Open Pacific Coast Study

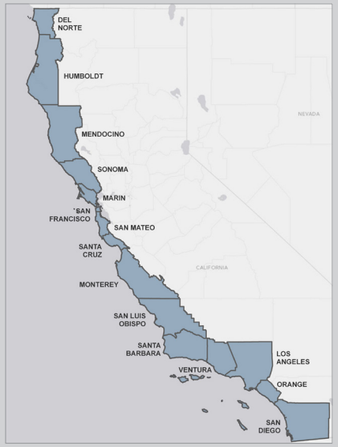
California Coastal Analysis and Mapping Project

October 2015

FEMA

CCAMP

California Open Coast Counties



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CCAMP

RiskMAP
Increasing Resilience Together

This publication is an initiative of the Mitigation Division of FEMA Region IX.

Open Pacific Coast Study Overview

The Federal Emergency Management Agency (FEMA) is performing detailed coastal engineering analysis and mapping of the Pacific coast of California in accordance with FEMA's February 2005 Pacific guidelines for new coastal studies, which are included in Appendix D of the *Guidelines and Specifications for Flood Hazard Mapping Partners*. Results from the Open Pacific Coast (OPC) Study will be used to re-map the coastal flood risk and wave hazards for all California counties along the open coast:

- Del Norte
- Humboldt
- Mendocino
- Sonoma
- Marin
- San Francisco
- San Mateo
- Santa Cruz
- Monterey
- San Luis Obisp
- Santa Barbara
- Ventura
- Los Angeles
- Orange
- San Diego

FEMA's coastal mapping efforts benefit from new technologies and coastal data contributed by a consortium of Federal and State agencies, academic institutions, and private sector consultants. The OPC Study is based on new high-resolution bathymetric and topographic data for the entire California coast acquired from the California Ocean Protection Council and National Oceanic and Atmospheric Administration. The collection of new high resolution digital elevation data using Light Detection and Ranging will update topographic maps throughout the coastal region. Two-dimensional wave models are used to transform offshore waves to nearshore coastal waters. The results from these modeling efforts provide boundary conditions for detailed onshore coastal flood hazard analyses. Key coastal processes such as dune erosion, wave setup, wave runup, overtopping, overland wave propogation, and evaluation of coastal structures are accounted for in determining new Base Flood Elevations (BFE).

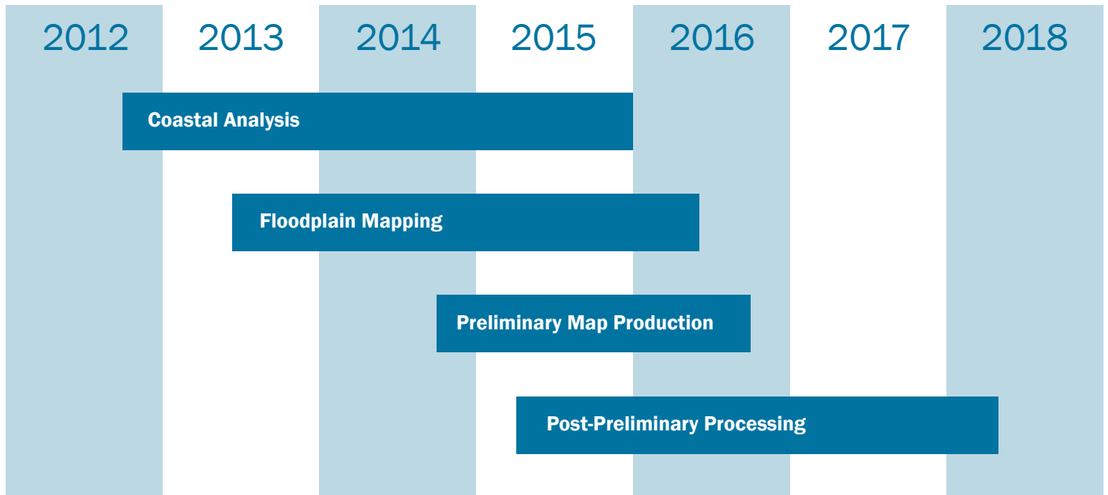
Following FEMA's due process and statutory requirements, the new BFE and hazard zones will be presented in revised Flood Insurance Study reports and on digital Flood Insurance Rate Maps (FIRM). FEMA is coordinating with Federal, State, Tribal, regional and local stakeholders and will continue to coordinate with these stakeholders as the study and mapping efforts progress.

