5-2014

Evaluation of Key Components of Draft Guidelines for the National Weather Service TsunamiReadyTM Community Program

Colleen Scott
East Tennessee State University

Evaluation of Key Components of Draft Guidelines for the National Weather Service TsunamiReady™ Community Program

A dissertation

presented to

the faculty of the Department of Community and Behavioral Health

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Public Health

by

Colleen Scott

May 2014

Dr. Robert Pack, Committee Chair

Dr. Chris E. Gregg, Committee Member

Dr. Mary Ann Littleton, Committee Member

Keywords: TsunamiReady™, Community Emergency Preparedness, Tsunami, Evaluation, Qualitative

ABSTRACT

Evaluation of Key Components of Draft Guidelines for the National Weather Service TsunamiReady™ Community Program

by

Colleen Scott

The National Tsunami Hazard Mitigation Program partnered with the National Weather Service (NWS) in 2000 to create the TsunamiReady™ (TR) Community program. TR is designed to help communities in coastal areas plan and prepare for tsunamis. To achieve TR recognition communities must meet certain criteria including specific emergency planning and management actions within the categories of mitigation, preparedness, response, and recovery.

This study's purpose was to evaluate the acceptability and usefulness of key components of a proposed revised set of TR Community program guidelines. Research was guided by the Elaboration Likelihood Model (ELM) using Community Based Participatory Research methods to gather input from expert panels composed of local expert community stakeholders from 5 states and 1 US territory. Two qualitative data collection methods were used: online prediscussion surveys administered via Survey Monkey© and focus group discussions. Fifty participants attended 1 of 6 focus group discussions, with 20 participants completing surveys.

Data analysis focused on 8 discussion topics: subdivision of communities by vulnerability, proportion of the population to be protected, evacuation effectiveness, evacuation drills or exercises, vertical evacuation, educating businesses, educating residents, and acceptability of a revised guidelines format. Supporting and opposing themes were identified, providing rich information of community-level perceptions regarding the guidelines. Most notably, the fidelity

of the 2 ELM pathways were confirmed as separate. The peripheral pathway demonstrated a significant need for clarification and definition of program terms and activities through the surveys, while focus groups facilitated the central pathway for participants to discuss and debate various program guidelines.

This study provides several recommendations based on community input for updating and revising the TR Community program guidelines including: revisions to the overall format, a new focus on community tsunami hazard, and additional actions and activities to improve community tsunami mitigation and preparedness efforts. Finally, the data and recommendations provided will be used to compile a final draft of the TR Community program guidelines for the NWS.

DEDICATION

This work is dedicated to all US communities at risk to tsunamis.

ACKNOWLEDGEMENTS

This project would not have been possible without the assistance of my dissertation committee: Dr. Robert Pack, Dr. Chris E. Gregg, and Dr. Mary Ann Littleton.

Research for this project was funded by the National Weather Service; Award Number NA10NWS4670015.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CASPER – Community Needs Assessment for Public Health Emergency Response
CBPR – Community-Based Participatory Research
CERT – Community Emergency Response Team
DART – Deep-ocean Assessment and Reporting of Tsunami
DAT – Disaster Action Team
DHS – Department of Homeland Security
ELM – Elaboration Likelihood Model
EPZ – Emergency Planning Zones
ESSA – Environmental Science Services Administration
FEMA – Federal Emergency Management Agency
IRB – Institutional Review Board
MES-EC – Mitigation and Education Subcommittee, Executive Committee
MRC – Medical Reserve Corps
NAPA – National Academy of Public Administration
NOAA – National Oceanic and Atmospheric Administration
NRC – Nuclear Regulatory Commission
NSF – National Science Foundation
NTHMP – National Tsunami Hazard Mitigation Program
NTWC – National Tsunami Warning Center
NWS – National Weather Service
PADM – Protective Action Decision Model
PTWC – Pacific Tsunami Warning Center
TA – Tone Alert (radios)
TR – TsunamiReady^{TM}
TWEA – Tsunami Warning and Education Act
US – United States
USGS – United States Geological Survey
WSSPC – Western States Seismic Policy Council

CHAPTER 1

INTRODUCTION

The TsunamiReady™ (TR) Community program is a community-based emergency preparedness program managed by the National Weather Service (NWS) aimed at preparing communities throughout the US for tsunamis. The following research describes the background, methods, findings, and recommendations from communities in Alaska, Oregon, California, Hawaii, North Carolina, and the US Virgin Islands shown below in Figure 1.

