



## **2007 NTHMP 5-Year Review Findings**

The National Tsunami Hazard Mitigation Program (NTHMP) was initiated in 1996 as a partnership between NOAA, the U.S. Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF) and five state partners – Alaska, California, Hawaii, Oregon, and Washington – to assess tsunami hazards, improve and coordinate tsunami warning systems, and develop state and local hazard mitigation programs. The program was assessed by five independent reviewers in 2002. This first review concluded that the program had led to several improvements in the U.S. tsunami warning system, and also provided several recommendations for the system. Following the strengthening of the U.S. tsunami warning system in 2005, the NTHMP was expanded to include 29 U.S. Coastal States, Territories, and Commonwealths.

In 2007, five independent reviewers assessed NTHMP progress and provided recommendations for the NTHMP's future. Professor Lori Dengler, Humboldt State University, Department of Geophysics; Professor Michael Lindell, Texas A&M University, Landscape Architecture and Urban Planning; John Aho, Professional Engineer, Structural and Earthquake Specialist; Richard McCarthy, California Seismic Commission; and Jay Raskin, Canon Beach, Oregon City Council Member and Architect conducted the review. Each Panel Member provided individual assessments and recommendations based on the materials presented and interviews conducted as part of the NTHMP Review process.

This document is the consolidated final report of their findings; including a consensus statement from all reviewers followed by a consolidated list of

recommendations. This report will help guide the development of the NTHMP Implementation Plan, which will serve as the five-year strategic document for the program. The NTHMP would like to express its gratitude to the Review Panel for their support of this valuable program. Their recommendations will be used to help the program continue its success into the future.

## **NTHMP Review Committee Consensus Statement**

The NTHMP has established a unique partnership among multiple states and federal agencies that has been developed over the past decade, has set challenging goals, and met many of them. This program has institutionalized a partnership between federal and state members that is unmatched by other hazard and risk management programs. The reviewers unanimously agree on the following points:

- NTHMP was established well before the Sumatra tsunami and its goals have been validated by the impacts of that event. Recognition of a broader regional vulnerability to tsunamis, coupled with the success of the NTHMP provided the foundation for the Tsunami Warning and Education Act.
- Despite modest budget allocations, the program has achieved much because the state and federal agency partners have made investments of time and effort that go beyond normal expectations.
- All state and federal NTHMP representatives were highly engaged in the activities of the program and committed to its success.
- The program has expanded beyond a narrow focus on mitigation to include community resiliency. The reviewers endorse this expanded interpretation of the program's goals
- The representatives recognize that the technology developed and used by the program must be tied to education and awareness in order to be effective.
- The program has allowed states to experiment with alternative methods of achieving tsunami safety. This has resulted in a variety of innovative approaches that now provide an opportunity to develop assessment tools for evaluating their relative effectiveness.
- Since products such as inundation maps have been implemented at the local level, NTHMP is in a unique position to establish performance standards and standardized assessment tools for evaluating its effectiveness.
- There is a strong need for the National Academy of Sciences' review of the forecast/warning system and an external review of the *TsunamiReady* community program.

- The expansion of the NTHMP from the five Pacific states to 29 coastal states, commonwealths, and territories and the passage of the Tsunami Warning and Education Act offers a unique opportunity to strengthen the organizational structure of the program and enhance tsunami resilience in the United States.
- The lessons learned from the existing program should now be transferred to the additional 24 members that have joined the expanded program.
- The overarching goal for all partners is to continue to demonstrate the program's value over the next five years and to achieve a sustainable program.

## **Summary of NTHMP Recommendations and Comments**

The following is the compiled list of comments from the NTHMP 5-Year Review Panel. Comments are organized into specific categories based on the program area it best applies to (e.g. Management Structure, Mapping and Modeling Sub-Committee, etc). In addition, the percentage of times the recommendation was made by a reviewer is provided. This percentage is given to show where there was greater consensus by the review panel for the NTHMP to implement a suggestion. The NTHMP needs to determine which recommendations, through the Implementation Plan development, will or will not be implemented by the program.

