



# Charlot House

## *Retrofitting and Preserving Resilience*

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Executive Director, NDPTC

University of Hawaii

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# Project Team

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UHCDC

**Creesha Layaoen**, student assistant UHCDC

**Megan Russell**, student assistant, UHCDC

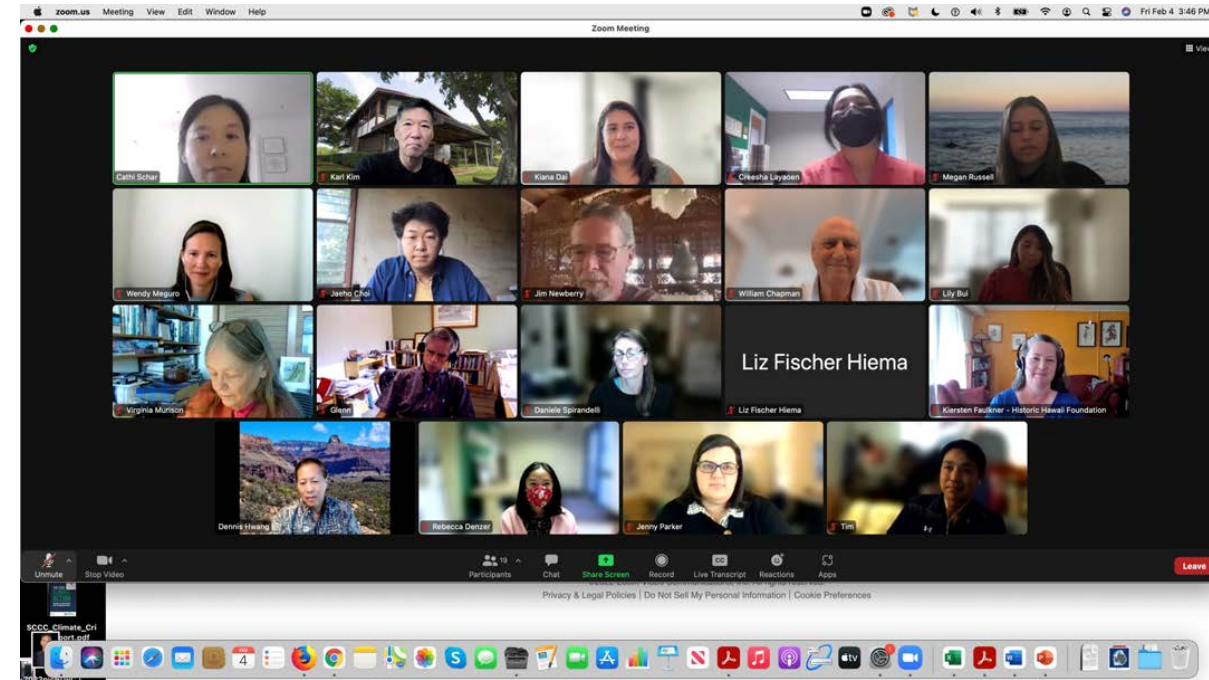
**Kiana Dai**, student assistant, UHCDC

**Keola Annino**, Charlot House Caretaker

**Jaeho Choi**, Graduate Assistant, NDPTC

**Sequoia Riley**, Graduate Assistant, NDPTC

**Eric Yamashita and Lily Bui**, NDPTC/PURL





# Overview

- Historic preservation *and* climate adaptation
- New tools, technologies, data, approaches to resilience
- Case Study houses for research, design, teaching
- **PARTNERSHIP with Historic Hawaii Foundation**
- **Embedded within University of Hawaii**
  - School of Architecture
  - Community Design Center
  - Department of Urban and Regional Planning
  - Disaster Management and Humanitarian Assistance Program
  - Pacific Urban Resilience Lab
  - National Disaster Preparedness Training Center  
([ndptc.hawaii.edu](http://ndptc.hawaii.edu))



Case Study #8 Eames, LA



# ndptc.hawaii.edu

- Authorized by U.S. Congress
- **Funded by FEMA**
- Housed at University of Hawaii
- Natural/coastal/island hazards
- **Response Recovery Mitigation**
- Tsunami, hurricane, climate change
- **detection/alert/warning**
- Evacuation Sheltering
- Member of National Domestic Preparedness Consortium: **ndpc.us**

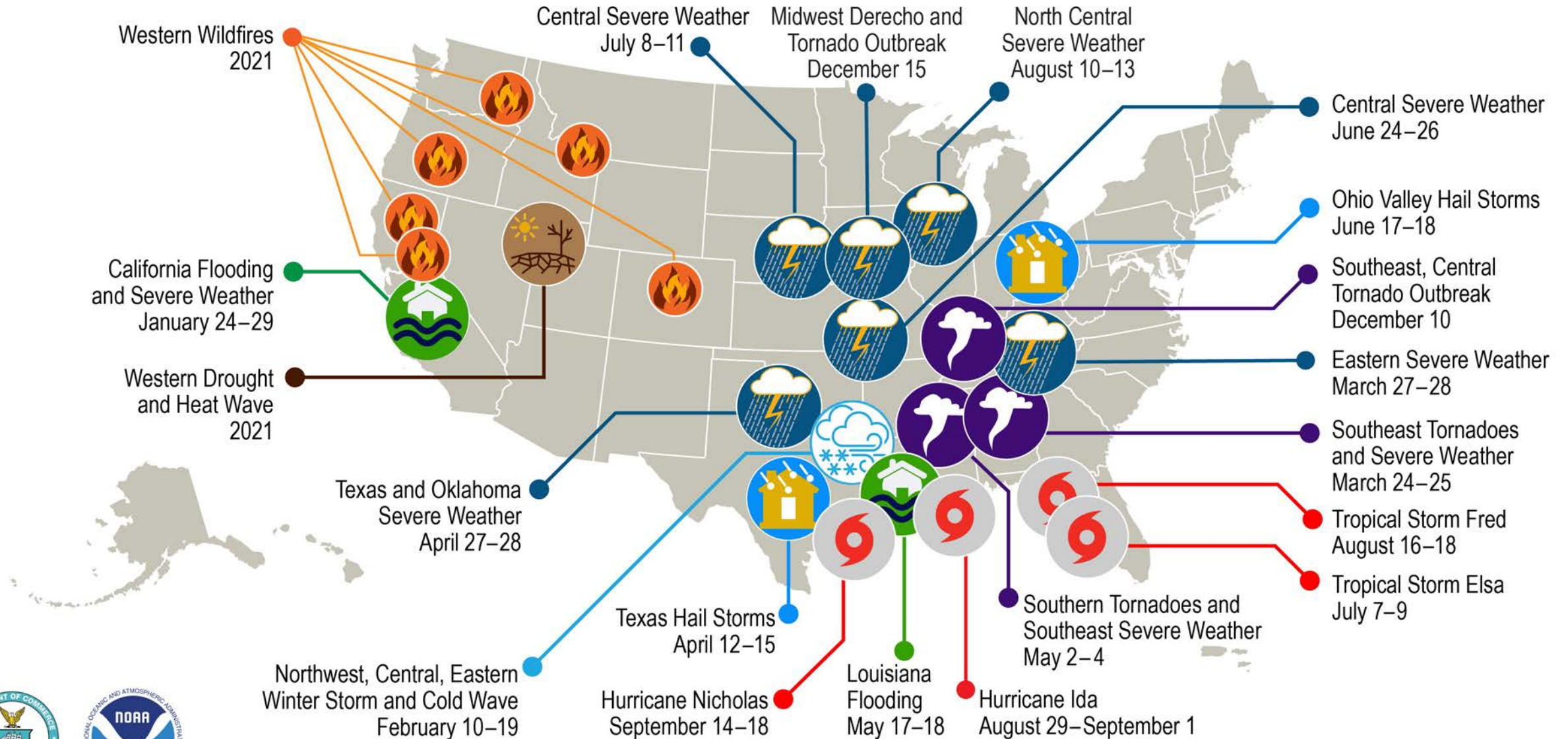
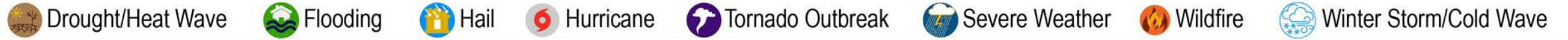


## FEMA

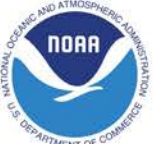




# U.S. 2021 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the **20 separate billion-dollar weather and climate disasters** that impacted the United States in 2021



