical and Horizontal Control

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

Flood elevations shown in this FIS Report and on the FIRMs are referenced to Local Tidal Datum. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between Local Tidal Datum and NAVD88 or other datum conversion, visit the National Geodetic Survey website at [www.ngs.noaa.gov](http://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](http://www.ngs.noaa.gov).

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

Table 20: Countywide Vertical Datum Conversion  
[Not applicable to this Flood Risk Project]
6.2 Base Map

The FIRM 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 FIRM. 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](http://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping).

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

### Table 22: Base Map Sources

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Data Provider</th>
<th>Data Date</th>
<th>Data Scale</th>
<th>Data Description</th>
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</thead>
<tbody>
<tr>
<td>2017 Tiger Lines Roads Kauai, HI</td>
<td>United States Census Bureau</td>
<td>2018</td>
<td>1:6,000</td>
<td>Transportation base data</td>
</tr>
<tr>
<td>HUC-8 Watershed: Kauai, HI</td>
<td>United States Geological Survey</td>
<td>2018</td>
<td>1:6,000</td>
<td>HUC-8 watershed data</td>
</tr>
<tr>
<td>Kauai County, HI Orthography</td>
<td>United States Department of Agriculture</td>
<td>2016</td>
<td>1:6,000</td>
<td>Orthography for panels and basemap index</td>
</tr>
</tbody>
</table>

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 Local Tide Datum. 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

<table>
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<tr>
<th>Community</th>
<th>Flooding Source</th>
<th>Source for Topographic Elevation Data</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>Kauai County</td>
<td>Hanapepe River,</td>
<td>2006 FEMA LiDAR: Hawaiian Islands</td>
</tr>
<tr>
<td></td>
<td>Waimea River</td>
<td>The vertical accuracy of the LiDAR was 0.137 meters, RMSEz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The horizontal accuracy was 0.30 meters</td>
</tr>
<tr>
<td></td>
<td>Moloa’a Bay, Moloa’a</td>
<td>2013 USACE NCMP Topobathy LiDAR: Kauai-LMSL (IS)</td>
</tr>
<tr>
<td></td>
<td>Stream</td>
<td>19.6 centimeters at 95% confidence level (10 centimeters RMSE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compiled to meet 1 meter at 95% confidence level</td>
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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.
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¹Stream distance in feet above confluence with Anahola Bay
²Stream distance in feet above confluence with Hanalei Bay
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1Stream distance in feet above confluence with Hanamaulu Bay
2Elevation influenced by Hanamaulu Bay
3Stream distance in feet above confluence with Hanamaulu Stream
### Table 24: Floodway Data (continued)

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¹Stream distance in feet above confluence with the Pacific Ocean
²Elevation riverward of levee
³Elevation landward of right bank levee
⁴Elevation landward of left bank levee
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1Stream distance in feet above confluence with the Pacific Ocean
2Elevation riverward of levee
3Elevation landward of right bank levee
4Elevation landward of left bank levee
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¹Stream distance in feet above confluence with Nawiliwili Bay
Table 24: Floodway Data (continued)

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¹Stream distance in feet above confluence with Kauai Channel
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\(^1\)Stream distance in feet above Limit of Detailed Study**

**Limit of Detailed Study is approximately 2,540 feet downstream of Lauoho Road

---

**Table 24: Floodway Data (continued)**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**KAUAI COUNTY, HI**

**FLOODWAY DATA**

**LAWAI STREAM**

72
**Table 24: Floodway Data (continued)**

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<th>DISTANCE</th>
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1Stream distance in feet above confluence with Kauai Channel
*Floodway coincident with channel banks
**Limit of Detailed Study is approximately 2,540 feet downstream of Lauoho Road

---

**TABLE 24**

FEDERAL EMERGENCY MANAGEMENT AGENCY
KAUAI COUNTY, HI

FLOODWAY DATA
MOIKEHA CANAL
Table 24: Floodway Data (continued)

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1Stream distance in feet above confluence with the Pacific Ocean
*Floodway not computed
Table 24: Floodway Data (continued)