<u><b>Management Structure</b></u>	<u><b>% of Times Recommendation Made</b></u>
• NTHMP needs to develop a leadership structure that can both adequately support the state programs and represent the program’s interests in Washington D.C.	40%
• States that are more advanced in their tsunami risk reduction efforts must assist those that are not. Some of these states may need a larger share of the funding to get started.	40%
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• With the expanded role of mitigation, education, outreach and planning in the NTHMP, the subcommittee structure and membership should be re-examined.	40%
• The Act should be the guiding force for the expanded NTHMP.	20%
• Assess budget priorities among program areas.	20%
• NOAA must insist on a state-funding match, as this is the most cost-effective way to help fund tsunami risk reduction programs with non-federal partners.	20%
• NTHMP should develop a Charter, which includes the NTHMP’s purpose, goals, behaviors, roles and responsibilities.	20%

- The NTHMP needs the continued input of someone from a human behavior field at the coordinating committee level. 20%
- NTHMP needs to develop strategic and implementation plans that reflect both the Act and the expanded membership. 20%
- Incorporate local/community representation into the NTHMP coordination structure. 20%
- NTHMP should consider developing closer ties with groups such as the Cascadia Regional Earthquake Working Group (CREW). 20%
- NTHMP should have one of its meetings in a small coastal community subject to a Cascadia or similar event and go through an exercise of looking from the “ground up” to see how warnings, evacuation, relief, and reconstruction would work. 20%

### **Information dissemination**

- NTHMP should establish an information clearinghouse, or at least a single website, where local officials can obtain the information they need for community tsunami hazard management. 40%
- NOAA should guide the development of products developed by the State Partners to reduce the duplication of effort that is not cost or performance-effective. 40%
- NTHMP should identify and recognize NWS Weather Forecast Offices that have been particularly successful in tsunami efforts and expect that all coastal weather regions be equally involved. 20%

### **Standards and assessment**

- Develop standards and/or endorse best practices for products including hazard and evacuation maps, mitigation and preparedness programs. 60%

- Develop specific, measurable, and achievable performance goals (e.g., 1) providing technical assistance to local jurisdictions in the selection and deployment of local warning systems and 2) collecting and assessing existing outreach materials). Measurable outcomes for educational/preparedness programs, maps and other products need to be included in this process. 40%
- NTHMP should establish procedures for collecting and assessing existing materials utilizing a system of principles such as Instructional System Design (ISD). 40%
- Develop tools and conduct assessments of the effectiveness of achieving outcomes that can be applied to all states, commonwealths and territories. 20%

### **General Comments**

- NOAA must make decisions on what is best for the nation as a whole and not show favoritism to any non-federal partner. 40%
- Without an active, interested leadership that has the confidence of the states, the program will not succeed. 20%
- State members will have to address traditional differences to focus on developing useable products, plans, education programs, warning and response policies, and others. 20%
- Any new approach to management of the NTHMP should place emphasis on stakeholder (e.g., coastal resident or visitor, local emergency managers) satisfaction. 20%
- The Act presents an opportunity to cost-effectively reduce the tsunami risk to U.S. citizens by utilizing emerging technology and educational outreach programs while providing the states innovative ways of addressing tsunami preparedness and mitigation. 20%
- State members must recognize that their voting authority is advisory and that the ultimate decision making responsibility lies with NOAA. 20%
- Multi-state programs should be supported by the NTHMP. 20%

### **Modeling and Mapping Recommendations**

- NTHMP needs to establish a long-term plan for developing and disseminating standard tsunami inundation maps. The plan should recognize that local planners and emergency managers can do much planning for hazard mitigation, emergency response preparedness, and disaster response preparedness with approximate maps produced from low resolution data. 60%
- Consistent/standard evacuation maps (symbols, resolution, etc.) should be produced but allow for necessary state and local variations in geography, facilities, and community needs. 60%
- NTHMP should prioritize community grid development utilizing the U.S. Tsunami Hazard Assessment and in coordination with the state membership. 40%
- NOAA should fund grid development outside of the NTHMP. 20%
- Grid development for NTHMP member states should return to NOAA as the responsible entity. 20%
- Emphasis must be placed on the necessity of interaction between the tsunami modeler and the structural designer to properly determine wave heights, velocities, etc. 20%