# Process•Approach•Workshop•Engagement

*What we wanted:*

F2F, design charrette

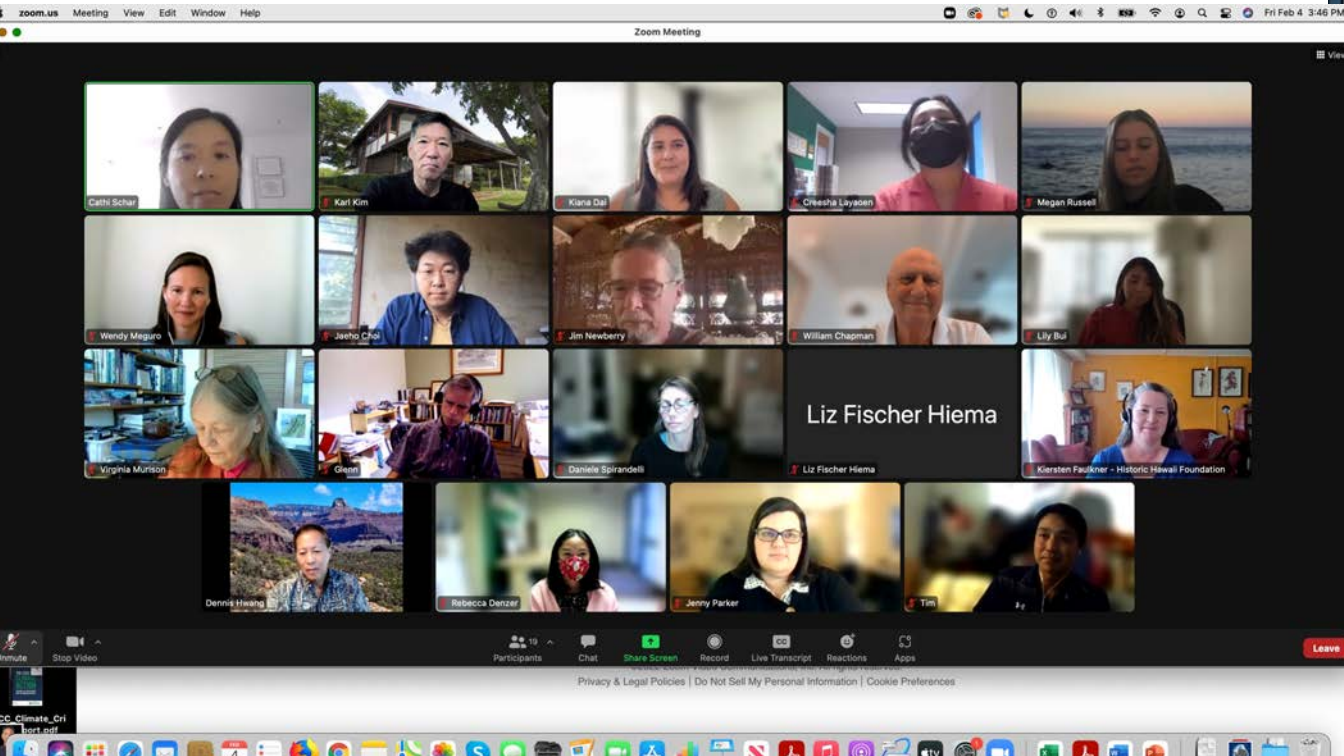
In-person, close engagement



*What we got:*

Yet more Zoom meetings

- With website, ArcGIS StoryMaps, 360 camera imagery...
- Breakout room discussions
- Professionals, faculty, students, designers, beyond Hawaii...





# Overview of Planning and Design Process



**01**

## Identify Hazards

Prioritize hazards to mitigate for, which will be the focus of subsequent steps.



**02**

## Document Existing Site Vulnerabilities

Catalog historic features and their risk due to their associated location within the site. Capture 360 images to visualize entire site.



**03**

## Map Hazards

Study predictions of sea level rise, hurricane storm surge, wind direction, and flooding maps to understand frequency and severity of risks.



**04**

## Review Literature and Compile Strategies

Investigate resources from NPS, FEMA, LEED, and others to compile strategies to withstand hazards. Categorize them by short, mid and long term actions.



**05**

## Engage Subject Matter Experts

Facilitate workshops with experts in architecture, landscape architecture, insurance, historic preservation, engineering, and planning to weigh in on mitigation strategies.



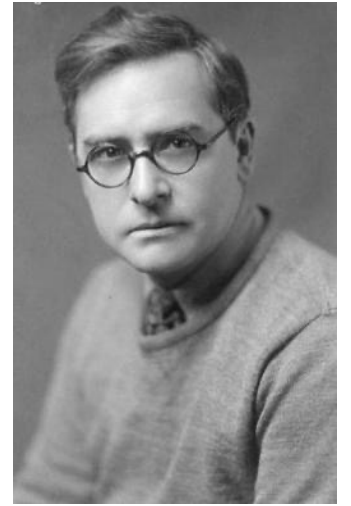
**06**

## Develop and Share Plan

After collecting and considering expert's recommendations, share a plan with HHF on concrete short term action items and mid term/regional recommendations.

# Jean Charlot: *Artist, Designer, Educator*

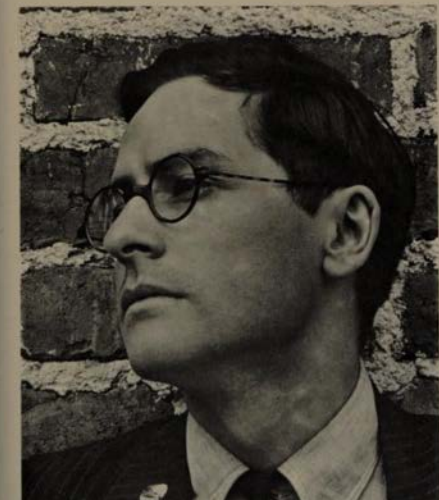
- **1898-1979**; born in Paris, lived and worked in Mexico, Colorado
- Painter, Muralist, Taught at **Black Mountain College**
- Faculty at the **University of Hawaii**



UNIVERSITY  
PRESS  
OF HAWAII  
HONOLULU  
1972



AN ARTIST ON ART  
Collected Essays of  
JEAN CHARLOT





# Jean and Zohmah Charlot Residence



**Pete Wimberly, Architect**  
**James Hubbard, Landscape Architect**  
**Built in 1958**  
**National and State Register of Historic Places**  
**Two Story Split Level Ranch-style**  
**Flat, sloping gable roof, L-shaped structure**  
**Open beam ceiling**  
**12'x12' Mural "Tropical Foliage" in Living Room**  
**Indoor/Outdoor with 3 Lanais**  
**Studio, Master Suite, Attic Above Kitchen**  
**Painted Concrete Floors, Cinderblock, Redwood**  
**Ceramic Tiles, Stained Glass, Fresco, Artwork**  
**Garage and one bedroom studio apartment**  
**Landscaping and trees**



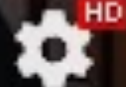




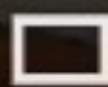
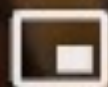




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HD





# Located Next to Canal and Golf Course





## NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updates or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **Floodway Data** have been determined, users are encouraged to consult the **Flood Profiles and Floodway Data** and/or **Summary of Stillwater Elevations** tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations (BFEs)** shown on this map apply only to landward of 50' Local Tidal Datum. Users of this FIRM should be aware that coastal flood elevations are also provided in the **Summary of Stillwater Elevations** tables in the FIS report. Users should be aware that coastal flood elevations shown in the **Summary of Stillwater Elevations** tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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 Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The projection used in the preparation of this map was Hawaii State Plane Zone 3 (FIPSZONE 5103). The horizontal datum was NAD 83. GRS80 spheroid. Differences in datum, spheroid, projection or UTM 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 this FIRM.

Flood elevations on this map are referenced to the **Local Tidal Datum**. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. No conversion factor is needed to compare Local Tidal Datum to the National Geodetic Vertical Datum of 1929. Elevations shown in the FIS report are equivalent to the National Geodetic Vertical Datum of 1929. For information, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NCS Information Services  
NCAA, NNC512  
National Geodetic Survey  
SSMC-5 #0032  
1315 East West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3342

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3342 or visit its website at <http://www.ngs.noaa.gov>.

