

Chapter 21

Improving Tsunami Resiliency: California's Tsunami Policy Working Group

Charles R. Real, Laurie Johnson, Lucile M. Jones, and Stephanie Ross

Abstract California has established a Tsunami Policy Working Group to facilitate development of policy recommendations for tsunami hazard mitigation. The Tsunami Policy Working Group brings together government and industry specialists from diverse fields including tsunami, seismic, and flood hazards, local and regional planning, structural engineering, natural hazard policy, and coastal engineering. The group is acting on findings from two parallel efforts: The USGS SAFRR Tsunami Scenario project, a comprehensive impact analysis of a large credible tsunami originating from an M9.1 earthquake in the Aleutian Islands Subduction Zone striking California's coastline, and the State's Tsunami Preparedness and Hazard Mitigation Program. The unique dual-track approach provides a comprehensive assessment of vulnerability and risk within which the policy group can identify gaps and issues in current tsunami hazard mitigation and risk reduction, make recommendations that will help eliminate these impediments, and provide advice that will assist development and implementation of effective tsunami hazard risk communication products to improve community resiliency.

Keywords Mitigation • Public policy • Tsunami hazards

C.R. Real (✉)

California Geological Survey, 801 K Street, MS 12-31 Sacramento, CA 95814-3531, USA
e-mail: creal@conservation.ca.gov

L. Johnson

Laurie Johnson Consulting | Research, 23 Portola Avenue, San Rafael,
CA 94903, USA

L.M. Jones

US Geological Survey, 525 S Wilson Ave, Pasadena, CA 91106, USA

S. Ross

US Geological Survey, 345 Middlefield Road, MS-999, Menlo Park, CA 94025, USA

21.1 Introduction

The disastrous Great Sumatra Earthquake and Tsunami of 2004 elevated international awareness of tsunami hazards, triggering a reevaluation of tsunami risk and hazard mitigation efforts among coastal communities around the world. Followed by tsunamis in Samoa (2009) and Chile (2010), and Japan's Tohoku-Oki Earthquake and Tsunami in 2011, human casualties over the past two decades now approach one-quarter million, with financial losses in the hundreds of billions (US Dollars) from a natural hazard previously thought to be rare. Japan's tsunami caused millions of dollars of damage to California's harbors and is the largest tsunami to strike the state since the 1964 Great Alaska Earthquake and Tsunami (Wilson et al. 2012). Nearly 2 years after the Tohoku tragedy, the west coast of the U.S., Alaska, and Canada have begun dealing with tsunami debris just now reaching shore.

Located on the tectonically active Pacific Plate margin capable of generating large tsunamis, California is reassessing tsunami hazard, vulnerability, and options to reduce future losses. These efforts predated the Tohoku earthquake, but were strengthened based on the lessons learned in the wake of Japan's devastating event. This paper describes a unique process currently underway to improve estimates of California's tsunami hazard and risk, and is helping to identify and resolve weaknesses in current hazard mitigation efforts in order to strengthen the resilience of coastal communities. The cornerstone of this effort is formation of a State/Federal twin-project partnership linked by a unifying policy working group that is collectively quantifying the tsunami threat: facilitating discovery of principal issues, gaps and roadblocks preventing effective tsunami hazard mitigation, and is providing the necessary focus for group analysis by experts to develop practical, workable solutions.

21.2 Federal Tsunami Program

21.2.1 *National Tsunami Hazard Mitigation Program (NTHMP)*

The NTHMP is a partnership between the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), the United States Geological Survey (USGS), the National Science Foundation, and Coastal States, Territories and Commonwealths, with a mission to reduce future tsunami losses by improving hazard assessments, providing effective notifications and warnings, and facilitating mitigation and preparedness at the local level. The NTHMP provides an overarching framework within which states can assist coastal communities in reducing the impact of tsunamis. Until recently the program has focused on short-term needs for preparedness and emergency management,