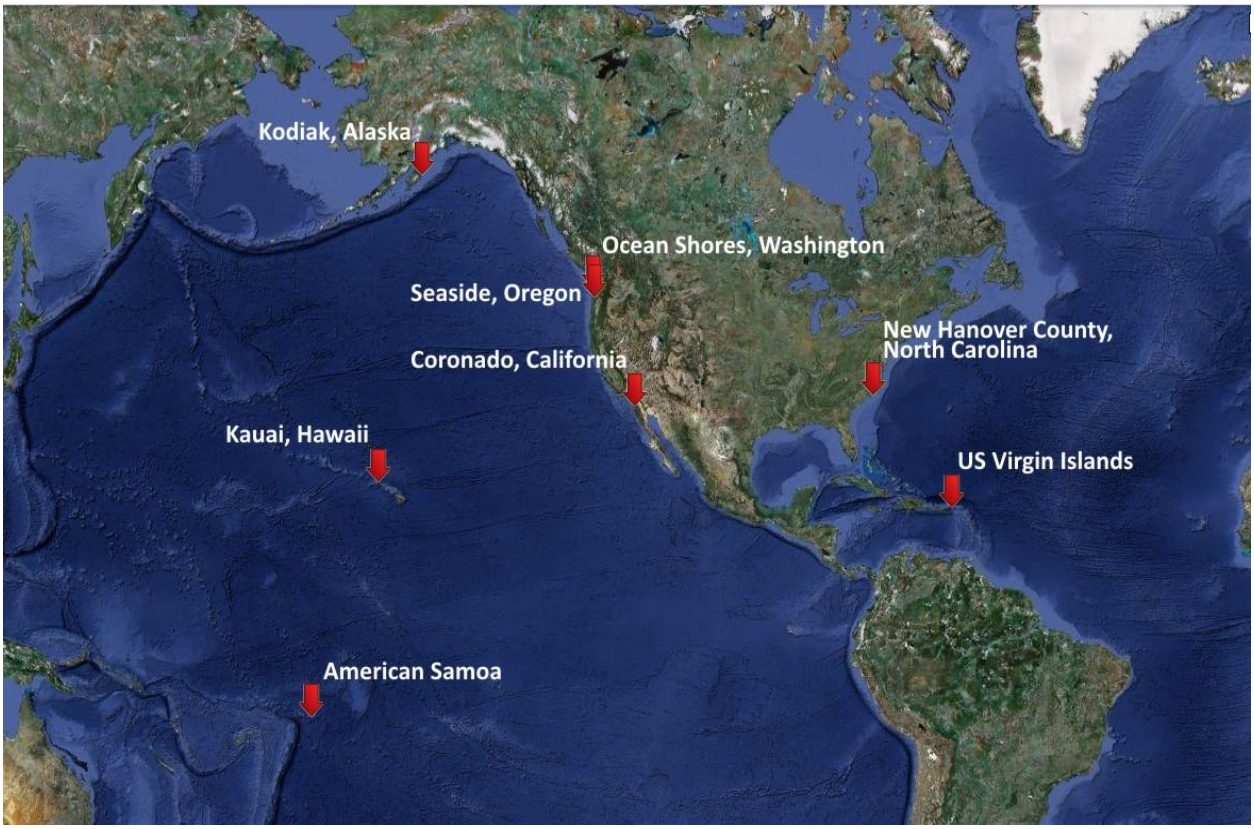


Figure 1: TsunamiReady™ Community Guidelines 2011 and 2013 Research Study Sites

Emergency Preparedness

Public Health

Natural disasters have devastating effects on basic human needs such as access to shelter, food, and clean water. Preparedness and relief efforts therefore constitute important elements of

public health emergency preparedness. Despite being overlooked by other agencies in the past, public health departments have played key roles in emergency response and the development of preparedness plans for many years (Morse, 2006). The Federal Emergency Management Agency (FEMA) was created in 1979 when President Carter signed an executive order merging several emergency response agencies, including those providing public health works, into one single structure, bringing forth the idea of modern emergency management (Coyne, Leeson, & Sobel, 2009).