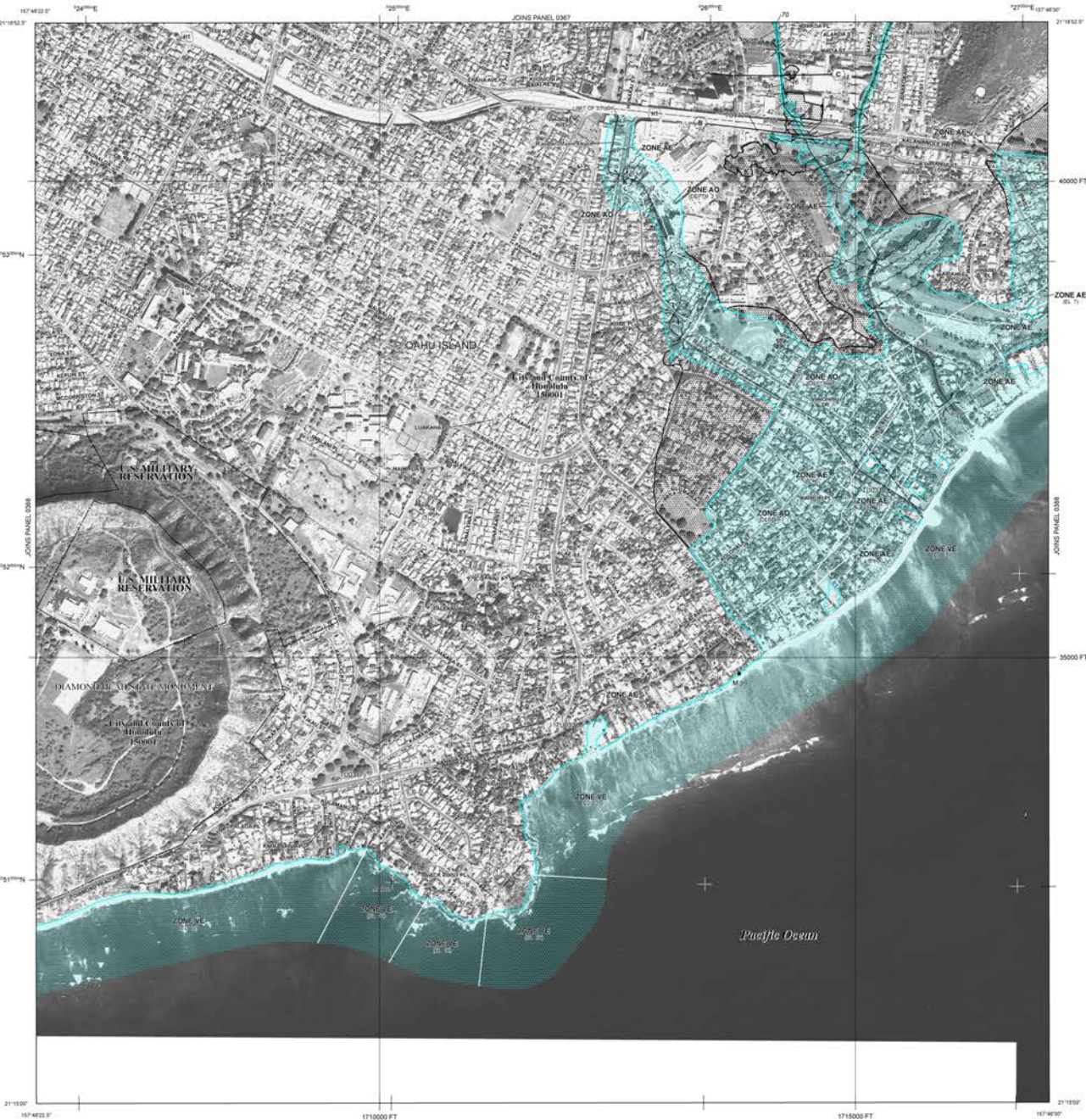
**Base map** information shown on this FIRM was provided in digital format by the U.S. Department of Agriculture, Natural Resources Conservation Service, National Geospatial Management Center. This imagery was derived from processed 50-centimeter ground resolution satellite imagery. These data were collected by DigitalGlobe between September 2002 and January 2003.

This map may reflect more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodways and floodway data were transferred from the previous FIRM and may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel configurations that differ from what is shown on this map.

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

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a listing of communities with corresponding National Flood Insurance Program data for each community as well as a listing of the panels on which each community is located.

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 (1-877-336-2527) or visit the FEMA Map Service Center website at <http://www.fema.gov>. Available products may include printed versions of Map Change, a Flood Insurance Study report, and/or digital versions of this map. Many of these products can be ordered or ordered directly from the website. Users may determine the current map data for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information Exchange.



## LEGEND

### SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone AE, AO, AR, VE, V, and X. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

**Zone AE**  
1% annual chance flood

**Zone AO**  
1% annual chance flood with average depths of 1 to 3 feet

**Zone AR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone VE**  
Coastal flood zone with velocity hazard (wave action)

**Zone V**  
Coastal flood zone with velocity hazard (wave action)

**Zone X**  
Areas of 1% annual chance flood with average depths of less than 1 foot or with damage ratios less than 1 (see note and areas protected by levees from 1% annual chance flood)

**Zone Y**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone Z**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AD**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AE**  
1% annual chance flood

**Zone AF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AG**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AH**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AI**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AJ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AK**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AL**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AM**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AN**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AO**  
1% annual chance flood with average depths of 1 to 3 feet

**Zone AP**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AQ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone AS**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AT**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AU**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AV**  
Coastal flood zone with velocity hazard (wave action)

**Zone AW**  
Coastal flood zone with velocity hazard (wave action)

**Zone AX**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AY**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone AZ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BD**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BE**  
1% annual chance flood

**Zone BF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BG**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BH**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BI**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BJ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BK**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BL**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BM**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BN**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BO**  
1% annual chance flood

**Zone BP**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BQ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone BS**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BT**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BU**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BV**  
Coastal flood zone with velocity hazard (wave action)

**Zone BW**  
Coastal flood zone with velocity hazard (wave action)

**Zone BX**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BY**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone BZ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CD**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CE**  
1% annual chance flood

**Zone CF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CG**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CH**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CI**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CJ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CK**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CL**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CM**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CN**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CO**  
1% annual chance flood

**Zone CP**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CQ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone CS**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CT**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CU**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CV**  
Coastal flood zone with velocity hazard (wave action)

**Zone CW**  
Coastal flood zone with velocity hazard (wave action)

**Zone CX**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CY**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone CZ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DD**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DE**  
1% annual chance flood

**Zone DF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DG**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DH**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DI**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DJ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DK**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DL**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DM**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DN**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DO**  
1% annual chance flood

**Zone DP**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DQ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone DS**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DT**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DU**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DV**  
Coastal flood zone with velocity hazard (wave action)

**Zone DW**  
Coastal flood zone with velocity hazard (wave action)

**Zone DX**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DY**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone DZ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone ED**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EE**  
1% annual chance flood

**Zone EF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EG**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EH**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EI**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EJ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EK**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EL**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EM**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EN**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EO**  
1% annual chance flood

**Zone EP**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EQ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone ER**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone ES**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone ET**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EU**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EV**  
Coastal flood zone with velocity hazard (wave action)

**Zone EW**  
Coastal flood zone with velocity hazard (wave action)

**Zone EX**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EY**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone EZ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FD**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FE**  
1% annual chance flood

**Zone FF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FG**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FH**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FI**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FJ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FK**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FL**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FM**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FN**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FO**  
1% annual chance flood

**Zone FP**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FQ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FR**  
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed

**Zone FS**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FT**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FU**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FV**  
Coastal flood zone with velocity hazard (wave action)

**Zone FW**  
Coastal flood zone with velocity hazard (wave action)

**Zone FX**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FY**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone FZ**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone GA**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone GB**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone GC**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

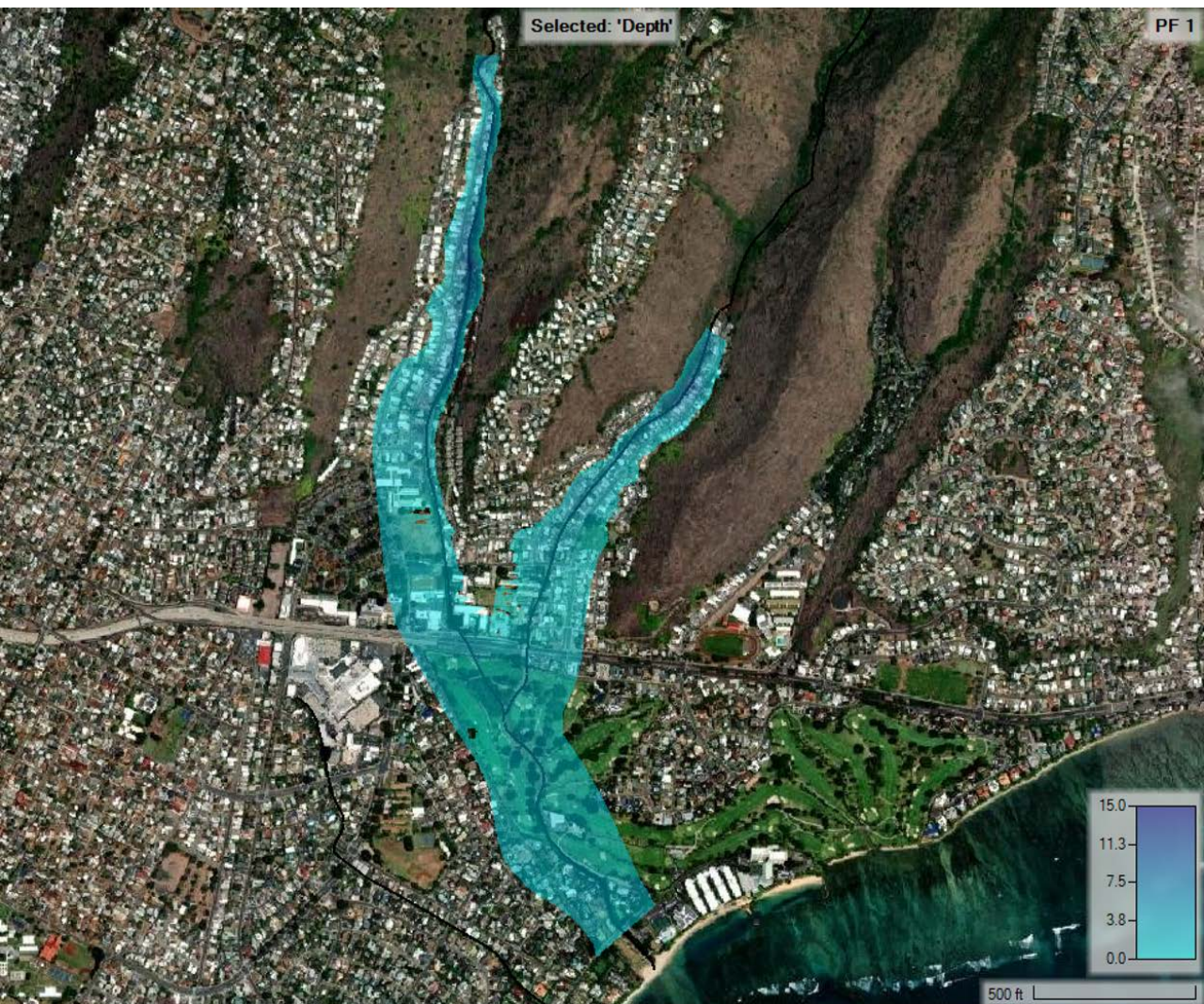
**Zone GD**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone GE**  
1% annual chance flood

**Zone GF**  
Areas of 1% annual chance flood with average depths of 1 to 3 feet

**Zone**







# National Flood Hazard Layer FIRMMette



157°47'1"W 21°16'34"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000  
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/18/2022 at 1:17 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.