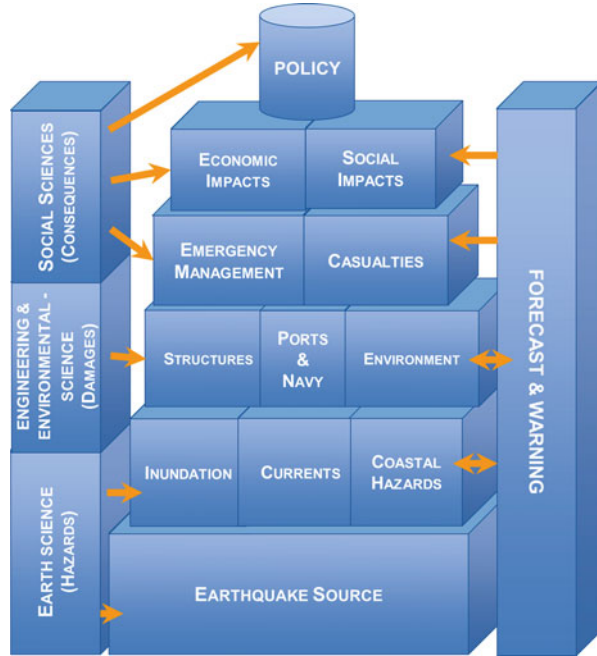
supporting development of tsunami inundation maps for evacuation planning, providing assistance to local emergency services for response planning, funding community warning systems and placement of evacuation signs, and improving public awareness through education. Following the 2004 Indonesian tsunami, NTHMP began expanding its long-term hazard mitigation plans to consider land-use and construction strategies (NTHMP 2009). Success within the national program depends on sustained federal/state partnership and continued support through the federal Tsunami Warning and Education Act of 2006 (WSSPC 2011). California is among the first NTHMP state partners to initiate projects in this new direction.

21.2.2 Science Applications for Risk Reduction (SAFRR)

The U.S. Geological Survey initiated the Multi-Hazard Demonstration Project (MHDP) with a strategy to help improve resiliency to natural hazards by application of science to community decision-making and emergency response (Jones et al. 2007). Based on stakeholder inputs from workshops, a program approach was created that consists of multi-year, multi-disciplinary scientific development efforts to construct plausible scenarios for various natural hazard events; events large enough to evaluate the adequacy of current preparedness and hazard mitigation efforts. Two major scenarios resulted: ShakeOut, a large earthquake impacting the southern California metropolitan area (Jones et al. 2008), and ArkStorm, a massive statewide winter storm (Porter et al. 2011). The MHDP has since expanded nationwide to become SAFRR, with the current focus a tsunami scenario with a large credible tsunami striking the west coast of the U.S. Like its predecessors, The SAFRR Tsunami Scenario is increasing community awareness and resiliency to tsunami hazard and risk by applying advanced science to characterize the hazard, and conducting an assessment of direct and indirect damage and economic impacts to California and the nation.

The tsunami scenario is based on a magnitude 9.1 M-thrust earthquake occurring along the Aleutian Islands Subduction Zone, which presents the greatest distant tsunami threat to southern and central California. While local landslides could produce larger tsunamis, the distant events are more frequent and allow for warnings to be part of the scenario. Characterization of the tsunami source was underway when the Tohoku earthquake occurred and was modified based on that event. Goals are to improve tsunami modeling practices, include advanced modeling of water currents and inundation for the scenario event, to spawn further research on characterizing Alaska tsunami sources, and to better understand the impacts to coastal infrastructure and environment, and local, regional and national economies. Local emergency managers are enlisted to develop effective ways to communicate and respond to the threat, enhance decision-making when responding

Fig. 21.1 The SAFRR Tsunami Scenario project involves an in-depth assessment of impact along Coastal California of a large hypothetical tsunami originating from an M 9.1 M-thrust earthquake in the Aleutian Islands Subduction Zone. Modeling the tsunami source, inundation, and consequent damage, both direct and indirect, is a multidisciplinary effort involving scientists, engineers, and dozens of stakeholders from government and industry



to tsunami warning center alerts, build the repository of lessons learned and evaluate mitigation options, and provide a tool for teaching preparedness.