Building and elaborating upon the framework initiated by President Carter, in disaster situations today, emergency management agencies assume the lead role in local response efforts. Public health agencies adopt supportive roles in information management, emergency operations coordination activities, and mass care or the management and distribution of medical materials (Hunter, Crawley, Petrie, Yang, & Aragon, 2012). Additionally, public health agencies lead surveillance and epidemiology activities, environmental health, and mental health and psychological support functions during the response phase of disasters.

Tsunamis as a Public Health Issue. One of the largest and deadliest tsunamis in recorded history occurred on December 26, 2004, after a 9.3 magnitude earthquake rocked Northern Sumatra and the Nicobar and Andaman Islands (Union Territory of India) (Grilli et al., 2007). The tsunami generated by this earthquake caused over 200,000 fatalities, tens of thousands of individuals reported missing, and some 1 million left without a home in more than 10 countries (Grilli et al., 2007). Seven years later, a 9.0 magnitude earthquake generated a tsunami that devastated the Pacific coast of Japan. This deadly tsunami caused more than 15,000 fatalities and more than 5,000 missing persons in Japan alone (Akiba, 2011; Suppasri et al.,

2012). Tsunamis are infrequent events but the damage and destruction caused by them can be significant.

In a systematic review including tsunami literature available from 1900 to 2009, Doocy et al. (2013) found that an estimated 2.5 million people world-wide were directly affected by tsunamis. Of those 2.5 million people, more than 255,000 deaths and an estimated 50,000 injuries were caused by tsunamis. It is likely that the number of injured persons due to a tsunami is underestimated because of low injury reporting levels in the early 20th century (Doocy et al., 2013). In an attempt to ascertain the true expected number of persons injured by tsunamis Doocy et al. applied statistical modeling techniques to all of the events that reported tsunami-related deaths. Using these statistical models, Doocy et al. estimate that between 10,900 and 116,950 unreported tsunami-related injuries most likely occurred world-wide during the study period. This study bolsters the understanding that tsunamis are infrequent events with the potential to cause significant damage and loss of life.

TsunamiReady™

In April of 1992, a 7.2 magnitude earthquake with strong subsequent aftershocks uplifted roughly 24 km of the Californian coast near Cape Mendocino (Bernard, 2001, Carver, Jayko, Valentine, & Li, 1994). The main shock generated a small tsunami that was recorded in California and Hawaii, but the <1.1m wave was not destructive. Later, in 1994, an 8.3 magnitude earthquake rocked the Kurile Islands and generated a tsunami warning that left local emergency managers feeling unprepared and unsure of appropriate response measures or activities, particularly for local tsunami (tsunamis with travel times of less than one hour) hazards (Dengler, 2005; Jonientz-Trisler et al., 2005). These events, combined with geological evidence of a large magnitude earthquake that occurred in ca. 1700 along the Cascadia

subduction zone, causing a great tsunami in Oregon, Washington, and northern California, prompted US government officials to address the lack of tsunami preparedness along the west coast of the US and the need for improved tsunami detection, monitoring, warning, and preparedness (Bernard, 2001). As a response to these needs, in 1995 the National Tsunami Hazard Mitigation Program (NTHMP) was formed through a congressional action calling for a partnership to be formed between the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), the US Geological Survey (USGS), the National Science Foundation (NSF), and the US Coastal States Territories (National Oceanic Atmospheric Administration, 2013).

The primary goals identified by the NTHMP include: 1) raising tsunami awareness of affected populations; 2) developing integrated tsunami maps and inundation models; 3) improving tsunami warning systems; and 4) incorporating tsunami planning into state and federal multi-hazard programs (NOAA, 2013). In response to these goals, an external partnership was formed between the NTHMP and the NWS to create the TR Communities program. This program was designed using the NWS StormReady® Communities program as a template (National Tsunami Hazard Mitigation Program, 2000). To achieve TR recognition, communities must meet certain criteria aimed at better preparing a community for a tsunami, including specific actions within the following categories: communications and coordination, tsunami warning reception, local warning dissemination, community preparedness, and administration (Appendix A).

