CSBPA California Coastal Conditions Symposium

May 12, 2026

CHAMP: Coastal Hazards Analysis and Mapping Project

A Framework for Mapping Compound Coastal–Fluvial Flood Hazards under Sea Level Rise

Presented by:

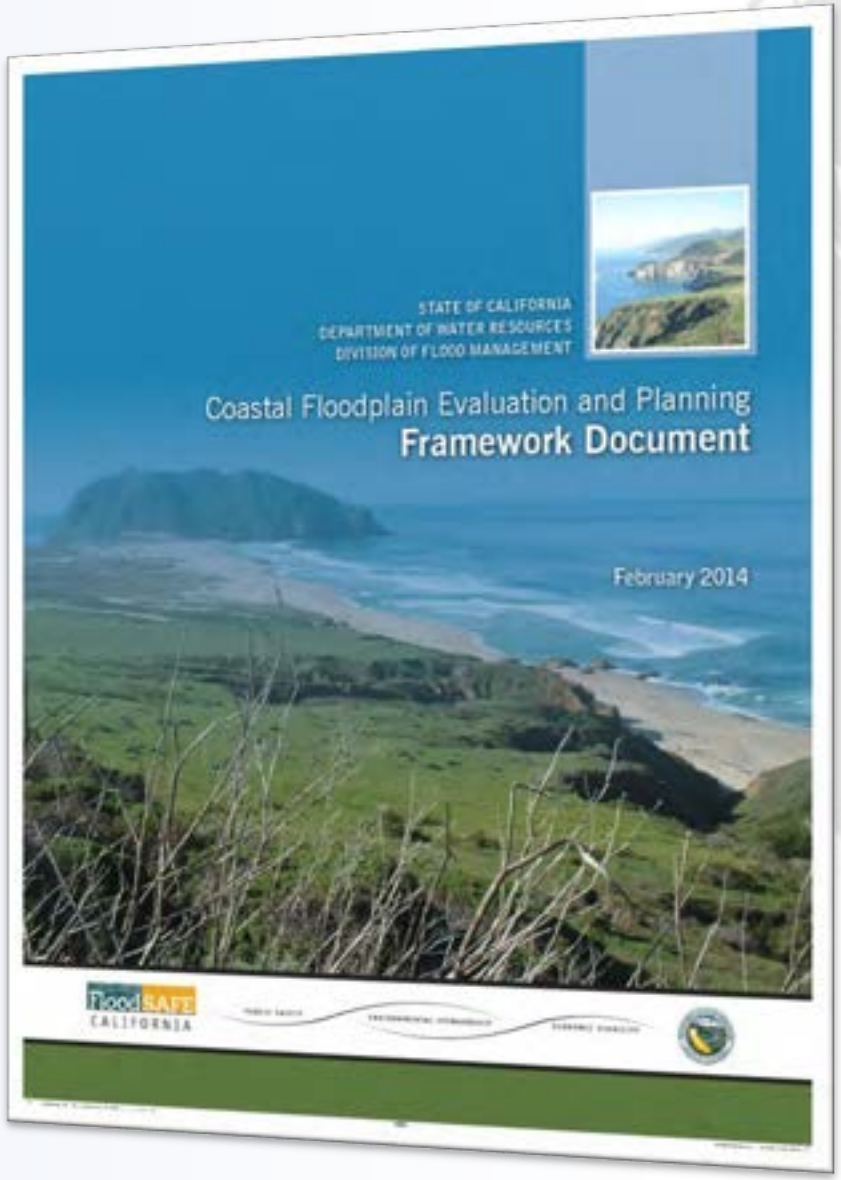
Samson Haile-Selassie, PE (DWR) samsonhs@water.ca.gov
Louis White, PE (ESA) lwhite@esassoc.com

Coastal Floodplain Evaluation & Planning (CFEP) 2012 - 2014

Framework Document

Background & Context

- Conducted research with the objective of drafting a high-level internal planning document, or —framework document
- Conducted needs assessment & inventoried programs
- Outlined opportunities to implement coastal flood risk management programs or projects
- Aimed to facilitate coordination and collaboration between government agencies, communities, and NGO's
- Tie in California's Flood Future recommendations, a set of recommendations for managing the State's Flood Risk



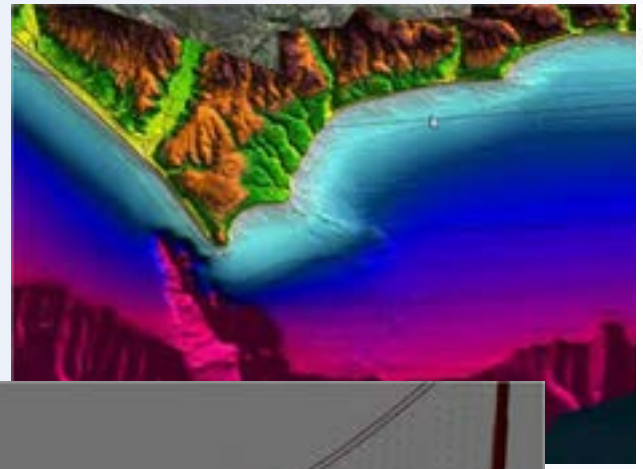
Coastal Data Merge Project 2012 – 2014

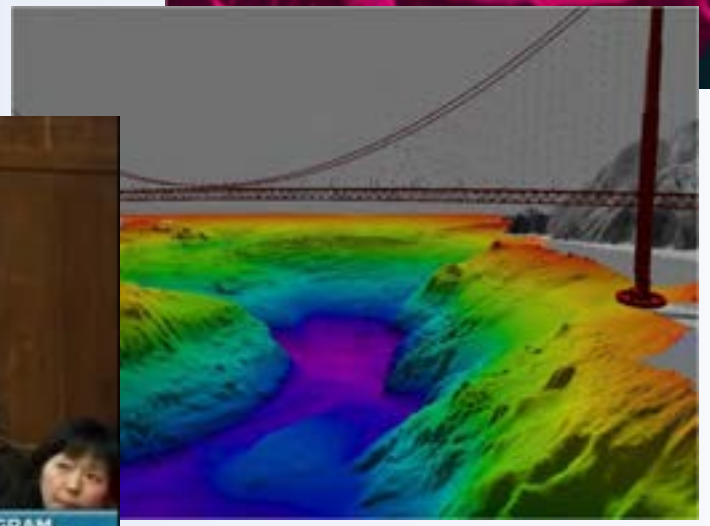
Contract between California Department of Water Resources and California Ocean Protection Council/State Coastal Conservancy