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2Stream distance in feet above confluence with Waikomo Stream
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\(^1\)Stream distance in feet from Kamalu Road
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²Stream distance in feet above confluence with Huleia Stream
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¹Stream distance in feet above confluence with Nawiliwili Bay
²Stream distance in feet above confluence with Pacific Ocean
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¹Stream distance in feet above confluence with Pacific Ocean
²Stream distance in feet above confluence with Waikomo Stream
Table 24: Floodway Data (continued)

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1Stream distance in feet above confluence with the Pacific Ocean
2Elevation riverward of levee
3Elevation landward of right bank levee
### Table 24: Floodway Data (continued)

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<td>5.4</td>
<td>26.8 (^2)</td>
<td>26.9</td>
<td>0.1</td>
</tr>
</tbody>
</table>

\(^1\)Stream distance in feet above confluence with the Pacific Ocean

\(^2\)Elevation riverward of levee

\(^3\)Elevation landward of right bank levee

---

**TABLE 24**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**KAUAI COUNTY, HAWAII**

**FLOODWAY DATA**

**WAIMEA RIVER**

---

82
## Table 24: Floodway Data (continued)

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>FLOODWAY</th>
<th>1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CROSS SECTION</td>
<td>DISTANCE</td>
<td>WIDTH (FEET)</td>
</tr>
<tr>
<td>Wainiha River</td>
<td>A</td>
<td>2,400&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>2,800&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>3,300&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>3,800&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>4,200&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4,700&lt;sup&gt;1&lt;/sup&gt;</td>
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<tr>
<td></td>
<td>G</td>
<td>5,300&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Waioli Stream</td>
<td>A</td>
<td>2,600&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>4,400&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>5,800&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Stream distance in feet above confluence with Wainiha Bay

<sup>2</sup>Stream distance in feet above confluence with Hanalei Bay

---

**Table 24**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**KAUAI COUNTY, HI**

**FLOODWAY DATA**

**WAINIHA RIVER – WAIOLI STREAM**
Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams
[Not applicable to this Flood Risk Project]

6.4 Coastal Flood Hazard Mapping

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

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

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

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

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

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

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

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

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

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

[Not applicable to this Flood Risk Project]

Tsunami and Hurricane Inundation Boundaries
Inundation limits from the 1-percent-annual-chance tsunami were computed for most of the shoreline of the Island of Kauai. The methodology employed in this computation is described in Section 5.3.4. The 1-percent-annual-chance tsunami inundation boundaries were delineated using methods outlined in Tsunami Inundation Prediction (Bretschneider and Wybro 1976), and the best topographic information available at the time of the analysis.

Previous and revised mapping of the tsunami hazard was merged with the detailed hurricane coastal hazard study. This was accomplished by comparing the zone type, base flood elevation, and inland flooding extent of coincident tsunami and hurricane storm surge hazards. The higher of the two elevations was retained and presented on the Flood Insurance Rate Map. If in a tsunami hazard-dominated area, the inland limit of the hurricane storm surge flooding extends further landward than the tsunami hazard, the tsunami base flood elevation is shown, and the flooding extent is extended to where the hurricane hazard is mapped. This is to reflect the increased hazard generated by the use of updated topographic data. In some cases, the dominant hazard transitioned from hurricane storm surge to tsunami (or vice-versa) moving inland, for which only a single transition was allowed. The VE Zone was extended and mapped to the inland limit of the Primary Frontal Dune for both tsunami and hurricane hazards. In cases where elevations were similar, engineering judgment was applied to facilitate the most appropriate representation of the higher hazard.

The inundation limits for the 1-percent-annual-chance tsunami are based on existing conditions. Any modification or alteration to existing conditions may have a significant effect on the tsunami inundation limits. For example, any regrading or reduction of surface roughness in onshore areas, such as that caused by the removal of native vegetation could increase the extent of inundation. Similarly, dredge and fill operations offshore could increase the extent of inundation because of the effects of coastal bathymetry on tsunami wave setup. However, existing or planned coastal features such as natural reefs, seawalls, groins, jetties, or beach stabilization projects may have a mitigating effect on tsunami inundation.