Project participants include researchers and officials from government, private, and academic sectors. Ten working groups, with group leaders comprising the project steering committee, are established covering: earthquake source, tsunami geologic field studies to determine the history of past tsunamis, tsunami modeling, engineering and physical impacts, environmental impacts, ecological impacts, emergency management and education, social vulnerability, economic and business impact, policy, and impacts to Naval operations. Each group is composed of specialists in the respective field, who are providing direction to collaborators and oversee research and evaluations that identify issues for policy consideration Fig. 21.1.

A principal focus is the tsunami's impact on ports and harbor operations, particularly the ports of Long Beach and Los Angeles, including estimating the economic consequences of service disruptions. During the process, project staff engage with the community through extensive outreach activities, including presentations, education forums, workshops/panels, consultations, and the media. The results of The SAFRR Tsunami Scenario project are estimates of losses, physical, environmental and economic, that can be used to support policy decisions. Participation of local government officials is a key component of the scenario project, and helps to ensure transfer of findings.

21.3 State Tsunami Program

21.3.1 *California Tsunami Preparedness and Hazard Mitigation Program (CTPHMP)*

For more than a decade, the California Governor's Office of Emergency Services (Cal OES) and the California Geological Survey (CGS) have partnered with the NOAA under the NTHMP's grant program to help coastal communities better prepare for the impact of tsunamis and assist in the process of becoming "Tsunami Ready". Cal OES administers the program and coordinates activities through the California Tsunami Steering Committee, comprised of representatives from the four regional National Weather Service offices, all relevant state agencies, and each of the 20 coastal and Bay Area counties. As technical advisor to Cal OES, the CGS is California's science representative on the NTHMP's Coordinating Committee, a consortium of federal and state agencies funded by NOAA to mitigate tsunami hazards at a "grass roots" level. CGS staff co-chairs the NTHMP Mapping and Modeling Subcommittee, responsible for setting standards for tsunami source identification, numerical modeling, and, inundation and hazard mapping on a national level.

As a NTHMP partner, the CTPHMP works with NOAA's West Coast/Alaska Tsunami Warning Center to develop and implement emergency response activities/plans when a *Tsunami Alert* is issued. In partnership with the University of Southern California's Tsunami Research Center, a series of tsunami inundation maps for developed portions of the California coastline were released to assist emergency managers in development of community evacuation plans (State of California 2009). This program also assists communities prepare for tsunamis generated locally offshore where there is insufficient time for a *Tsunami Alert* to be useful. In addition to assisting local emergency managers, pilot projects funded by NTHMP and FEMA are underway to support local tsunami hazard mitigation decision-making via land-use and construction, and to develop and design products for use in the construction of maritime facilities and response operations. The communities of Crescent City and Huntington Beach were chosen for study because their populations, economies, and exposure to tsunami hazard sharply contrast. This provides a broader spectrum of potential issues regarding their requirements and capacity to adopt and implement tsunami hazard mitigation measures. Maps depicting tsunami hazard for 100-, 500-, 1,000-, and 2,500-year return periods have been prepared using newly developed probabilistic methods (Thio 2010), which have been used to assess the vulnerability of the state's coastal transportation infrastructure. The objective is to provide the local planning and building departments with a more detailed up-to-date perspective of tsunami hazards, and collaboratively look at hazard mitigation options for reducing impact in a framework of acceptable risk. Products are being prepared that express hazard in terms of engineering parameters such as flow depth, current velocity, and momentum flux as a prototype dataset supporting building code provisions under development by the

American Society of Civil Engineers Subcommittee on Tsunami Loads and Effects (ASCE 2012). These products will help form the basis for tsunami design provisions in future editions of the California Building Code, as the statewide assessment of seismic hazard did more than a decade ago (Petersen et al. 1996). Products tailored for the maritime community that are based on detailed hydrodynamic modeling of harbor response are also under development to assist with identification of vulnerable port and harbor infrastructure (Wilson et al. 2012). Other maritime products include maps designating offshore safety zones for evacuation planning and response.