# Flood risk...located in 100 YR Floodplain

<https://www.youtube.com/watch?v=nMbufS4Mmdw>

**100 YR FLOOD is 1% chance** of being equaled or exceeded...in any given year

500 year flood is **1 in 500 chance** in any given year (0.2%)

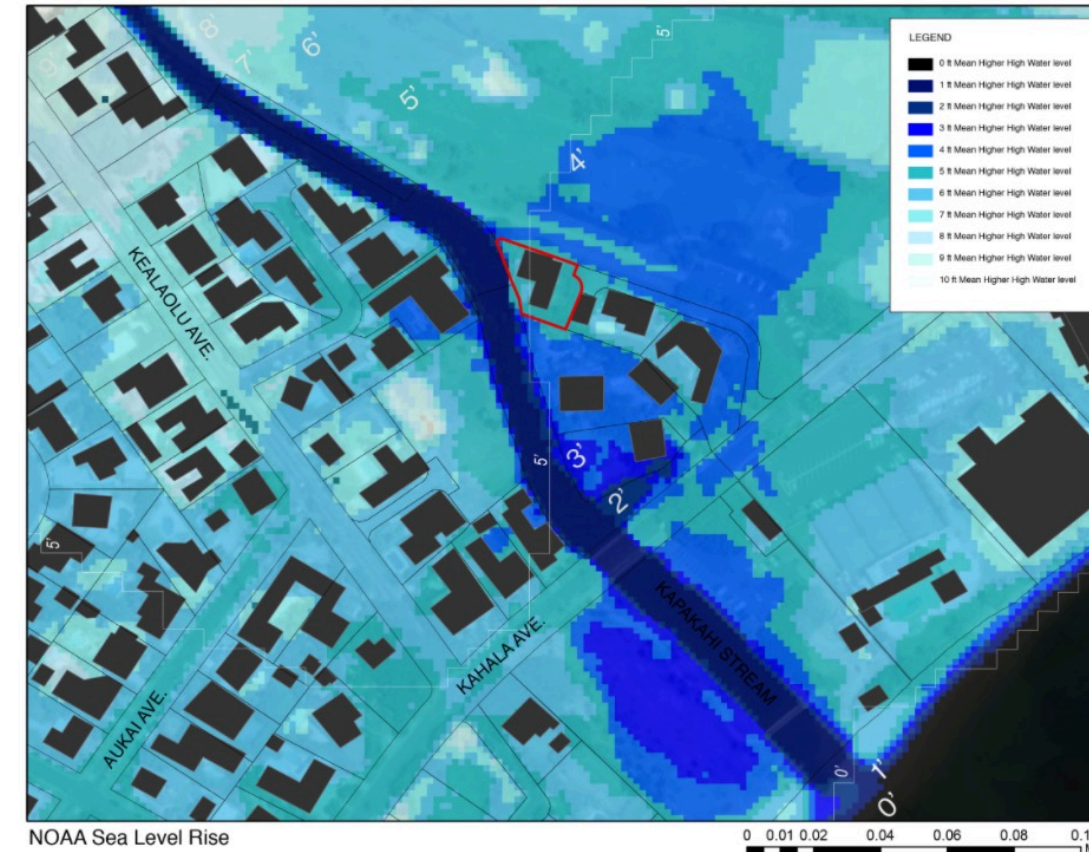
## ESTIMATE FOR 30 YEAR MORTGAGE:

Probability of flood event will be equaled or exceeded one or more times in N years is  **$1-(1-P)^N$**  where P = the percent annual flood; for house located in the 100 year flood zone, P = 0.01. N = the number of years is 30

$$1-(1 - 0.01)^{30} = .26$$

**26 percent** chance that there will be a 100 year flood over 30 years.

**WITH SEA LEVEL RISE RISK IS UNDERESTIMATED**







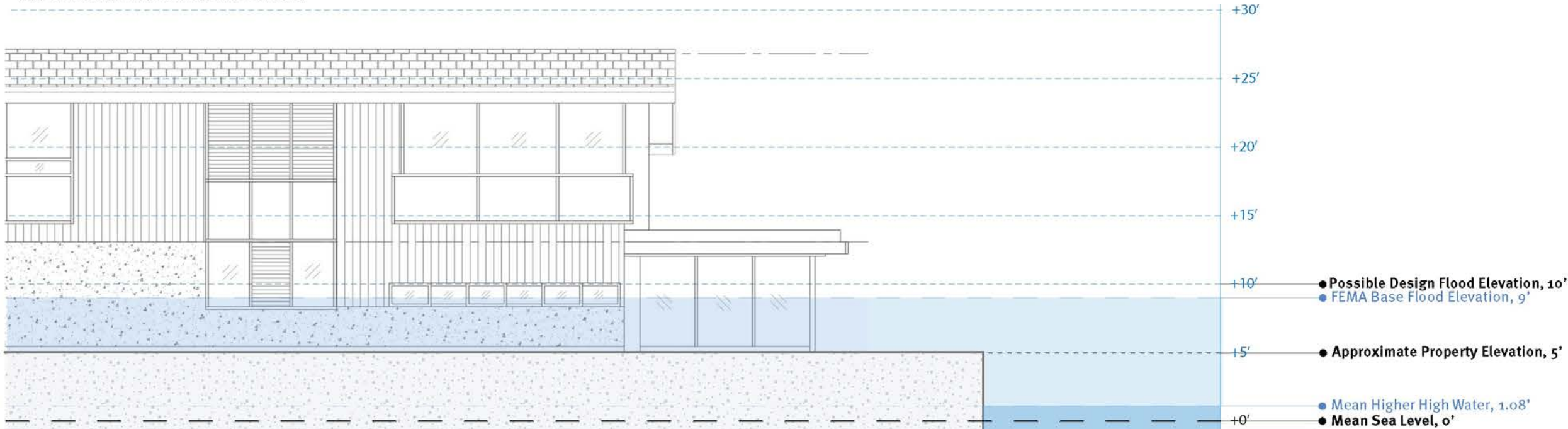
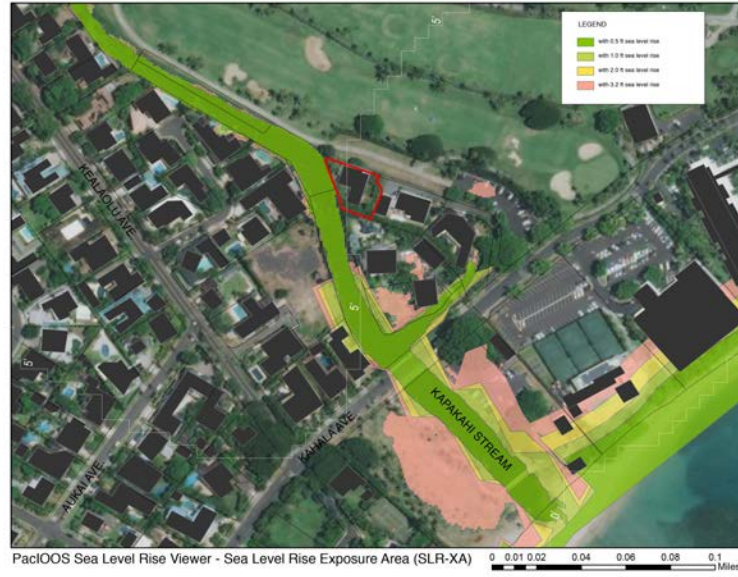