Next Steps: Stay Informed and Engaged

After FEMA's review and approval of the coastal flood hazard analyses, floodplain mapping will commence on a county-by-county basis. Once draft work maps are prepared for an entire county, FEMA will schedule a Flood Risk Review meeting with county/community officials. The Flood Risk Review meeting provides communities with an opportunity to review the work maps and understand their coastal flood risks, discuss study methods and results, and begin developing risk awareness strategies to communicate risks to impacted residents and businesses. Following issuance of the Preliminary FIRMs and during the Post-Preliminary Process, FEMA will conduct additional meetings with communities and continue to support community and stakeholder efforts to identify and implement mitigation actions for coastal flood risk reduction.

FEMA welcomes your feedback, questions, and comments. Visit www.r9coastal.org for additional coastal study information. To stay current with the Open Pacific Coast Study, and the companion San Francisco Bay Area Coastal Study, sign up for our e-bulletin, *Coastal Beat*, for schedule updates, technical articles, and relevant information as the study progresses. Sign up for RSS feeds at the website to receive the latest OPC Study updates.

Open Pacific Coast Study Timeline



The duration of each workflow task includes all 15 coastal counties; individual county schedules vary.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Open Pacific Coast Study
California
DEL NORTE
HUMBOLDT
MENDOCINO
SONOMA
MARIN
SAN FRANCISCO
SAN MATEO
SANTA CRUZ
MONTEREY
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
SAN DIEGO
Crescent City
Trinidad
Eureka
Arcata
Fort Bragg
Point Arena
Daly City
Pacifica
Half Moon Bay
Santa Cruz
Capitola
Monterey
Pacific Grove
Carmel
Marina
Sand City
Seaside
Morro Bay
Pismo Beach
Grover Beach
Point Conception
Goleta
Santa Barbara
Carpinteria
San Buenaventura
Oxnard
Port Hueneme
Los Angeles
Malibu
Santa Monica
El Segundo
Manhattan Beach
Hermosa Beach
Redondo Beach
Torrance
Palos Verdes Estates
Rancho Palos Verdes
Long Beach
Huntington Beach
Newport Beach
Laguna Beach
Dana Point
San Clemente
Oceanside
Carlsbad
Encinitas
Solano Beach
Del Mar
San Diego
Coronado
Imperial Beach
Summary Information
FIRM Panels
Coastal Communities
Study Areas
PHASE 1
PHASE 2
N
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E
W
0 15 30 60 90 120
Miles
Projection: Albers Equal Area Conic, North American Datum 1983

Coastal Flood Issues Along the Open Pacific Coast

Types of Flooding

Pacific Winter Storms

- **How it works**: During the winter, storm systems from the Aleutian Islands, Hawaii ("Pineapple Express"), and other parts of the North Pacific impact the California coastline. Storms generally approach from the west or northwest, although "southeaster" events can also occur in southern California. These low pressure systems generate large waves and meteorological effects can elevate tide levels along the coast.
- **Example Events**: Typical winter extratropical storms and southeasters.
- **Types of Impacts**: Waves move sand offshore and narrow protective beaches; breaking waves damage homes and coastal structures in eroded or vulnerable areas; rainfall saturates bluff material and waves impact bluff toes, increasing likelihood of failure; high tides inundate some sheltered areas.
- **Location of Impacts**: Typically west and northwest facing shorelines; south facing beaches can be vulnerable to southeaster storms. Developed shorelines with erodible beaches or bluffs are most vulnerable to damage.