CALIFORNIA COASTAL DATA MERGE PROJECT

Background & Context

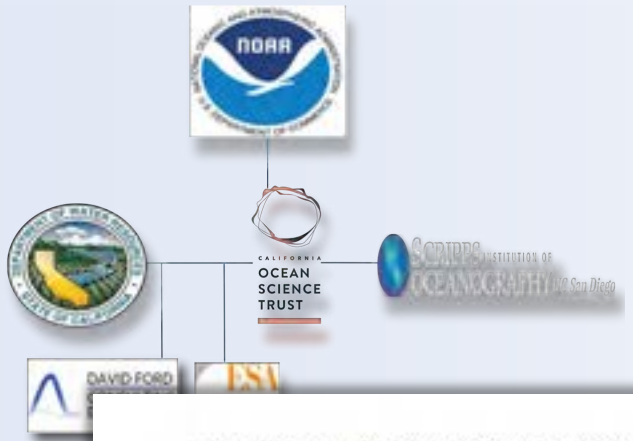
- Combine seafloor bathymetric maps of the state's entire offshore waters with coastal aerial imagery (LiDAR)
- Partnership between DWR, OPC & NOAA
- Utilized by FEMA coastal mapping
- Uploaded on OPC's coastal data portal for uses by other agencies

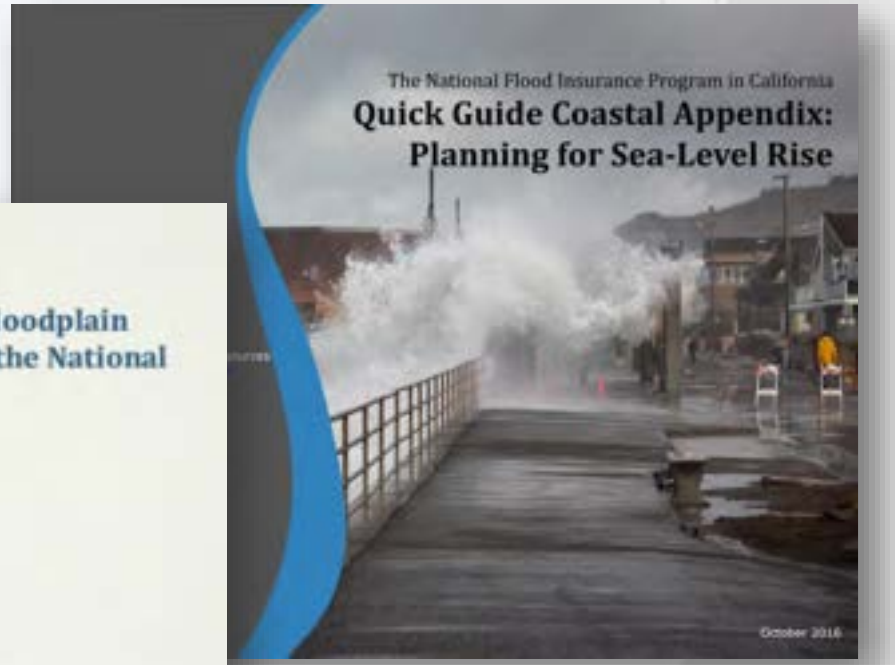




Sea Level Rise Information/Guidance Products 2014 - 2016

Background & Context





ESA

Coastal Flood Risk Reduction Grant Program 2018-21

Background & Context

- Coastal watersheds
  - Flood risk and public safety,
  - Enhance coastal ecosystems,
- $24M awarded, Proposition1 funded
- Priority given to projects in FEMA Coastal VE, AE and A zones and Special Flood Hazard Areas (SFHAs)

- Santa Cruz County ($7M), Pajaro River flood management
- Ventura County ($3.1M) levee repair / habitat enhancement
- Monterey County ($5.1M) floodplain restoration enhancement
- City of San Luis Obispo ($6M), flood bypass improvement
- City of Eureka ($2.5M), climate adaptation project

Coastal Floodplains Assessment Program (CFAP)

Planning Document

2020 - 2022

Background & Context

Chapter 1 - Introduction and Background
Describes the purpose of the workplan and the types of flooding hazards on the California coastline.

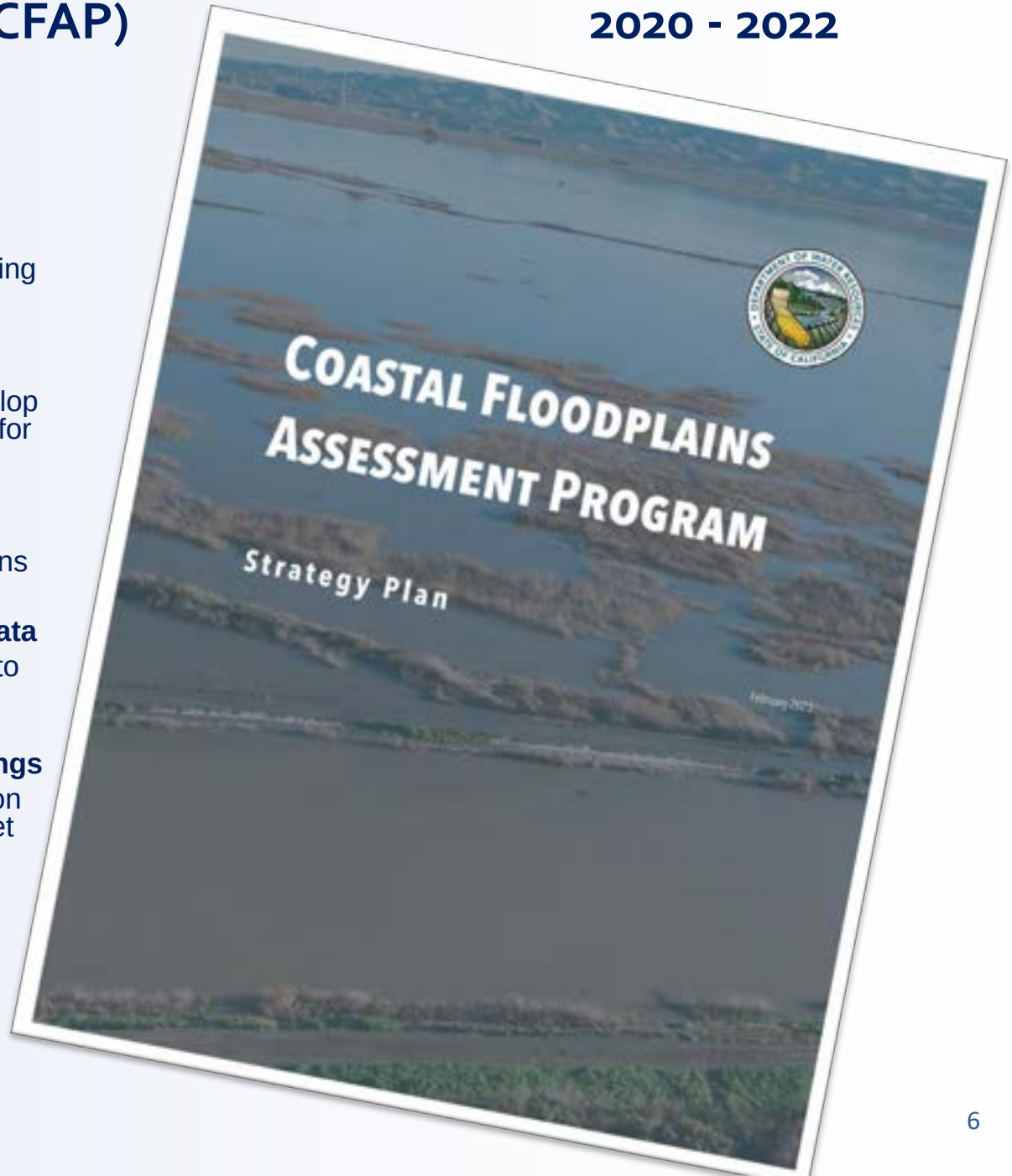
Chapter 2 - Plan Development Tasks and Methodology
Details the CFAP goals, the planning process utilized to develop this Workplan, and the geographic scope and areas of focus for the CFAP.