Revisions to coastal tsunami floodplain boundaries were completed as a part of this 2018 FIS revision for Moloa’a Bay. Detailed study of the Moloa’a Bay area re-mapped the 1-percent annual chance tsunami runup elevations and special flood hazard areas using topographic and bathymetric LiDAR data from the USACE (USACE, 2013).

All AE and VE Zones are identified on the FIRM, except where the zones are too narrow to show because of map scale limitations. In cases where the AE and VE Zones are too small to be shown separately, only Zone VE was shown.
The Coastal High Hazard Zone consists of all areas that are identified by Zone VE. Special performance standards for construction in Coastal High Hazard Zones have been set by FEMA. The Coastal High Hazard Zones and areas of known bore formations are delineated on the FIRM.

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 and download the form “MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill”. Visit the “Flood Map-Related Fees” section to determine the cost, if any, of applying for a LOMA.

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

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

6.5.2 Letters of Map Revision Based on Fill

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

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

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

6.5.3 Letters of Map Revision

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

To obtain an application for a LOMR, visit www.fema.gov/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 Kauai County FIRM are listed in Table 27.

<table>
<thead>
<tr>
<th>Case Number</th>
<th>Effective Date</th>
<th>Flooding Source</th>
<th>FIRM Panel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>199210608MBJ</td>
<td>08-07-1986</td>
<td>Pacific Ocean</td>
<td>*</td>
</tr>
<tr>
<td>1995105419FIA</td>
<td>04-06-1987</td>
<td>Pacific Ocean</td>
<td>*</td>
</tr>
<tr>
<td>199210607MBJ</td>
<td>06-09-1988</td>
<td>Pacific Ocean</td>
<td>*</td>
</tr>
<tr>
<td>03-09-0017P</td>
<td>10-21-2002</td>
<td>Pacific Ocean</td>
<td>1500020035E</td>
</tr>
<tr>
<td>07-09-0537P</td>
<td>01-26-2007</td>
<td>Pacific Ocean</td>
<td>1500020055E</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1500020313F</td>
</tr>
</tbody>
</table>

*Unable to determine

6.5.4 Physical Map Revisions

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

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

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

6.5.5 Contracted Restudies

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

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of Kauai 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 Kauai County FIRMs was November 4, 1981.

**Table 28: Community Map History**

<table>
<thead>
<tr>
<th>Community Name</th>
<th>Initial Identification Date</th>
<th>Initial FHBM Effective Date</th>
<th>FHBM Revision Date(s)</th>
<th>Initial FIRM Effective Date</th>
<th>FIRM Revision Date(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11/26/2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>09/16/2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10/18/2002</td>
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<tr>
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<td>09/30/1995</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>03/04/1987</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>FIS Report Dated</th>
<th>Contractor</th>
<th>Number</th>
<th>Work Completed Date</th>
<th>Affected Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anahola Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Hanalei River</td>
<td>9/16/2005</td>
<td>USACE</td>
<td>EMW-96-1A0288</td>
<td>October 2002</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Hanamaulu Stream</td>
<td>9/30/1995</td>
<td>Sam O. Hirota, Inc. (SHI)</td>
<td>EMW-89-C-2842</td>
<td>September 1995</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Flooding Source</td>
<td>FIS Report Dated</td>
<td>Contractor</td>
<td>Number</td>
<td>Work Completed Date</td>
<td>Affected Communities</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------</td>
<td>-------------------------------------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Hanamaulu Stream Tributary</td>
<td>9/30/1995</td>
<td>Sam O. Hirota, Inc. (SHI)</td>
<td>EMW-89-C-2842</td>
<td>September 1995</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Hanapepe River</td>
<td>12/17/2020</td>
<td>STARR II (Strategic Alliance for Risk Reduction)</td>
<td>HSFE60-15-D-0005</td>
<td>September 2017</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Huleia Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>EMW-84-E-1506</td>
<td>June 1985</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Kalama Stream</td>
<td>9/30/1995</td>
<td>Sam O. Hirota, Inc. (SHI)</td>
<td>EMW-89-C-2842</td>
<td>September 1995</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Kapaa Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Kekaha Drainageway</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>EMW-84-E-1506</td>
<td>June 1985</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Lawai Stream, Lawai Stream Side Channel</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>EMW-84-E-1506</td>
<td>June 1985</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Moikeha Canal</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Moloa’a Bay/Pacific Ocean</td>
<td>12/17/2020</td>
<td>STARR II (Strategic Alliance for Risk Reduction)</td>
<td>HSFE60-15-D-0005</td>
<td>October 2018</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Moloa’a Stream</td>
<td>12/17/2020</td>
<td>USACE</td>
<td>DACA83-93-D-0016</td>
<td>June 1994</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Nawiliwili Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Omao Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Opaekaa Stream, Opaekaa Tributary</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>EMW-84-E-1506</td>
<td>June 1985</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Papakolea Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>EMW-84-E-1506</td>
<td>June 1985</td>
<td>Kauai County</td>
</tr>
</tbody>
</table>
### Table 29: Summary of Contracted Studies Included in this FIS Report (continued)