### **Modeling and Mapping Comments**

- The standards for inundation mapping should be followed (ref. document). 100%
- The code for the PMEL MOST model should be made available for use by qualified modelers. 20%
- Inundation maps should be based on both models and paleotsunami mapping-i.e. height and inland extent of tsunami sand, etc. 20%
- Expand tsunami inundation mapping to address broader issues of tsunami impact characterization. 20%



## **Tsunami Warning Recommendations**

- A more clear definition of “false alarm” is required in order to clearly identify the measurement of success for this goal. NWS should look at the criteria developed for storm surge and flood water height forecasts and develop consistent, statistically-based definitions. 60%
- In the development of graphical products, it is recommended that there is a determination made about how to display uncertainties about impact parameters such as wave amplitude and wave train duration. A common standard should be established for the quality and type of graphical displays to be used and a method should be established for their distribution. 40%
- With NOAA as the lead, NTHMP partners should map actual NOAA All-hazards Radio coverage and use the results of the mapping study to make decisions about either increasing transmitter signal strength or installing repeaters to increase the actual coverage area. 40%
- NTHMP should develop guidance documents and decision aids that will support local managers in planning for and deciding when to implement evacuations. This system could rely on current research on hurricane evacuation costs. In addition to evacuation cost, effective evacuation decisions should also consider the deaths that would result from a failure to evacuate and the probability of those events. 40%
- NTHMP should conduct research on tsunami warnings to identify disparities between the intended and actual notification chain between the tsunami warning centers and local jurisdictions. 20%
- Future performance criteria in relation to tsunami impact forecasts should more specifically distinguish between demonstrated capabilities and operational capabilities. 20%
- NTHMP should address post-incident studies of warning reception and response by households, businesses, and special facilities. 20%
- Efforts should be made to estimate forecast uncertainties. 20%

- NOAA should make the SIFT model simulations operational as soon as possible and ensure that the output include local tide conditions. 20%

### **Tsunami Warning Comments**

- Due to improving technology, the term “inundation forecast error” would seem to be a more accurate, not to mention less emotion-laden, term than “false alarm.” 40%
- Warning and Bulletin Information from the two Tsunami Warning Centers need to be presented in similar formats. 20%
- Warning/Information dissemination procedures/methodologies need to take into account the differing circumstances of local and distant tsunami events 20%

### **Mitigation Recommendations: TsunamiReady Program**

- The TsunamiReady Certification process should be reevaluated for its appropriateness and procedures should be developed to ensure that the population of a community understands the aspects of “tsunami ready” and, finally, methods should be developed that ensure a community continues the efforts necessary to maintain the certification. The NOAA TsunamiReady program should be integrated with state and FEMA mitigation programs. A process should be developed to convey the value of the program to local governments. 80%
- NTHMP should 1) assess local government’s incentives (FEMA Hazard Mitigation and Pre-Disaster Mitigation Grants) and impediments to joining the TsunamiReady program; 2) in coordination with the TsunamiReady Program, design a program for increasing the incentives and overcoming the impediments; 3) implement the program; and 4) evaluate the program’s effectiveness. 80%
- There should be strict guidelines within the TsunamiReady program that require certified communities to have a regular, monitored, program of public outreach to maintain certification. 40%

- Some pressure should be placed on the communities that are designated TsunamiReady to ensure that information is available to the businesses in their community and to periodically check on whether businesses are distributing that information to their clients. 40%
- NTHMP should work with the TsunamiReady Program to define grades of membership--similar to the grades of qualification within the National Flood Insurance Program. 20%