Chapter 3 - Coastal Floodplains Needs
Review of unmet needs within the California coastal floodplains

Chapter 4 - Review of Existing Programs, Studies, and Data
Discussion of the agencies and programs that directly relate to the coastal floodplains flood risk reduction

Chapter 5 - Coastal Floodplains Risk Gap Analysis Findings
Provides the finding of a detailed gap analysis and comparison of the existing projects and programs with the identified unmet needs

Chapter 6 - Coastal Project Portfolio
Offers list of prioritized programs and projects



ESA

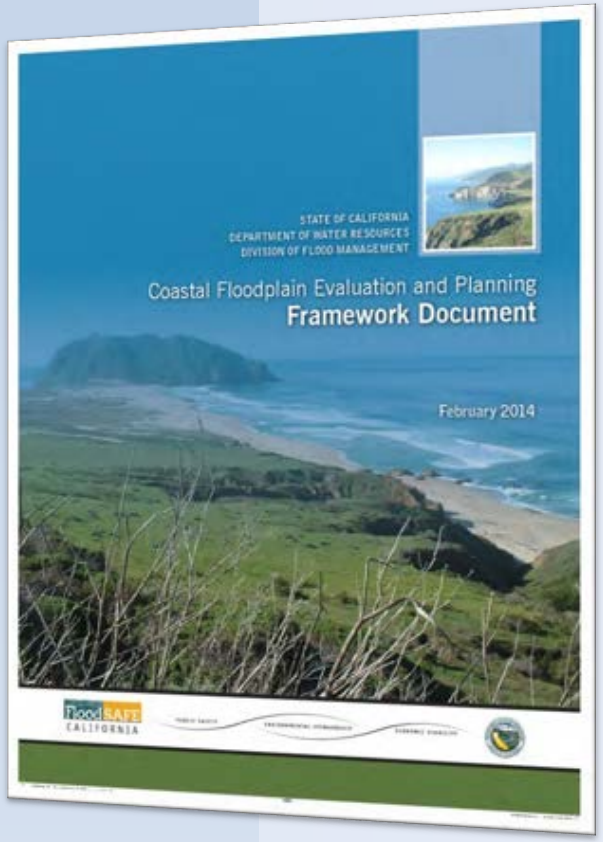
from CFAP Project Portfolio…

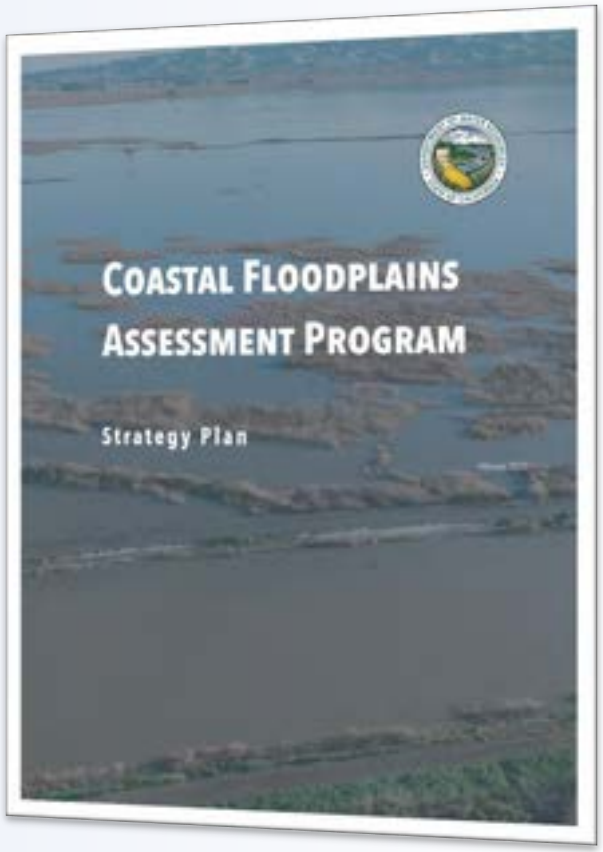
Mapping

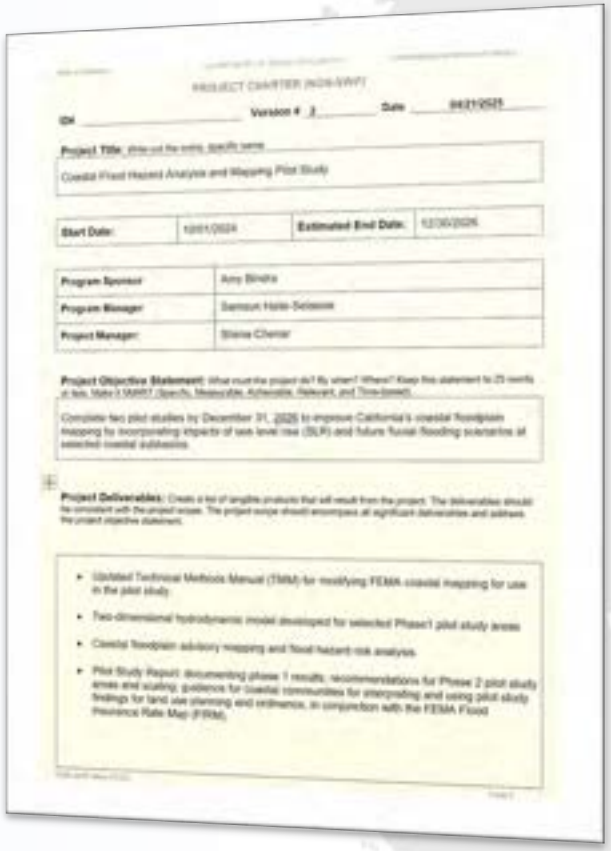
Modeling

Update FEMA Coastal Floodplain Maps with SLR : The FEMA Mapping Master Plan identified FEMA mapping priorities. Pilot studies on selected HUCs would develop advisory coastal flood hazard maps incorporating a joint probability of Sea Level Rise Projections and Flood Frequency.

