

## State of California tsunami 5-year review (1997–2001)

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**Abstract.** The California coast is at risk of tsunamis that are generated both locally and from a distance. In 1964, 10 people died and 35 were injured when a tsunami caused by an Alaskan earthquake reached Crescent City, at the California/Oregon border. In addition to tsunamis originating in seismic zones across the Pacific Ocean, Northern California communities are at risk of a local tsunami generated by an earthquake in the Cascadia Subduction Zone, an undersea thrust fault system that runs along the coasts of Canada, Washington, and Oregon, down to Mendocino County, 100 miles north of San Francisco. While tsunamis originating in Alaska can take hours to reach California, providing some time for planned evacuation, a Cascadia earthquake could send a tsunami to Northern California within 15 minutes.

In the Santa Barbara Channel and in Monterey Bay, recent bathymetric studies reveal evidence of past submarine landslides capable of generating large tsunamis. The threat of seismically generated submarine landslide off the Southern and Central California coasts still exists. With intensive development along the coast and the commercially strategic ports of Long Beach and Los Angeles, Southern California is particularly vulnerable to tsunamis generated locally by undersea landslide or earthquake. Because locally generated tsunamis provide such little time for warning, communities need to be informed of the exact areas that could be inundated and the precise routes for self-evacuation.

The general public needs to understand what can cause a tsunami and what to do when natural warnings of a tsunami are observed while on the coast. If a large earthquake happens or if the ocean suddenly recedes abnormally, a visitor or resident on the coast should know to move immediately to higher ground. Local emergency managers need to know which areas of their coastlines will be inundated and how lives and property can be protected. These are the challenges to the California Tsunami Hazard Mitigation Program.

### 1. What Was Promised

In 1997, a Steering Committee was formed to set the goals of the California Tsunami Hazard Mitigation Program. The Committee, chaired by the Governor's Office of Emergency Services (OES) and consisting of coastal county emergency managers and state agencies such as the Coastal Commission, Department of Transportation, Division of Mines and Geology, and State Parks, guides the development and implementation of tsunami mitigation products. The group provides a forum to share tsunami information, particularly with the coastal communities that are at risk. The Tsunami Steering Committee set the following mitigation priorities:

- Develop a guidance for local governments to help emergency managers plan a response to both near-source and distant tsunamis.
- Improved tsunami inundation and evacuation maps for local and state agencies.
- Training and education to coastal land use planners (Mintier)

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- Incorporation of tsunami mitigation planning into local and state all-hazard mitigation programs.
- Raise and maintain awareness of affected populations to the threat posed by tsunami.

## 2. What Was Accomplished

The Local Planning Guidance on Tsunami Response was published in 1999. It was introduced to local emergency managers and other stakeholders in a series of four workshops throughout the State that explained how to use the document. The workshops also enabled local government officials to raise further tsunami mitigation issues to be addressed by the State. The guidance includes sections describing the use and limitations of inundation maps, development of evacuation plans, and a description of warning systems. Appendices give background on the threat of tsunami to the State coastline, the history of damaging tsunamis in California, sample planning templates, a copy of one county's response plan, and legal guidelines for evacuation.

Tsunami inundation maps were produced and distributed to the following counties: San Diego, Los Angeles, Santa Barbara, and San Mateo/San Francisco. The maps and the research done to produce them were presented to all coastal counties and relevant state agencies in order to generate feedback that can help improve the accuracy of maps to be produced for the remaining coastline. Costas Synolakis of USC, the seismologist contracted to produce the maps, is working individually with the GIS staff of each of the four counties to the accuracy of inundation projections.

In the third year of the Tsunami Hazard Mitigation Program, the Steering Committee decided that because county emergency managers need evacuation maps as a first step in response planning, the production of inundation maps for the entire coast became the top priority. Funds previously set aside for mitigation efforts were reassigned to the inundation mapping effort. The Committee agreed that once such maps are produced, the threat of tsunami will become tangible and easily understood by the public. Counties with maps already completed are refining them, together with local jurisdictions and other departments such as Building Inspection, Public Works, and Police, so that efficient evacuation routes can be developed. Four more sections of California's coast will be mapped before September 2002. Until the entire coast is finished, general run-up and inundation figures, backed by existing seismic and bathymetric data, are being developed so that unmapped counties can develop evacuation plans now.

OES is integrating tsunami hazard information into existing public information programs and the state wide annual earthquake campaign. As the coordinating agency, OES is working with Department of Transportation and State Parks to install standardized tsunami hazard signs that are consistent with local government evacuation plans. OES and the Coastal Commission are developing tsunami information to be added to current K-12 education curriculum on coastal issues. The educational component is based on the State of Washington's successful tsunami school curriculum.

OES is integrating current tsunami information in all-hazard preparedness training that is given to school districts along the coast.

### **3. What Was The Impact**

Until tsunami inundation maps were actually presented to coastal counties and the research that produced the maps was explained, enthusiasm about tsunami mitigation planning was limited. When the inundation projections for such highly developed areas such as Los Angeles were made clear, local and state government agencies really began work creatively to develop the products needed to raise awareness about tsunami hazards in the public. Workshops for the initial presentation of the Local Planning Guidance on Tsunami Response brought agencies other than emergency planners into the effort to mitigate the tsunami hazards through collaborative evacuation plans.

Because tsunami hazard signs have not yet been installed and the educational materials for school management and students are still in development, the impact of efforts to raise the general public's awareness about tsunami hazards and how to respond has not yet been measured.

### **4. Recommendations**

To effectively raise awareness of a rare but potentially damaging hazard such as tsunami, it is important to involve more than emergency managers in planning. However, keeping stakeholders as diverse as educators, scientists, land use planners, and government resource managers interested in the effort requires considerable staff time.

The current energy to creatively raise public awareness was sparked by the visual impact of the tsunami inundation maps. Though three years into the Tsunami Hazard Mitigation Program, only a third of California's coastline has been mapped. With more funding allocated toward the mapping effort Program, efforts to educate the public could be more solidly on track at stage.

## 5. Budget

OES will take the lead in working with Operation Areas (counties) to develop tsunami inundation projections and evacuation maps and necessary public information. This effort will be in addition to and separate from any activities funded by NOAA and is projected for a 2-year period.

<b>Task</b>	<b>Cost</b>
Technical Staff Contribution by the State	\$181,988
GIS Technical Staff by State	47,970
Local Government Contribution	240,000
Professional Staff by State	60,080
Travel and Per Diem by State	10,000
<b>Total</b>	<b>540,038</b>