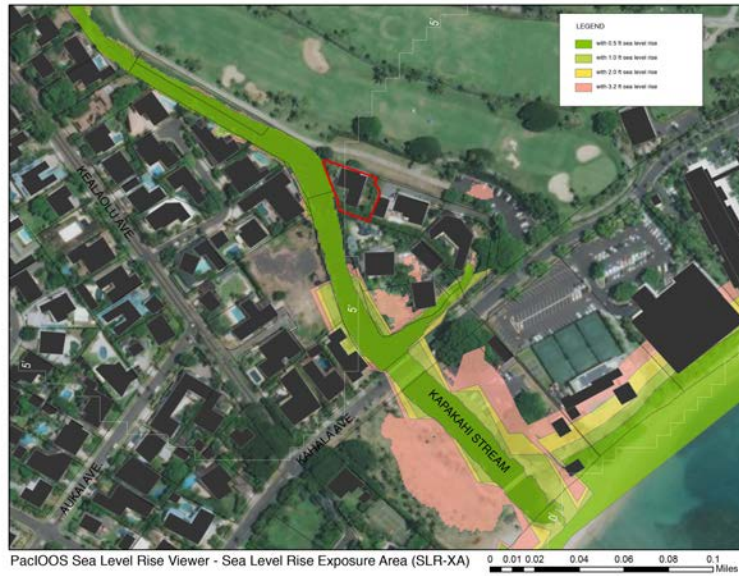
## CHARLOT HOUSE WEST ELEVATION

Base Flood Elevation

1% Annual Chance Flood Hazard

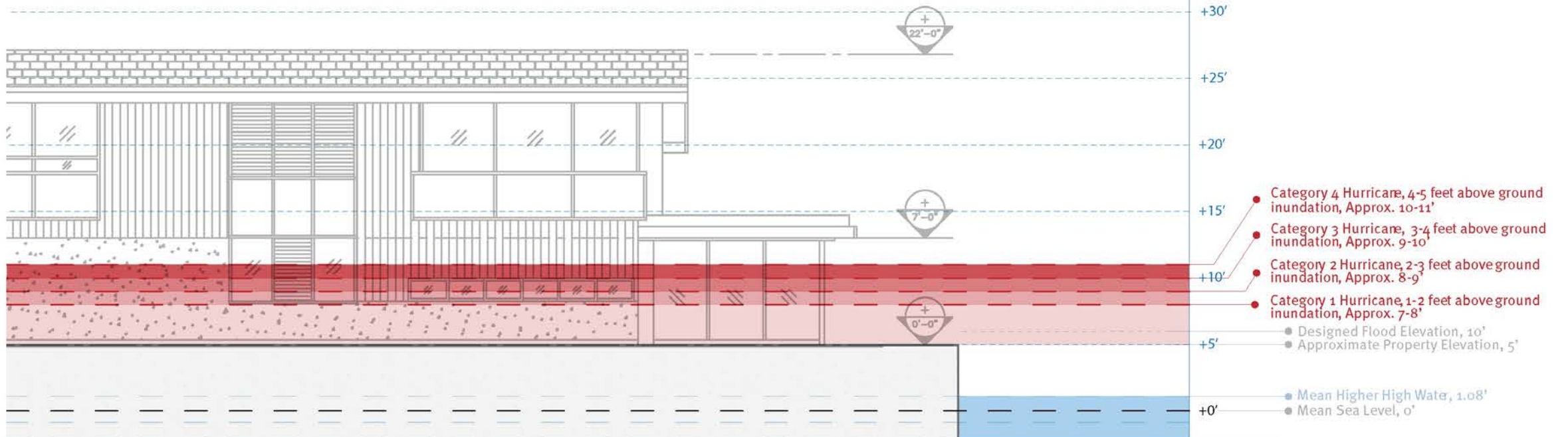






## CHARLOT HOUSE WEST ELEVATION

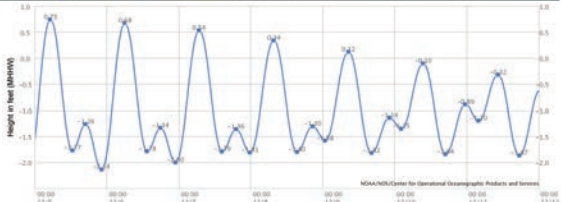
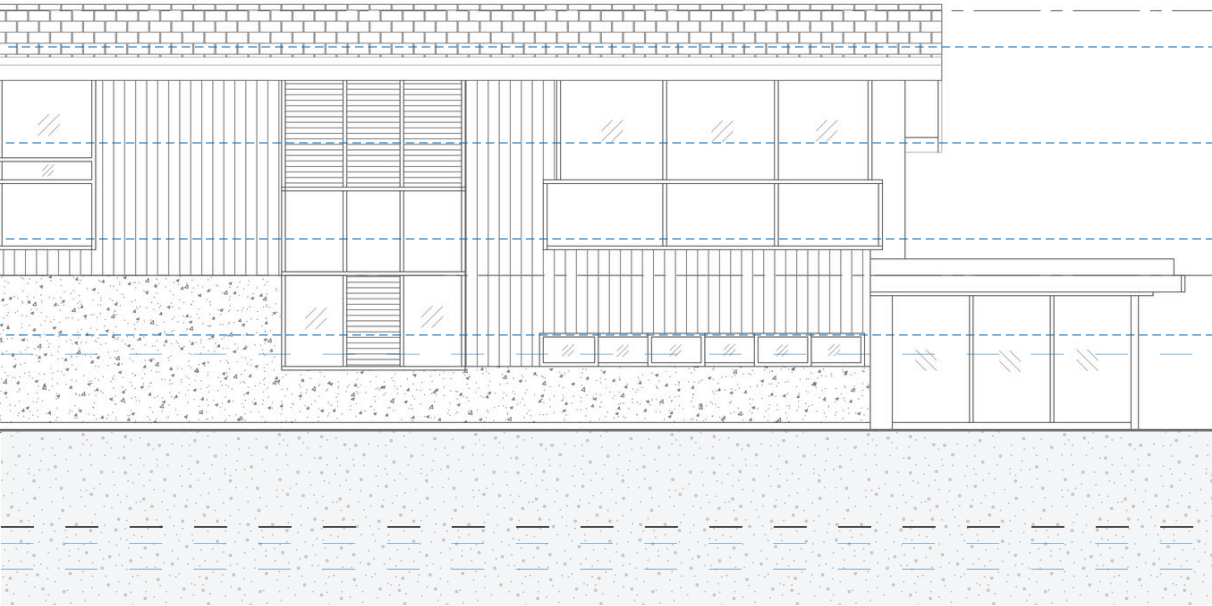
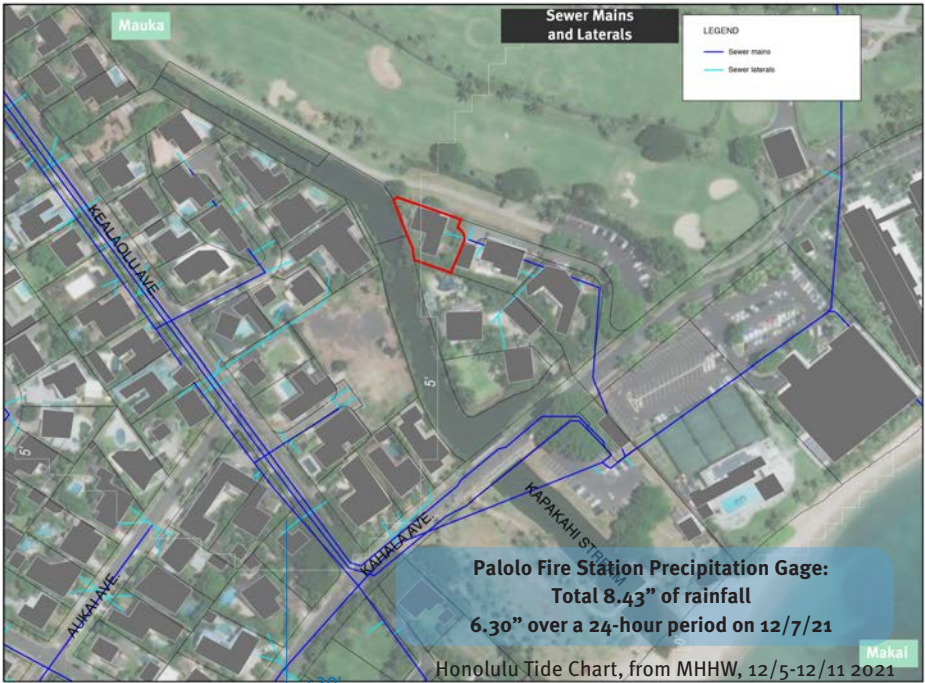
### Storm Surge Inundation







**CHARLOT HOUSE WEST ELEVATION**  
 December 5-11, 2021 Severe Rain and Flooding Event



- FEMA Base Flood Elevation, 9'
- Approximate Property Elevation, 5'
- **Approximate Water Height, 4' 6"**  
~6" below overtopping wall
- **Highest Tide, 0.75'**  
Mean Sea Level, 0'
- Stream Bed, -2.02'
- **Lowest Tide, -2.14'**



TEMPORARY WATER FILLED BARRIERS

FLOOD



Temporary water-filled barriers are designed to keep areas protected from flood water.

**Cost**  
\$9,000 - \$12,000  
Not including installation

**Term**  
Short-term

**Required Alteration**  
No

**Storage**  
Yes



Physical Barrier

DESCRIPTION OF MITIGATION STRATEGY

Temporary water-filled barriers provide fast, effective relief for floods by controlling water to prevent flooding. They stretch across the site then inflate with water from the prospected dry area to create a dry working environment. Due to its liquid state and flexible material, these barriers conform to uneven ground conditions, forming a good seal at the bottom over most surfaces. When they are no longer need, they can be stored away. On-site requirements includes a portable pump and a local water supply.

IMPACT ON HISTORIC ATTRIBUTES

No impact. Every foot of height requires approximately twice the width for the aqua dam. i.e. 5 feet of protection requires a dam that is 10 feet wide.