Compound Flooding Analysis: The project would take advantage of the collaboration underway with DHS and to expand it to evaluate the surge dynamics unique to the west coast. Advancing both the science associated with compound flooding events to accurately model the physical systems associated with compound flooding events







2014

Coastal Floodplain Evaluation & Planning (CFEP)

2016

Technical Methods Manual (TMM)

2022

Coastal Floodplain Assessment Program (CFAP)

2024

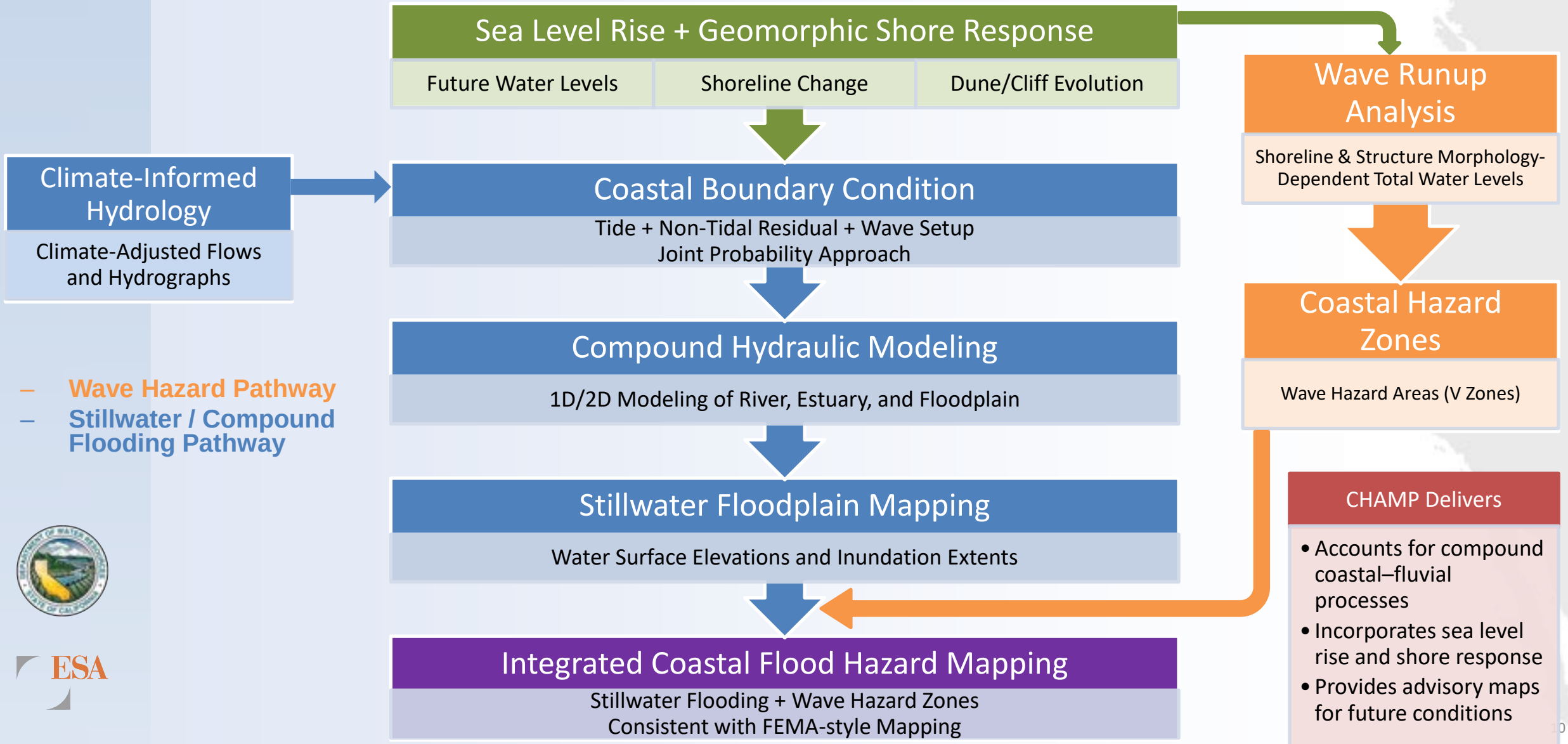
Coastal Flood Hazard Analysis and Mapping Project

ESA

CHAMP Project Goals & Deliverables

- Purpose:
  - Develop a framework for advisory coastal floodplain mapping that integrates sea level rise, climate change, and compound flooding
- Mapping
  - Future-condition advisory floodplain maps
- Hazard Analysis
  - Wave runup and compound flooding
- Pilot Studies
  - Santa Cruz and Ventura
- Guidance + Tools
  - Updated TMM
  - Executable wave runup model