<table>
<thead>
<tr>
<th>Flooding Source</th>
<th>FIS Report Dated</th>
<th>Contractor</th>
<th>Number</th>
<th>Work Completed Date</th>
<th>Affected Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puali Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Waikaea Canal</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Waikomo Stream, Waikomo Stream Tributary</td>
<td>9/30/1995</td>
<td>Sam O. Hirola, Inc. (SHI)</td>
<td>EMW-89-C-2842</td>
<td>September 1995</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Waimea River</td>
<td>12/17/2020</td>
<td>STARR II (Strategic Alliance for Risk Reduction)</td>
<td>HSFE60-15-D-0005</td>
<td>September 2017</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Wainiha River</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>EMW-84-E-1506</td>
<td>June 1985</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Waioli Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
<tr>
<td>Waipa Stream</td>
<td>9/30/1995</td>
<td>USACE</td>
<td>IAA-H-7-76, IAA-H-10-77</td>
<td>June 1978</td>
<td>Kauai County</td>
</tr>
</tbody>
</table>

### 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>
<thead>
<tr>
<th>Community</th>
<th>FIS Report Dated</th>
<th>Date of Meeting</th>
<th>Meeting Type</th>
<th>Attended By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauai County</td>
<td>11/04/1981</td>
<td>03/1976</td>
<td>Initial CCO Meeting</td>
<td>COE, FEMA and Kauai County</td>
</tr>
<tr>
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<td>02/23/1977</td>
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<td>Kauai County</td>
</tr>
<tr>
<td></td>
<td></td>
<td>02/28/1978</td>
<td>Intermediate CCO Meeting (Tsunami Conference)</td>
<td>University of Hawaii, Joint Tsunami Research Effort of NOAA, COE, Oahu Civil Defense Agency and FEMA</td>
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<td>03/01/1978</td>
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<td>08/1983</td>
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<td>09/30/1995</td>
<td>Intermediate and Final CCO Meetings</td>
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<td>11/08/2001</td>
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<td>11/26/2010</td>
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*Data Not Available
SECTION 8.0 – ADDITIONAL INFORMATION

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

The additional data that was used for this project includes the FIS Report and FIRM that were previously prepared for Kauai County, (FEMA 2010). In addition, the USACE prepared a Tsunami Prediction Study for Kauai County in 1967 in response to the destruction caused by the March 1964 tsunami (USACE 1967).