**Product:**  
Aqua Dam Water-Filled Cofferdam

water depth control up to 120"

**Cost:**  
\$20/foot for shortest option @ 30"  
\$50/foot for tallest option @ 48"

**Source:**  
Aqua Dam Inc.

**Link:**  
<https://www.aquadam.net/>



**Product:**  
Dam-It Dams Water Inflated Cofferdams

water depth control up to 144"

**Cost:**  
requires a quote  
shortest option @ 12"  
tallest option @ 120"

**Source:**  
Dam-It Dams, Inc.

**Link:**  
<https://damitdams.com/>



**Product:**  
Aqua-Barrier Water Inflated Dams

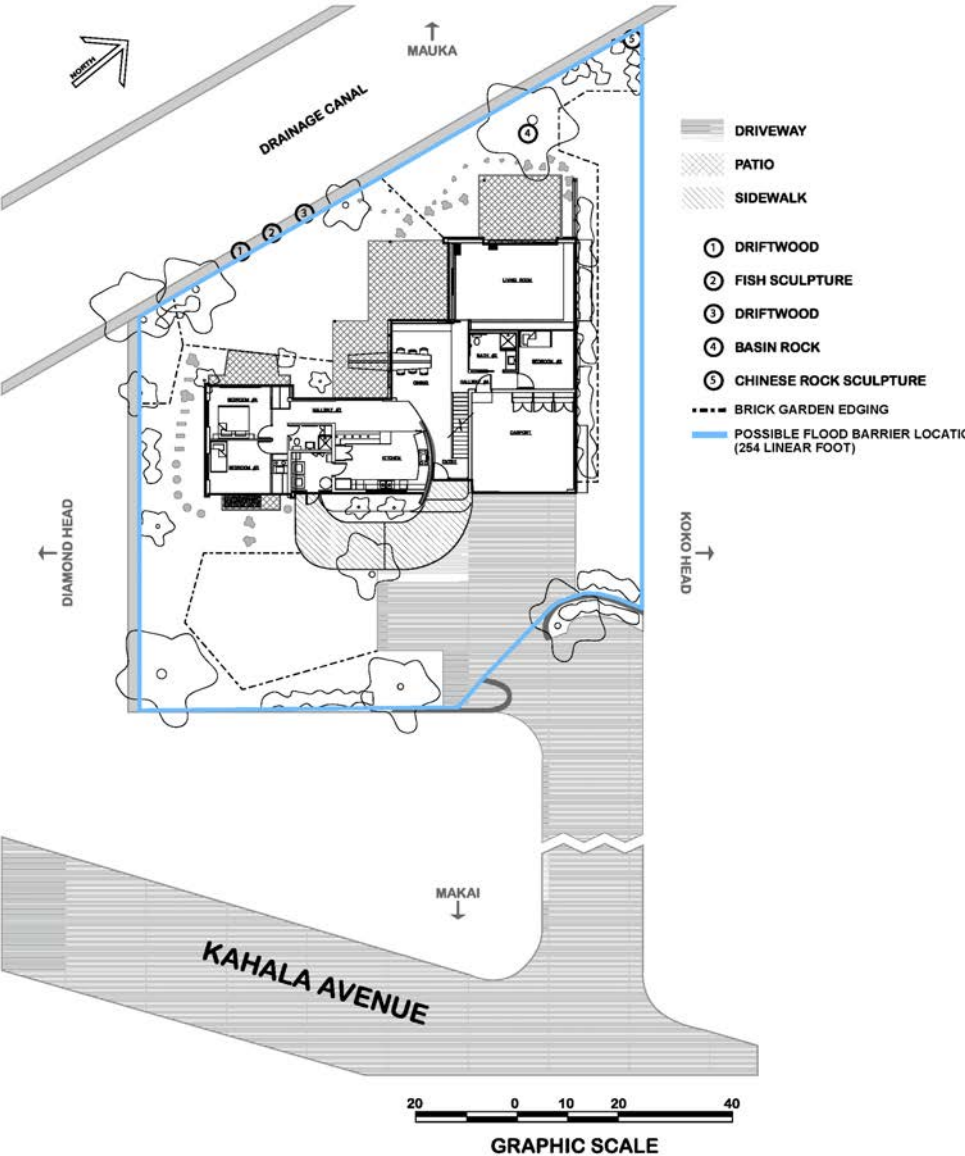
water depth control up to 72"

**Cost:**  
requires a quote  
shortest option @ 36"  
tallest option @ 96"

**Source:**  
HSI Services, Inc.

**Link:**  
<https://aquabarrier.com/>

CURRENT SITE PLAN  
POSSIBLE FLOOD BARRIERS LOCATIONS





## TEMPORARY WATER FILLED BARRIERS

### FLOOD



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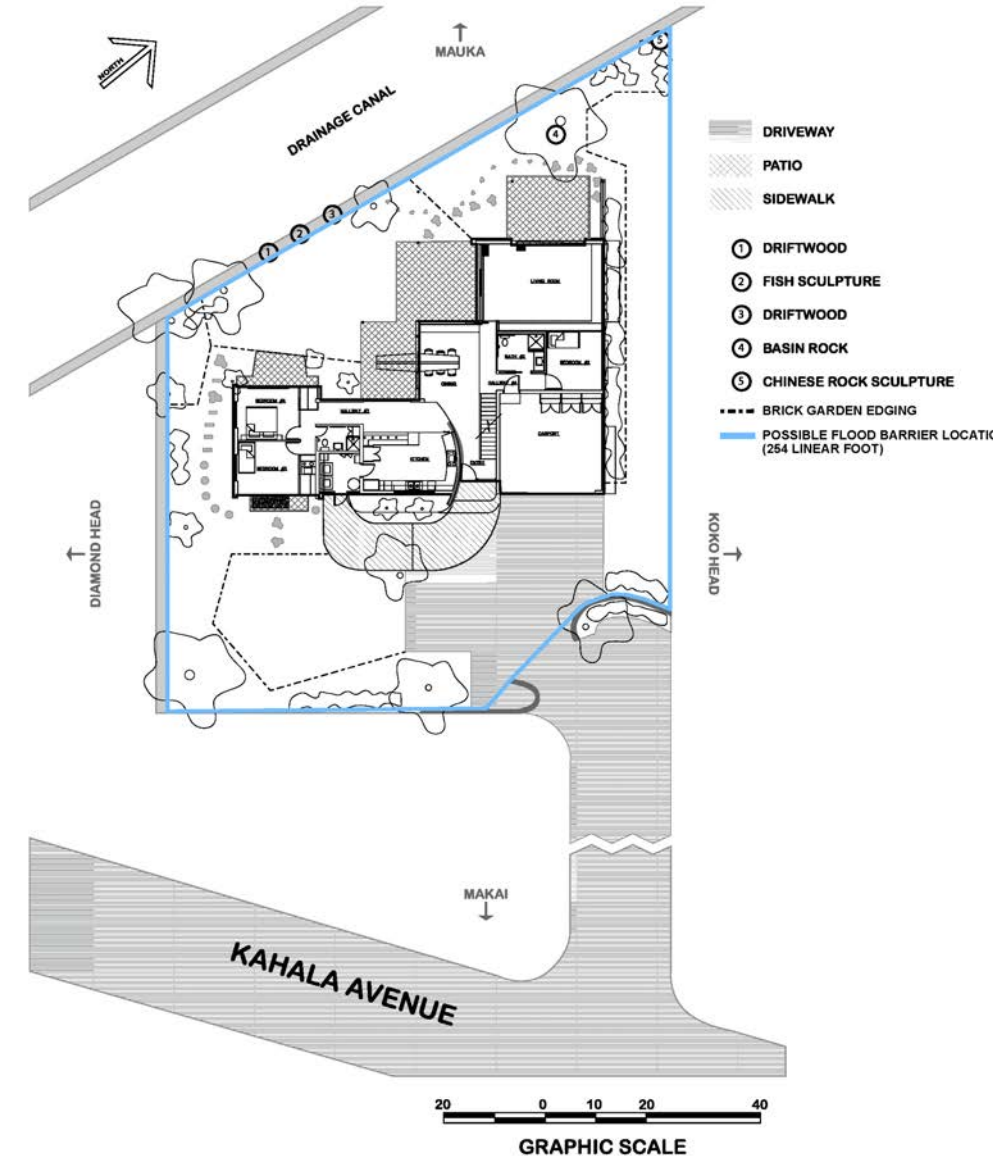
**Source:**  
HSI Services, Inc.

**Link:**  
<https://aquabarrier.com/>

Temporary Walls  
Bladders  
Flood Barriers  
Pumps  
Retention/Detention  
Absorbent Materials  
Landscaping/Drainage  
Porous Surfaces