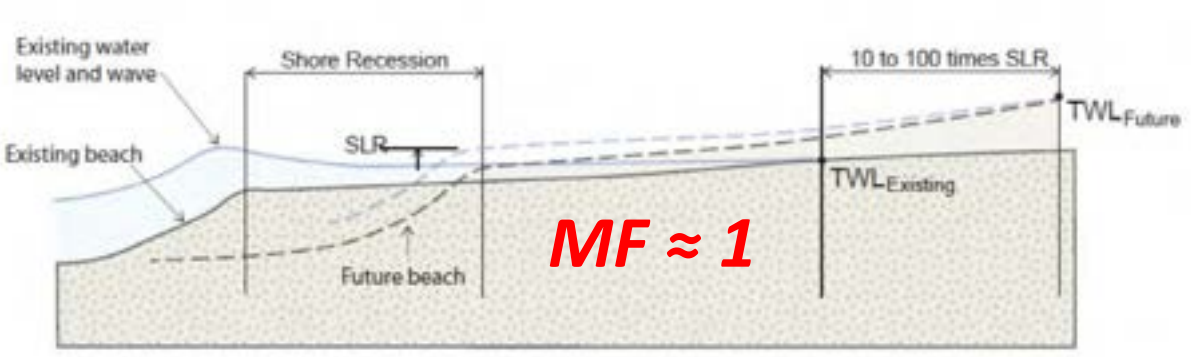
The CHAMP Framework



ESA

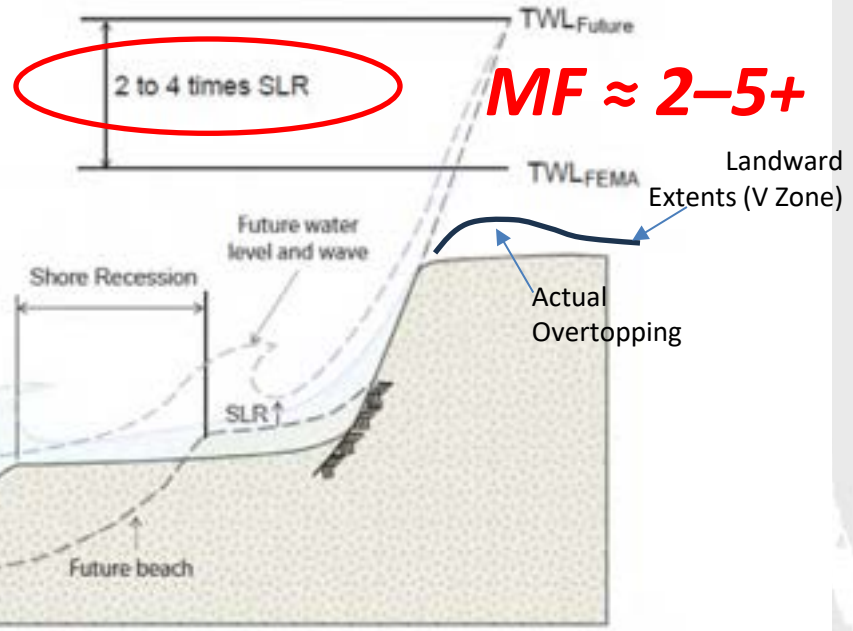
Wave Runup Controls Coastal Hazard Mapping

- Shore morphology effects on wave runup
  - Wide sandy beach
    - Lower runup
    - Greater recession
  - Steep or armored shore
    - Higher runup
    - Limited recession
- Runup methods:
  - Empirical vs. numerical
  - Response analysis vs. event
- FEMA-consistent V-zone mapping



Erodible backshore: TWL future = TWL existing + SLR and shore recession

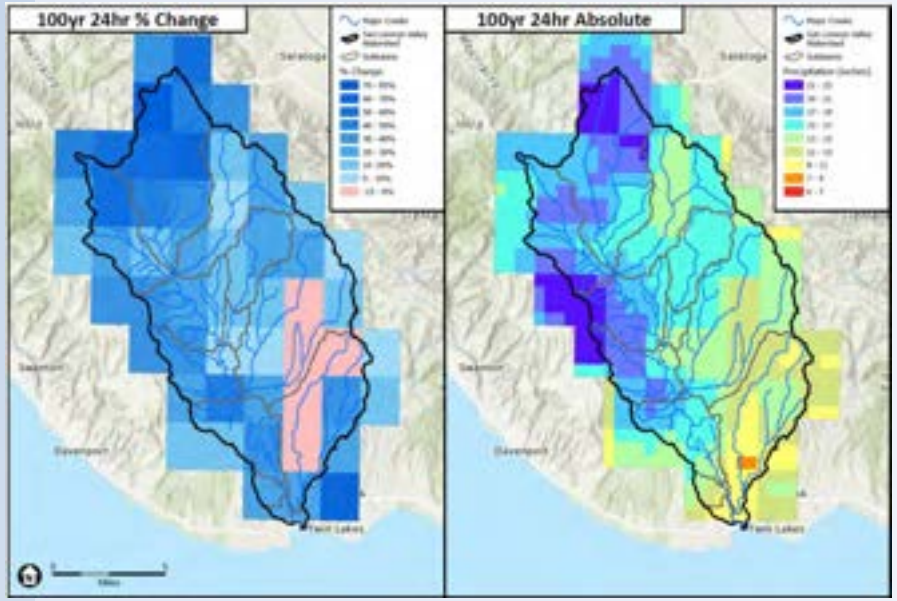
Morphology Factor (MF)



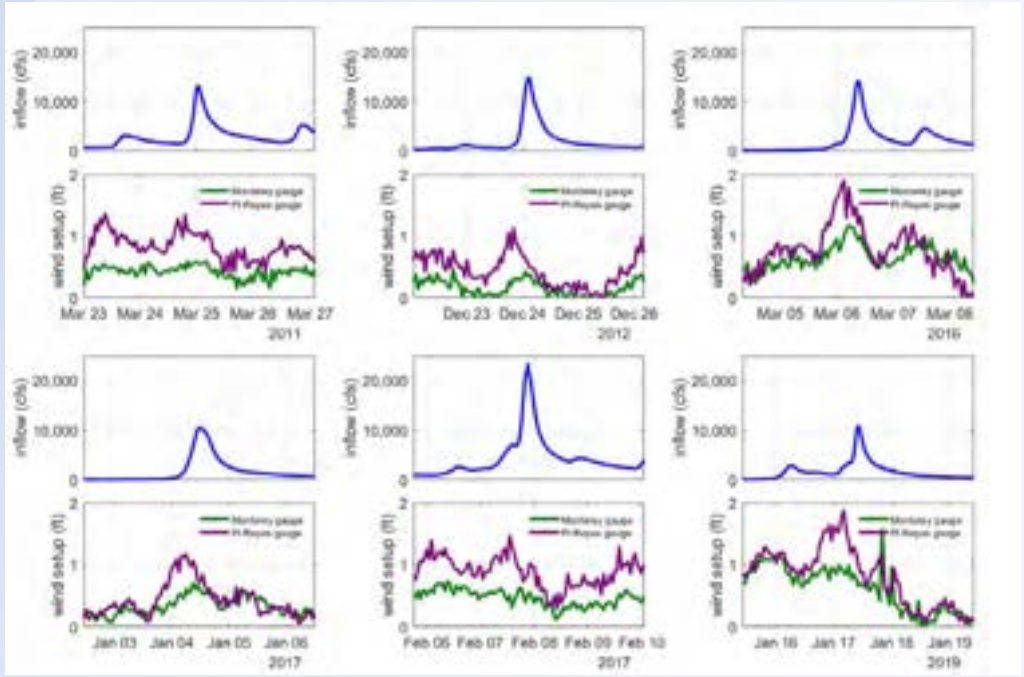
Erosion resistant backshore: TWL future = TWL existing + (2 to 3) SLR