Table 31 is a list of the locations where FIRMs for Kauai 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>
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<tr>
<th>Community</th>
<th>Address</th>
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<th>Zip Code</th>
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<tr>
<td>Kauai County</td>
<td>Department of Public Works 4444 Rice Street</td>
<td>Lihue</td>
<td>HI</td>
<td>96766</td>
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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

<table>
<thead>
<tr>
<th>FEMA and the NFIP</th>
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<tr>
<td>NFIP website</td>
<td><a href="http://www.fema.gov/national-flood-insurance-program">www.fema.gov/national-flood-insurance-program</a></td>
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<tr>
<td>NFHL Dataset</td>
<td><a href="http://msc.fema.gov">msc.fema.gov</a></td>
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</tbody>
</table>
| FEMA Region IX | Federal Regional Center  
1111 Broadway, Suite 1200  
Oakland, CA 94607  
(510) 627-7181 |
| Other Federal Agencies |  |
| USGS website | [www.usgs.gov](http://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 | Carol Tyau-Beam, CFM  
Hawaii Dept. of Land & Natural Resources  
Post Office Box 373  
Honolulu, Hawaii 96809  
(808) 587-0267  
carol.l.tyau@hawaii.gov |
| State GIS Coordinator | Arthur Buto  
GIS Program Director  
Post Office Box 2359  
Honolulu, Hawaii 96813  
Phone: (808) 587-2894  
arthur.j.buto@dbedt.hawaii.gov |

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>
<thead>
<tr>
<th>Citation in this FIS</th>
<th>Publisher/Issuer</th>
<th>Publication Title, “Article,” Volume, Number, etc.</th>
<th>Author/Editor</th>
<th>Place of Publication</th>
<th>Publication Date/Date of Issuance</th>
<th>Link</th>
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<tr>
<td>Houston, et al. 1977</td>
<td>U S. Department of the Army, Corps of Engineers</td>
<td>Tsunami-Wave Elevation Frequency of Occurrence for the Hawaiian Islands</td>
<td>J.R. Houston, R.D Carver, and D C. Markle</td>
<td>Vicksburg, Mississippi</td>
<td>August 1977</td>
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<tr>
<td>Kauai DPW 1976</td>
<td>Kauai County Department of Public Works</td>
<td>The Moikeha Canal Improvement Plans</td>
<td>Kauai County Department of Public Works</td>
<td>Lihue, Kauai, Hawaii</td>
<td>October 1976</td>
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<tr>
<td>NOAA 2006</td>
<td>NOAA</td>
<td>2006 FEMA LiDAR: Hawaiian Islands</td>
<td>NOAA’s Ocean Service, Office for Coastal Management</td>
<td>Charleston, South Carolina</td>
<td>October 2012</td>
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<td>STARR II 2017</td>
<td>STARR II</td>
<td>Hanapepe and Waimea Rivers Detailed Analysis</td>
<td>STARR II</td>
<td>San Diego, California</td>
<td>October 2017</td>
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<td>STARR II 2018</td>
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<td>Tsunami runup study of Moloa’a Bay</td>
<td>STARR II</td>
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<td>STARR II</td>
<td>Calveron, Maryland</td>
<td>December 2018</td>
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<td>Tiger 2017</td>
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<td>2017 Tiger Lines Roads, Kauai County, HI</td>
<td>U.S. Census Bureau</td>
<td>Washington D.C.</td>
<td>February 2018</td>
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<td>University of Hawaii 1976</td>
<td>Hawaii Institute of Geophysics, University of Hawaii</td>
<td>Tsunami Wave Runup Heights in Hawaii</td>
<td>Loomis, N.G.</td>
<td>Honolulu, Hawaii</td>
<td>May 1976</td>
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<td>USACE 1967</td>
<td>U.S. Army Corps of Engineers</td>
<td>Tsunami Prediction Study for Kauai County</td>
<td>Army Corps of Engineers</td>
<td>1967</td>
<td></td>
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<td>Citation in this FIS</td>
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<td>USACE 1994</td>
<td>U.S. Army Corps of Engineers</td>
<td>Detailed study of Moloa’a Stream</td>
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<td>Honolulu, Hawaii</td>
<td>June 1994</td>
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<td>Hurricane Iniki Coastal Inundation</td>
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<td>USACE 2013</td>
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<td>USDA-NRCS 2016</td>
<td>U.S. Department of Agriculture</td>
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<td>USDA-NRCS</td>
<td>Fort Worth, Texas</td>
<td>October 2016</td>
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Table 33: Bibliography and References *(continued)*

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