## CURRENT SITE PLAN

### POSSIBLE FLOOD BARRIERS LOCATIONS





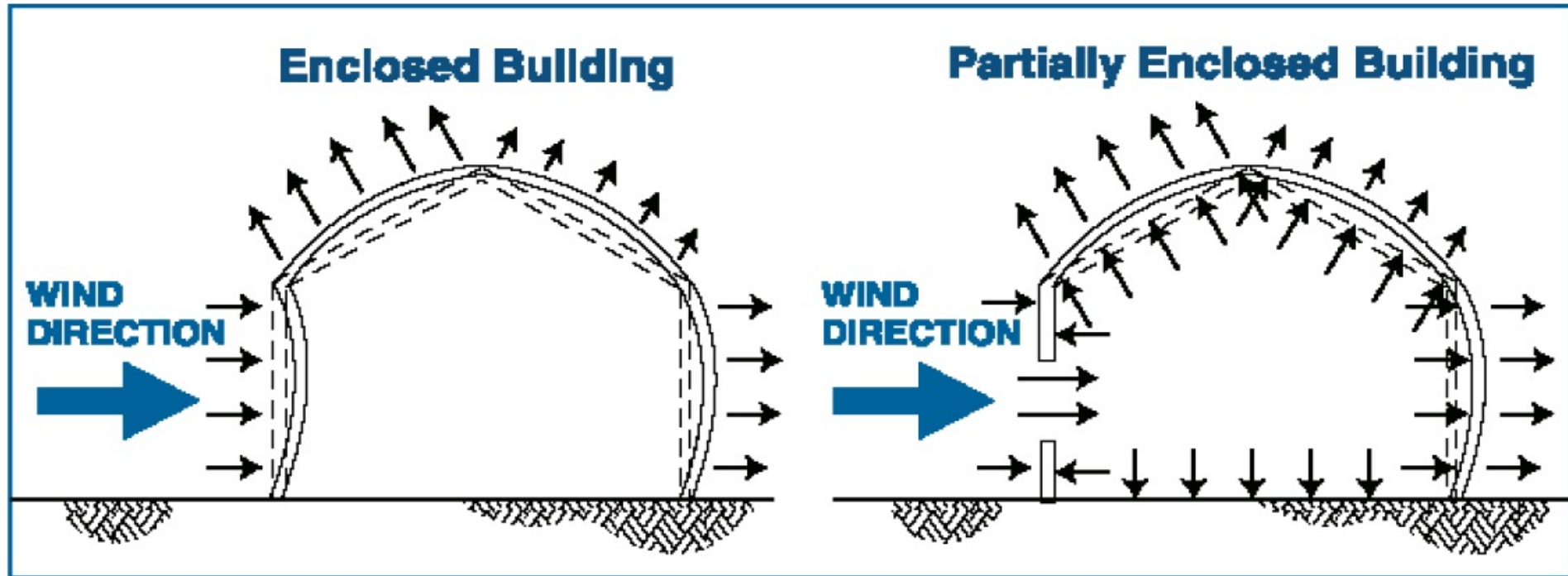




# Creating Wind and Rain Resistant Envelope

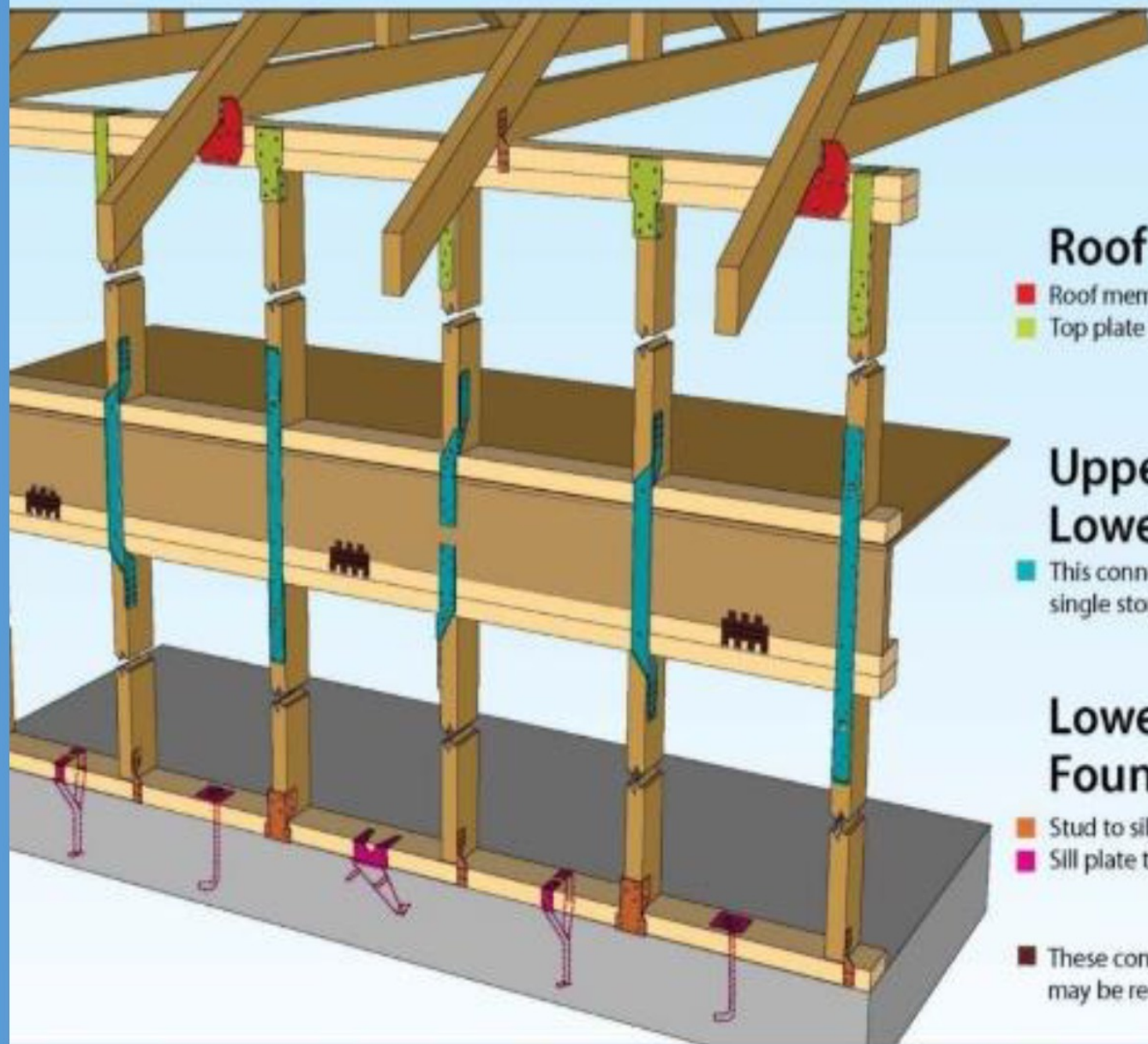
## Multi Hazard Design

*From FEMA CCM*





# Continuous Load Path To Resist Uplift Forces



## Roof to Wall Connection

- Roof member to top plate connections
- Top plate to stud connections

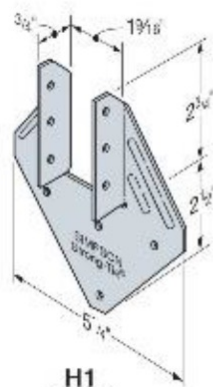
## Upper Wall to Lower Wall Connection

- This connection is not required for a single story home.

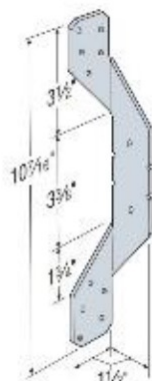
## Lower Wall to Foundation Connection

- Stud to sill plate connections
- Sill plate to foundation connections
- These connections are not required for uplift but may be required to transfer shear loads.

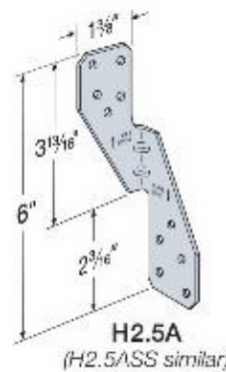




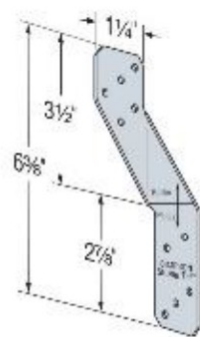
**H1**  
(H1.81Z  
similar)



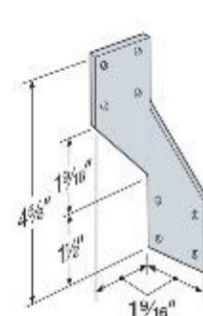
**H2A**  
(H2ASS similar)



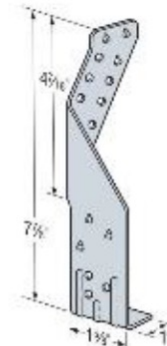
**H2.5A**  
(H2.5ASS similar)



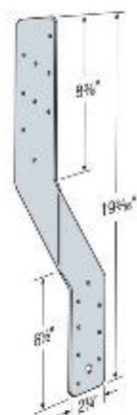
**H2.5T**



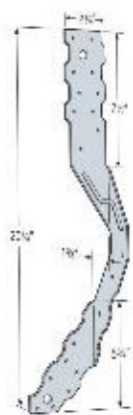
**H3**  
(H3SS similar)



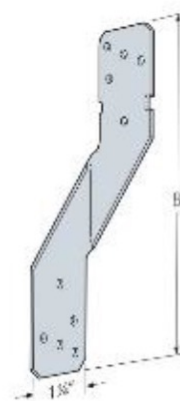
**TSP**



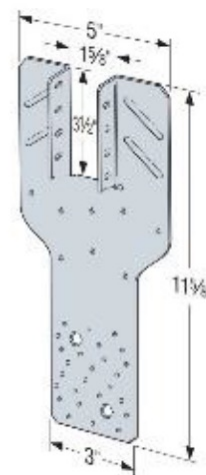
**H6**



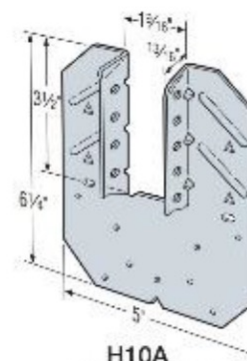
**H7Z**



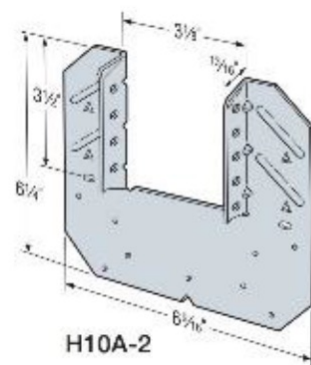
**H8**  
(H8SS similar)