**Mitigation Recommendations: Community Planning and Outreach**

- The NTHMP needs to develop innovative approaches to utilizing the media and national organizations (e.g., National Emergency Management Agency) for education and outreach efforts. 60%
- Performance measures for community resilience need to be defined and assessment and evaluation tools developed. 40%
- The NTHMP should develop simplified guidance for small and rural jurisdictions on pre-impact disaster recovery planning 40%
- NTHMP should work with the NSF and possibly the U.S.DOT to develop evacuation planning tools. 20%
- The NTHMP should conduct a needs assessment that compares typical tsunami planning and response demands on coastal emergency managers with their capabilities and the capabilities of collaborating agencies. This needs assessment should be used to identify crucial training shortfalls and recommend training opportunities to remediate the shortfalls. 20%
- Develop a guidance document that specifically explains the similarities and the differences among tsunamis, coastal storms (including hurricanes), and riverine flooding in terms of their community impacts. 20%
- Establish a clearer integration between the objectives and procedures of the NTHMP and the National Flood Insurance Program. 20%

- Develop guidance for local emergency managers to use in planning for warning dissemination and evacuation response in coastal communities. 20%
- Determine if any aspects of the National Response Plan are impediments to tsunami response and recovery. NTHMP should work to eliminate any impediments that are discovered. 20%
- Develop computer-based analysis tools for multi-modal (pedestrian and vehicular) household, transit-dependant, and special-needs facility (e.g., schools, hospitals, nursing homes, and jails). 20%
- Assess existing business continuity planning guidance (e.g., FEMA) to see if tsunami threat requires any supplementary material. 20%
- There is a need for reasonable tsunami and tsunami/earthquake scenarios that include physical and economic loss estimations. 20%
- NOAA needs to continue to partner with the USGS to make sure that earthquake issues are included for near-source events like Cascadia, the Lesser Antilles, and the Alaska-Aleutian regions. 20%
- Develop a computer-based decision support system to assist local emergency managers, land use planners, and elected officials in choosing a suitable portfolio of tsunami hazard management measures. 20%

### **Mitigation Recommendations: Structural**

- Since this will be the only manual (ATC64) dealing with design of tsunami resistant evacuation structures, how will users be trained? There are enough uncertainties in the equations that are to be used and how loads will in fact impact the structure that only well-trained individuals should use the manual. 20%
- Since people will be directed to go to these structures in the case of a tsunami the structures must be designed to a higher standard than current codes prescribe. 20%

- The appropriate load combinations (D, L, and T<sub>s</sub>) and multiplier on the tsunami load are important determinations as well as establishing the appropriate safety floor level above the anticipated tsunami wave height. 20%
- Examine the need for, and feasibility of, developing special tsunami resistance standards for special needs facilities. 20%
- Analyze planning, legal, and behavioral issues associated with vertical evacuation from tsunami. 20%

### **Mitigation Comments**

- Expand the scope of planning to include a regional catastrophe. 40%
- The NTHMP should promote, support, and encourage community, state, and multi-state exercises. 40%
- Tsunami literature needs to better address a local tsunami events triggered by an earthquake. Literature needs to include the resulting damage from an earthquake and describe how that may impede evacuation. 40%
- Public outreach is an important aspect of the NTHMP and should be closely tied to the TsunamiReady program. 20%
- Tsunami literature needs to realistically address how long communities and individuals could be without outside assistance in the aftermath of a tsunami event, so communities/individuals can better prepare. 20%
- The hospitality and tourism industry needs to be included in the tsunami preparation/mitigation process. 20%

### **Research Recommendations**

- Strengthen ties with the tsunami research community to identify and support research needed to improve mitigation/preparedness and to communicate results of research with potential users. 60%
- Develop a stronger linkage to social science research in coordination with NSF's NTHMP Representative and the NOAA Tsunami Research Program. 40%

- NTHMP should support research on the effects of tsunami warning fatigue and evacuation costs. 20%
- The development of future tsunami forecast products should take advantage of findings from current research projects on the usability of hurricane forecast products (Lindell & Prater, 2007c). 20%
- Development of a tsunami evacuation decision support system should be considered. The system could rely on current research on Hurricane evacuation costs. In addition to evacuation cost (the cost of a “false positive decision”), effective evacuation decisions should also consider the deaths that would result from a failure to evacuate (the cost of a “false negative” decision) and the probabilities of those events. 20%
- Use some of the increased NOAA research funding from the Act to Support NTHMP grant program. 20%