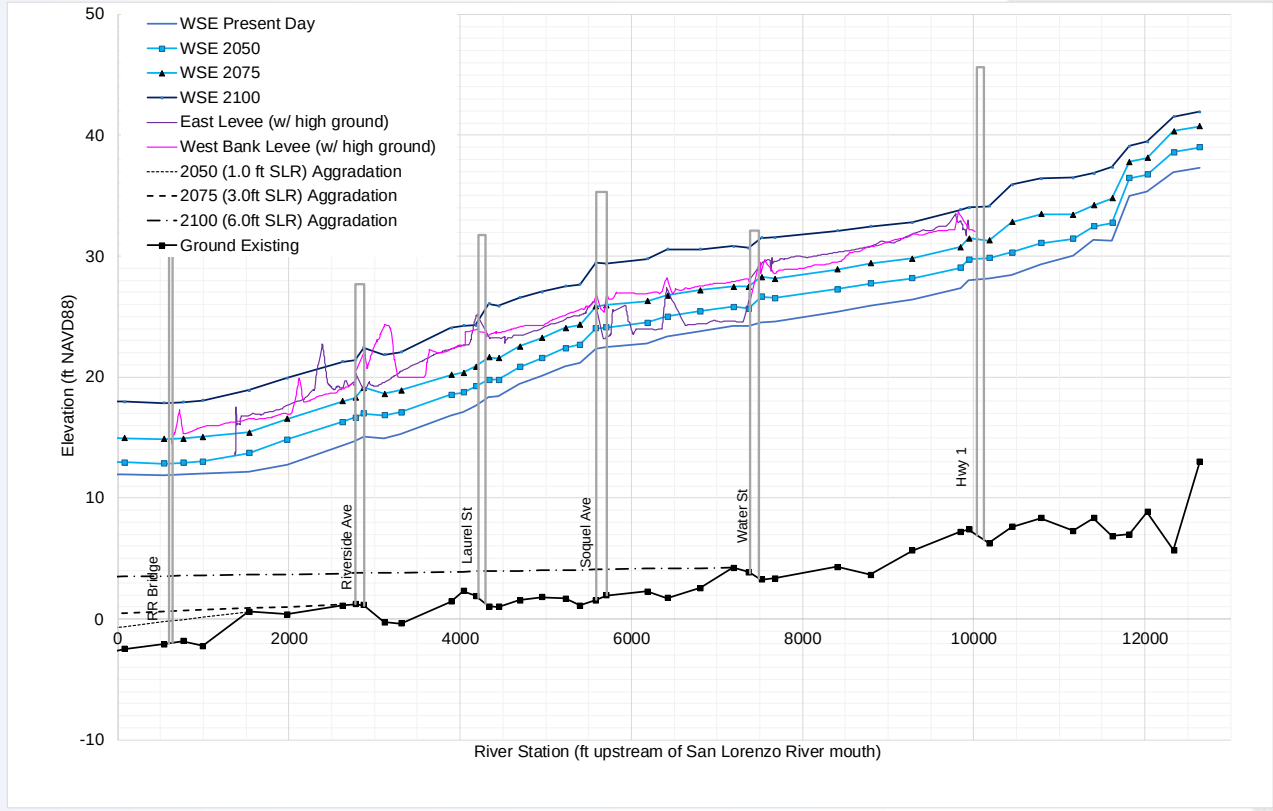
Graphic from TMM (Battalio et al. 2016)

Compound Coastal–Fluvial Flooding

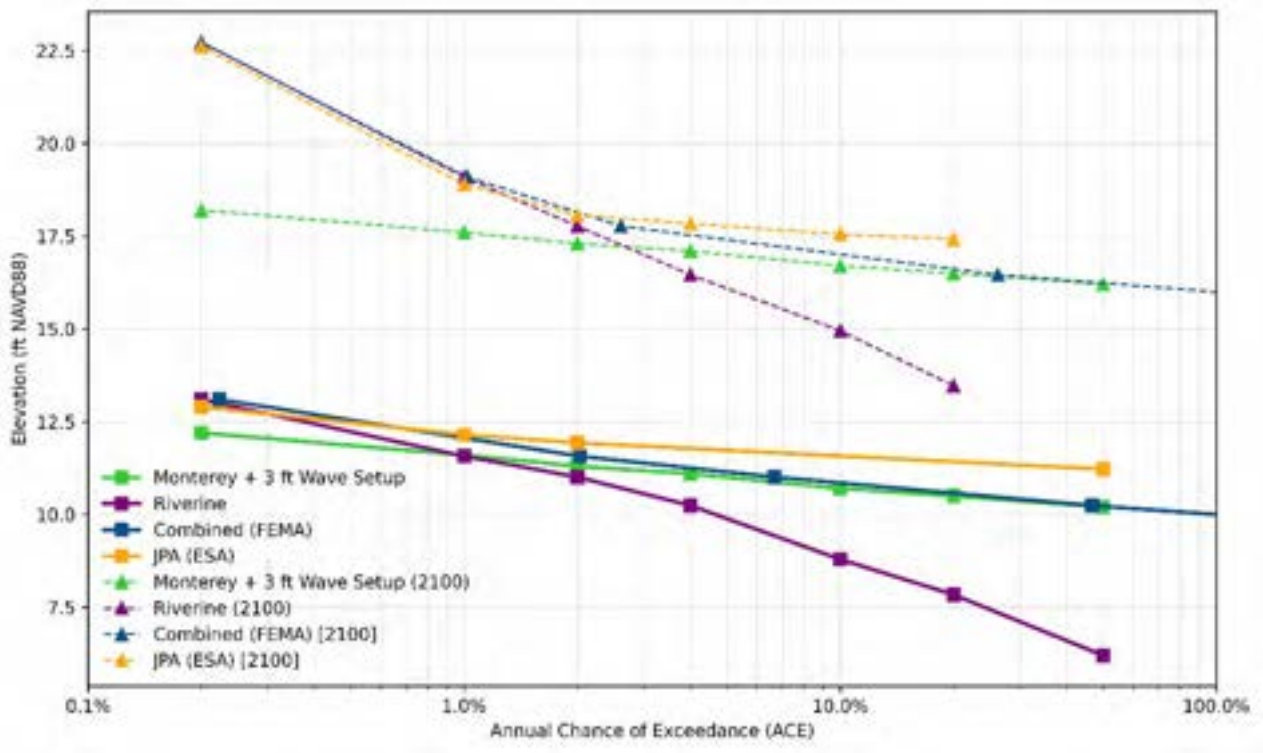


- Correlated drivers:
  - Watershed Flooding + Coastal Surge + Waves (*From the **same storm***)
- Coastal boundary condition:
  - Tide + NTR + Wave Setup