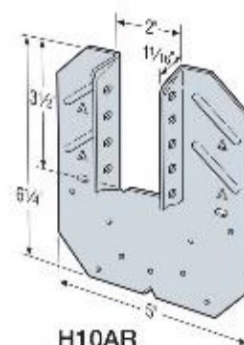
**H10S**



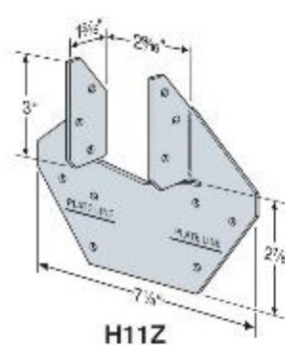
**H10A**  
(H10ASS similar)



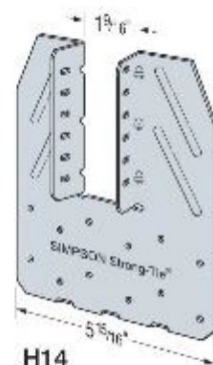
**H10A-2**



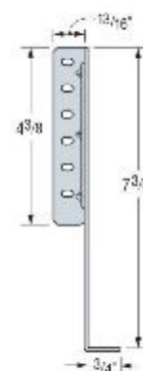
**H10AR**



**H11Z**



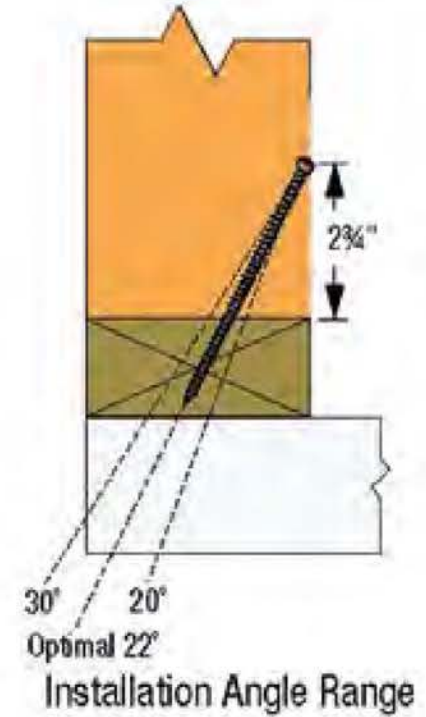
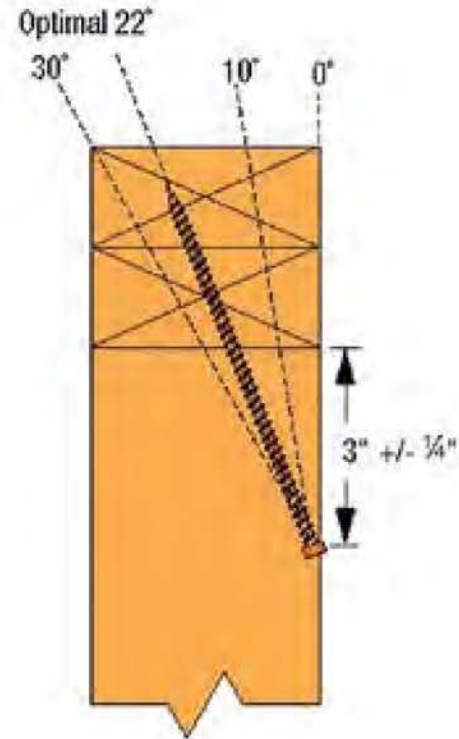
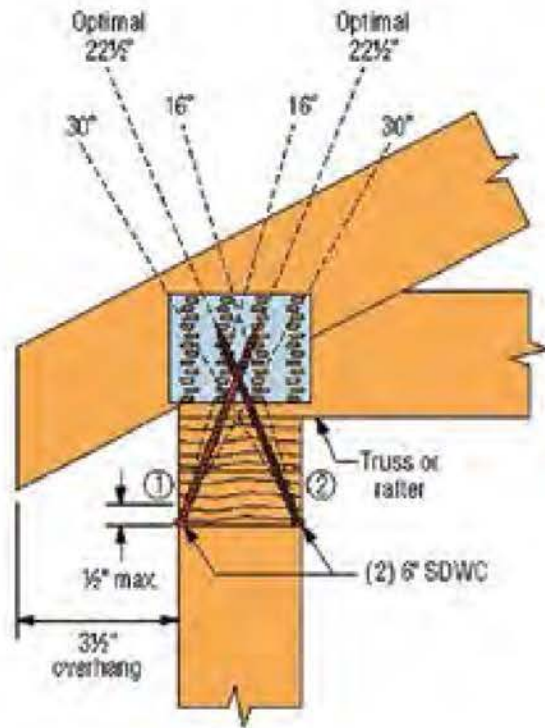
**H14**



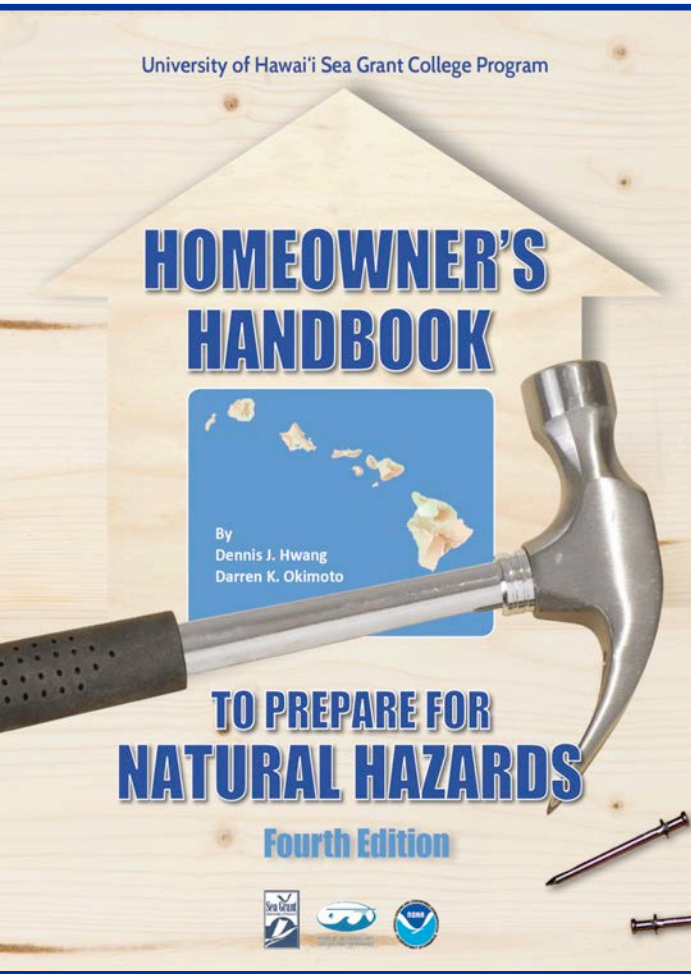
**H14  
Profile**



# Structural Screws to Complete the Load Path



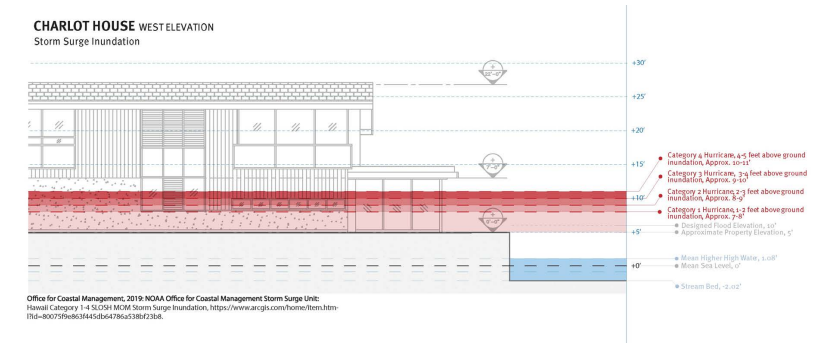






# CHALLENGES

- Protect and Preserve Architectural Features
- Multiple threats and hazards
- Flooding, High Winds, Rainfall, Lightning, Debris
- Management of Uncertainty
- Climate Change + Extreme Events + Urbanization
- Disciplinary Biases, Stovepipes, Entrenchment
- Learning and Engagement during Covid-19
- Place-based planning, design, and preservation
- Lack of knowledge, understanding, misinformation
- Insurance: Flood/Hurricane, Catastrophe
- Social and Environmental Justice







[karlk@hawaii.edu](mailto:karlk@hawaii.edu)





## Discussion questions:

- 1. What are we missing?***
- 2. Charlot Case Study House ?***
- 3. Apply the NPS flood guidance?***  
***Risk and vulnerability assessment,***  
***Site analysis,***  
***Landscaping, Dry/Wet Proofing,***  
***Retention/detention,***  
***Elevation, Relocation, other?***



THE SECRETARY  
OF THE INTERIOR'S  
STANDARDS FOR  
REHABILITATION &

GUIDELINES  
ON **FLOOD  
ADAPTATION** FOR  
REHABILITATING  
HISTORIC  
BUILDINGS