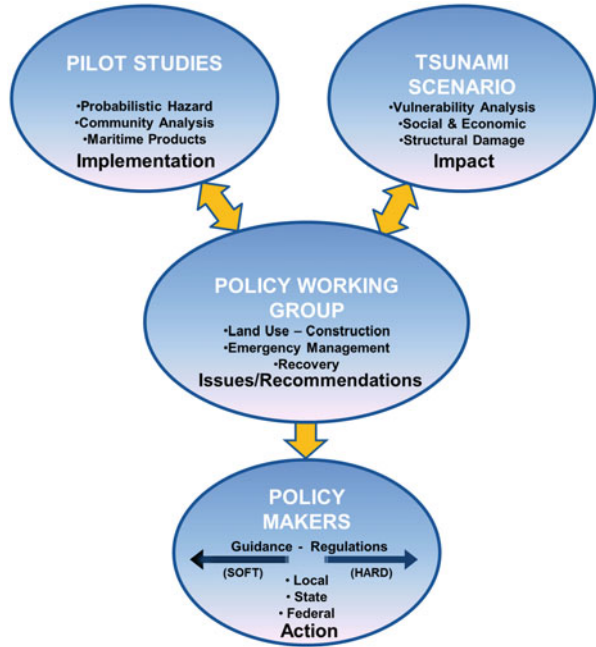
21.3.2 Tsunami Policy Working Group

The California Tsunami Policy Working Group (CTPWG) is a voluntary advisory body operating under the California Natural Resources Agency (CNRA), Department of Conservation, and is composed of experts in earthquakes, tsunamis, flooding, structural and coastal engineering and natural hazard policy from government, industry, and non-profit natural hazard risk-reduction organizations. The working group serves a dual purpose as an advisor to State programs addressing tsunami hazards and as a consumer of insights from The SAFRR Tsunami Scenario: raising awareness and facilitating transfer of policy concepts to other coastal states in the nation. CTPWG's role is to identify, evaluate and make recommendations to resolve issues that are preventing full and effective implementation of tsunami hazard mitigation and risk reduction throughout California's coastal communities.

Parallel work on The SAFRR Tsunami Scenario and State pilot projects provides a unique opportunity to simultaneously evaluate tsunami impacts with representative stakeholder groups in order to identify issues and gaps in preparedness, while evaluating alternative solutions, exploring issues and barriers to their implementation, and developing products and public policy strategies to facilitate tsunami hazard mitigation and risk reduction. The work is accomplished by having representatives of the State tsunami program placed on The SAFRR Tsunami Scenario Steering Committee representing *Geologic Field Studies* and *Emergency Management and Education*, and having a representative from SAFRR and CTPHMP Co-chair the CTPWG. This arrangement greatly facilitates transfer of project findings from The SAFRR Tsunami Scenario project and the State tsunami program to the CTPWG, which links both programs to policy makers at local, state, and federal levels Fig. 21.2.

Membership in the CTPWG is selected to represent entities responsible for coastal development, insurance, local and regional planning, public works, foreign and domestic disaster preparedness, recovery and seismic policy (see Acknowledgements). Among those selected are representatives of the two cities chosen for the State's tsunami pilot studies. Their participation in working group deliberations provides an opportunity to bring forth local implementation issues in a

Fig. 21.2 The California Tsunami Policy Working Group plays a critical role assessing current tsunami hazard mitigation in California, identifying gaps and roadblocks and developing policy recommendations to enhance resiliency based on input from The SAFRR Tsunami Scenario project and the State Pilot Studies



forum conducive to multidisciplinary resolution, and an opportunity to incorporate a local perspective while formulating recommendations.