Remote Swell Events

- **How it works**: Pacific Ocean swell is generated by remote storms from other regions, such as offshore Baja California, New Zealand, and other areas of the North Pacific. Storm types include offshore extratropical storms, tropical storms, hurricanes, and southern hemisphere swell. Remote swell events can be difficult to predict.
- **Example Events**: Labor Day 2011 south swell event; 1858 San Diego hurricane; 1939 Long Beach tropical storm; Hurricane Joanne in 1972; Hurricane Kathleen in 1976; Tropical storm Ignacio and Hurricanes Linda and Nora in 1997.
- **Types of Impacts**: Wave damage and overtopping along the shoreline, particularly to coastal structures such as breakwaters, docks and piers, wharfs, and revetments; backshore inundation due to wave overtopping of structures and ponding.
- **Location of Impacts**: All along the California coastline; for south swell events, south and southwest facing beaches and harbors in the southern CA bight, including beaches, harbor breakwaters, piers, and beach-front homes.

Extreme High Tide Inundation

- **How it works**: When Pacific Ocean storms coincide with high tides, storm surge due to meteorological effects can further elevate open coast water levels to produce extreme high tides. El Niño conditions along the California coast can also contribute to storm surge and produce extraordinarily high water levels. Extreme high tides can exceed 7.5 to 8 ft Mean Lower Low Water (MLLW) in Southern and Central California and 10 ft MLLW in Northern California.
- **Example Events**:
  - Northern CA: January 1983 (10.66 ft), January 2005 (10.1 ft), February 1978 (10.01 ft), January 2006 (9.96 ft)
  - Central CA: January 1983 (8.66 ft), December 1983 (8.65 ft), February 1998 (8.38 ft), January 2005 (8.14 ft)
  - Southern CA: January 2005 (7.66 ft), January 1997 (7.65 ft), August 1983 (7.55 ft), January 1983 (7.45 ft)
- **Types of Impacts**: Severe inundation of inland bay shorelines; intensification of upstream riverine flooding; interference with coastal and bay stormwater outfalls.
- **Location of Impacts**: All along the coastline, particularly along developed low-lying beaches and bay shorelines, and tidally influenced creeks, bays, and sloughs prone to high tide flooding.

El Niño Winter Storms

- **How it works**: During El Niño winters, atmospheric and oceanographic conditions in the Pacific Ocean produce severe extratropical winter storms that impact the California coast. Storms follow a more southerly track and bring intense rainfall and storm conditions. Riverine and coastal flooding often coincide and produce upstream flooding. Tides are elevated by approximately 0.5 to 1.0 feet above normal throughout the winter. Changes in alongshore sediment transport patterns can greatly erode beaches and decrease beach widths, exposing areas typically protected from ocean swell.
- **Example Events**: Winters of 1977-1978; 1982-1983; 1997-1998; 2009-2010
- **Types of Impacts**: Wave damage to coastal structures such as breakwaters, piers, and seawalls; damage to homes and other beachfront structures; severe coastal erosion of dunes and bluffs; intense rainfall saturates bluff material and large waves increase likelihood of failure; inundation by extreme high tides in sheltered areas.
- **Location of Impacts**: All along the California coastline. Sheltered south facing beaches are particularly vulnerable due to more southerly storm tracks during El Niño winters.

Tsunamis

- **How it works**: Tsunamis are long period waves generated primarily by earthquakes, but can also be caused by volcanic eruptions or landslides.
- **Example Events**: 1960 Chile earthquake; 1964 Great Alaskan earthquake; February 2010 Chile earthquake; March 2011 Japan earthquake.
- **Types of Impacts**: Strong currents in harbors damage docks and piers; boats torn from moorings; inundation of shoreline in harbor areas; and overland flow of tsunami bores that damage structures in low-lying areas.
- **Location of Impacts**: Damage typically concentrated in harbor areas where tsunami waves and associated currents are focused; damage particularly severe in Crescent City due to offshore topography.

Note: Tsunami hazards will not be included in FEMA's determination of coastal BFEs as part of the CCAMP/OPC Study. FEMA is partnering with the California Geological Survey, California Office of Emergency Services, and University of Washington to develop non-regulatory products to help communities better understand and mitigate tsunami risk.

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For more information on the California Coastal Analysis and Mapping Project (CCAMP) visit: www.r9coastal.org

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www.fema.gov/plan/prevent/fhm/rm_main.shtm · 1–877–FEMA MAP