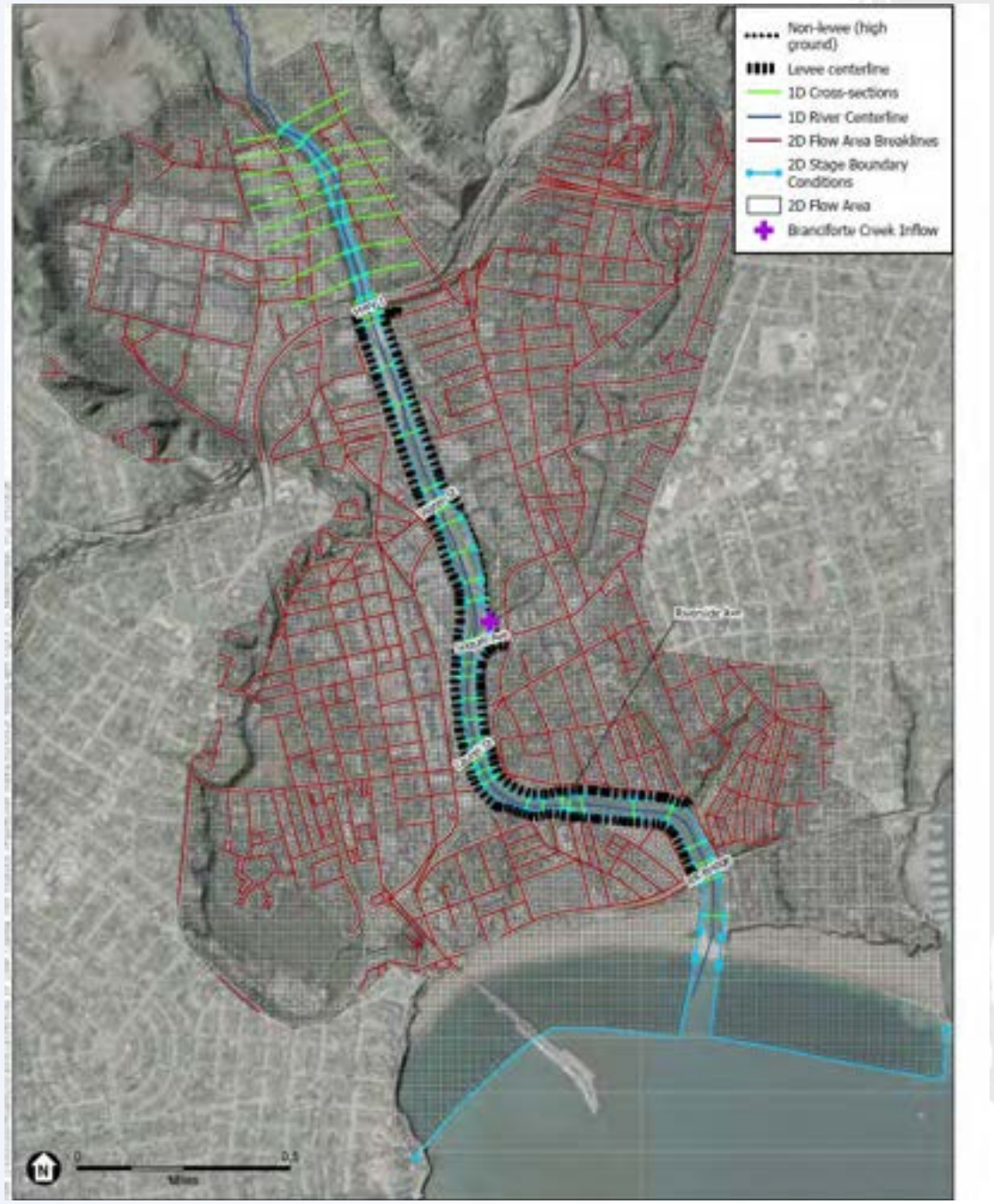




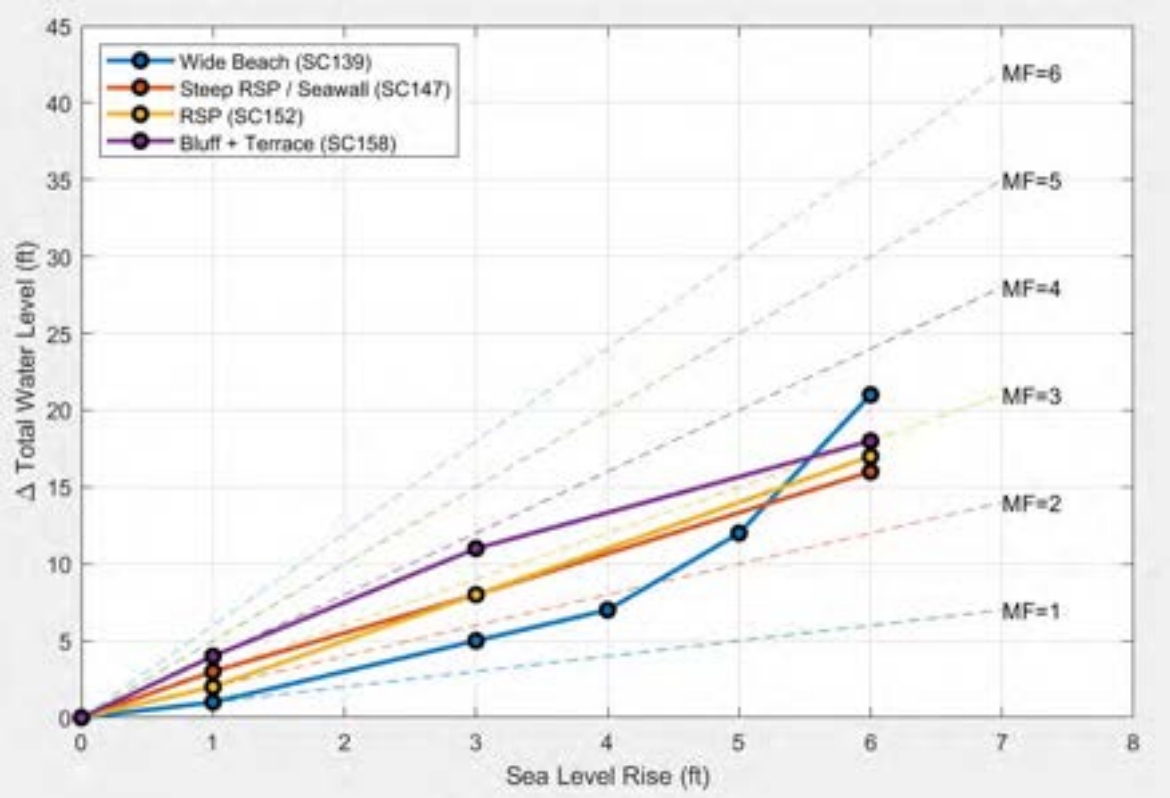
Hydraulic Modeling + Mapping



- Coastal and Riverine WSE as function of ann. chance exceedance
- 1D/2D river modeling (grid shown at right)
- Mapping products and FEMA-style outputs



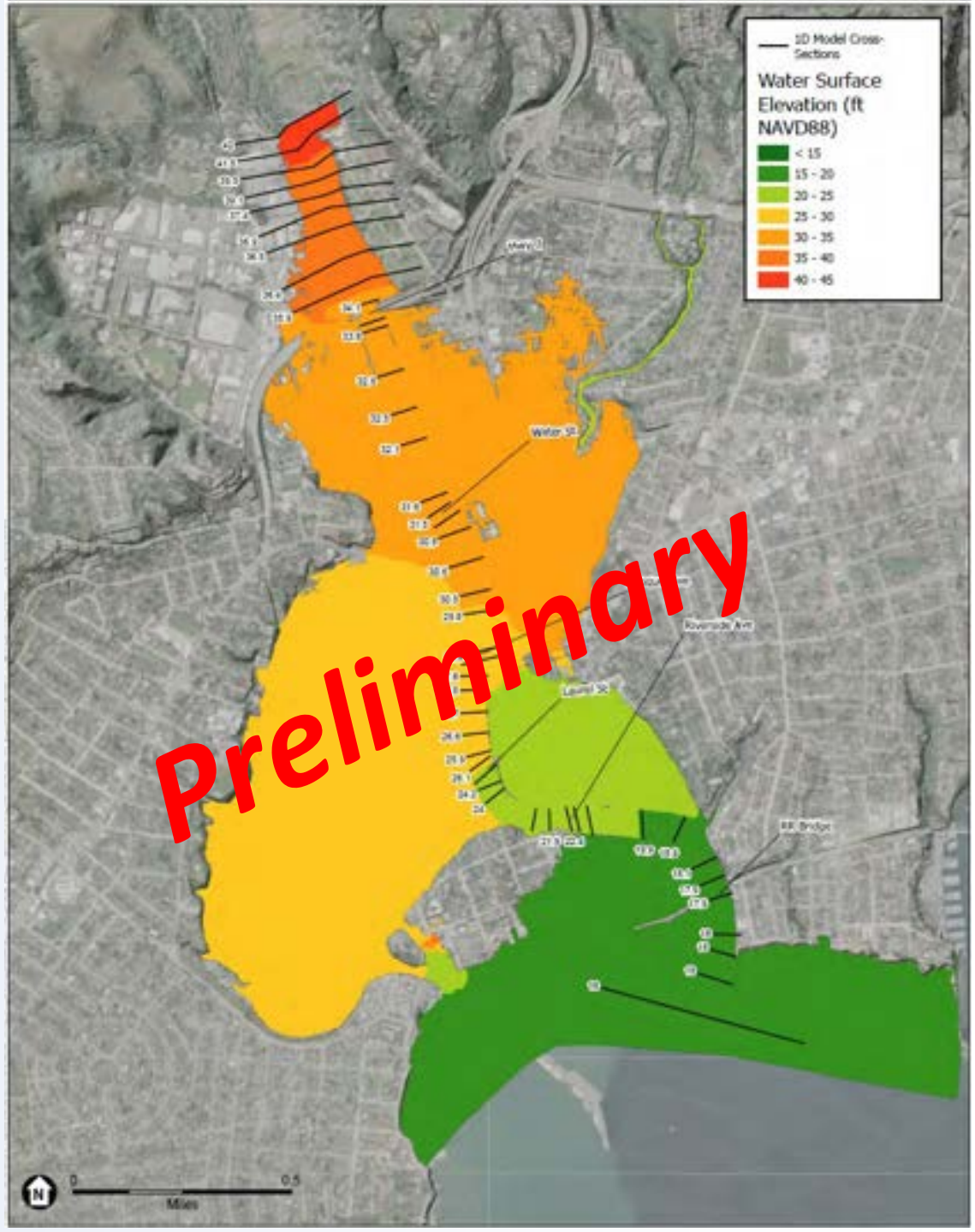
Santa Cruz Pilot Study: Wave Hazard Response to SLR and Shore Change



- Wave runup response function of SLR and morphology change
- Wave hazards increase for existing and 6 feet SLR

Santa Cruz Pilot Study: Compound Coastal–Fluvial Flooding under SLR

- Compound coastal–fluvial flooding increases due to
  - Increased watershed flows
  - Elevated coastal boundary conditions
- Wave runup hazards not yet integrated into this map



2100 / 6 ft SLR

What's Next

- Ventura pilot
- Executable runup model
- Guidance refinement
- Toward statewide implementation

Acknowledgments

- CA Department of Water Resources
  - Shima Chenar, PhD, CFM
  - Samson Haile-Selassie, PE
  - Amarjot Bindra
  - Ricardo Pineda
  - Mike Mierzwa
  - Romain Maendly
- City of Santa Cruz
  - Tiffany Wise West, PhD, PE
- ESA and GEI Team
  - Yi Liu, PhD
  - Phong Ly
  - James Gregory, PE
  - John Pritchard, PE
  - Louis White, PE
  - Bob Battalio, PE (GEI / Coastal Futures)
  - Sevim Onsoy (GEI)
- TAC Members (many of you)