Furthermore, the composition of CTPWG provides linkages to agencies that not only provide valuable input to the group’s mission, but can benefit from its findings and recommendations, helping to spread knowledge that will facilitate and expedite dissemination and utilization of tsunami hazard mitigation strategies. The principal product of the CTPWG is a report consisting of a general overview of the tsunami threat to California and shortcomings in coastal communities’ preparedness and mitigation to lessen the impact, followed by a series of issues, and a list of specific recommendations to resolve each issue that have been carefully evaluated and prioritized based on viability and potential effectiveness in reducing future losses. CTPWG has a liaison from the Department of Conservation’s Office of Government and Environmental Affairs, through which the document will be reviewed for actionable content of potential importance to CNRA and other agencies involved with coastal affairs.

The seven basic principles outlined in *Designing for Tsunamis* (NTHMP 2001) and detailed land-use strategies presented in the *Hawaii Coastal Hazard Mitigation Guidebook* (Hwang 2005) have been useful guides for CTPWG when assessing a community’s preparedness. CTPWG obtains insights on the degree to which loss-reduction measures are implemented from the community *Action Plan* component of Local Hazard Mitigation Plans (GPO 2000), *zoning ordinances* that are implemented under Local Coastal Programs (PRC 2010), whether a community is certified *Tsunami Ready* (NOAA 2012), and whether a community participates in

the National Flood Insurance Program. These programs, along with California's regulatory zoning for natural hazards, provide a strong policy framework for communities to reduce future losses from natural hazards, within which tsunami hazard mitigation in particular can be strengthened (Real 2010). Until recently, California's coastal communities almost universally considered tsunamis to be a rare event that ranks low in priority for risk reduction as evidenced by these documents. Following the recent tsunami disasters this perception is changing.

When developing recommendations to improve tsunami hazard mitigation, CTPWG considers application to land development, emergency management, and recovery for each of the following land-use categories: coastal infrastructure, coastal industry, maritime sector, and general development (all other types). Issues that are identified in The SAFRR Tsunami Scenario and the State pilot projects are sent to the CTPWG for analysis, where once categorized, they are prioritized based on importance/value in reducing loss, sufficiency of the existing knowledge base to resolve the problem, and the anticipated difficulty implementing a solution. The group meets quarterly to discuss issues and work on ways to resolve them. During the interim, group interaction continues through a collaborative website, e-mail, and conference calls. The website keeps members aware of new information, allowing for the generation and review of documents by all. Issues and recommendations can be shared and refined prior to meetings where they form the basis of discussion. Similar collaborative project websites have been established for The SAFRR Tsunami Scenario project and State Pilot projects, which are accessible to members of the CTPWG.

Policy recommendations generated by the group go through a screening process for viability based on their potential to evoke community resistance (conflict) according to three program categories: voluntary programs (least conflict), encouraged programs (moderate conflict potential), and mandatory (greatest potential for conflict). Each program category has several advantages and disadvantages that weigh in on viability, and can form a basis for considering alternative solutions during working group deliberations. For example, mandates within tsunami hazard zones that restrict land use too late in the development process, when property owners have accumulated investment-backed expectations, can incite sufficient public resistance to defeat the proposal. Experience in Hawaii demonstrates that such strategies should be operative as early as possible, before land is subdivided (Hwang 2005).

21.4 Conclusions

The CTPWG believes that significant reduction in future tsunami losses can be achieved through a balanced program of voluntary, incentive-based, and regulatory hazard mitigation programs that will increase the resiliency of California's coastal communities to tsunami hazard. The dual-track approach of The SAFRR Tsunami Scenario project analysis of impact and vulnerability combined with local implementation State Pilot projects serves to not only facilitate discovery of weaknesses

in tsunami hazard resiliency, but documentation from these projects will also serve to support the California Tsunami Policy Working Group recommendations and related policy initiatives that they may spawn. The final Issues/Recommendations report will be a useful resource for federal, state, and local action.

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