Tsunami Warning and Education Act

Until 2005 NOAA operated a national program created to warn the US Pacific coastal areas of tsunamis. This program consisted of two regional US tsunami warning centers based in

the Pacific Ocean (Morrissey, 2005). The two regional stations are directly operated by the NWS. The Pacific Tsunami Warning Center (PTWC) is located within the basin of the Pacific Ocean at Ewa Beach, Hawaii. The PTWC is responsible for monitoring tsunami activity in the Hawaiian Islands, the US Pacific territories, the Indian Ocean, the South China Sea, and the Caribbean Sea. Established in 1949, the PTWC monitors for tsunamis and issues notifications (Morrissey, 2005). The second regional tsunami warning center, formerly called the West Coast/Alaska Tsunami Warning Center (WCATWC) is situated along the rim of the Pacific Ocean in Palmer, Alaska. The WCATWC was initially created in 1964 following the Great Alaskan earthquake in Anchorage that caused a local tsunami (Morrissey, 2005). The name of the WCATWC was changed in the fall of 2013 to the National Tsunami Warning Center (NTWC). In addition to issuing warnings to emergency managers in Alaska, the scope of the NTWC has been expanded to provide warnings to US Atlantic and Gulf of Mexico coasts, Puerto Rico, the Virgin Islands, and the Atlantic coast of Canada (Morrissey, 2005).

In December 2006 Congress signed into law the Tsunami Warning and Education Act (TWEA). This purpose of this legislature was to authorize, expand, and strengthen NOAA's programs to detect, forecast, warn, and mitigate tsunamis in order to protect the life and property of US citizens ("Tsunami Warning and Education Act," 2005). NOAA's Tsunami Program continues to be administered by the NWS. The most notable product of this legislation is the major geographical expansion of the Tsunami Forecasting and Warning Program. Prior to the passage of this bill, NOAA and the NWS focused tsunami detection, forecasting, and warning on the five states along the Pacific coast and the Pacific US territories. With the passage of this new law, the NWS and NOAA expanded their programmatic obligation to 29 states including: the

states along the Atlantic coast, the Gulf of Mexico, and the Caribbean Sea region ("Tsunami Warning and Education Act," 2005).

This significant program change doubled the size of the territory covered by the Tsunami Forecasting and Warning Program, with the proposed inclusion of an additional tsunami warning center in the Caribbean (Morrissey, 2005). In a time of governmental cut-backs and program reductions, the resources allotted to the protection of these regions are now being spread even thinner. With the passing of this legislation, NOAA and the NWS realized how important it would be for the Tsunami program to recognize the varying levels of tsunami risk associated with all of the US coastal states and territories now included in the program and allocate program resources appropriately.

Research Significance

The current TR Community program guidelines were first instituted in June 2001 with the recognition of the program's first two communities: Ocean Shores and Grey Harbor County, Washington (C. Maier, personal communication, July 24, 2013). Over the past 12 years, there have been no official revisions, modification, or updates of the TR Communities program or guidelines as described on the NWS website. Since the initial two communities gained recognition, an additional 130 communities (for a total of 132 communities as of January 2013) have completed the required actions to also become TR recognized (C. Maier, personal communication, July 24, 2013). As of the end of April 2014, there are now 168 TR recognized communities (National Weather Service, 2014).

Recognizing the need to incorporate social science research to support and improve the NWS Tsunami Program mission and mission-related activities, the NWS released a request for

proposals (RFP) in 2010. The RFP called for project proposals using social science research methods to address three primary objectives:

1. Improve Tsunami Warning Center (TWC) products, including warnings, advisories, watches, and information statements,
2. Evaluate the TsunamiReady^{TM} Program Improvement, and
3. Assess previous and on-going tsunami-related social science studies including regional, state, and local efforts, to determine how to best integrate such information at the national level.

This research contributes to the larger NWS funded research study by evaluating and offering program recommendations for key components of the TR Community program guidelines using expert community stakeholders from study communities across the United States and its territories in the Atlantic and Pacific Oceans. The findings and recommendations from this research will help address objective 2 above.

Research Purpose and Aims

The purpose of this research is to evaluate the acceptability and usefulness of key components within a revised set of national guidelines for the TR Community program including: 1) perceptions of effective evacuation strategies, 2) perceptions of required evacuation strategies; specifically vertical evacuation, and 3) perceptions of defining a proportion of population requiring protection through evacuation planning for inclusion in the TR guidelines, and 4) provide data and recommendations to the original research team so that they may compile a final draft of the TR Community program guidelines for the NWS. The specific research aims identified to elicit the information for these topics are described below.

Aim 1: Investigate the potential for subdividing the TR guidelines based on community vulnerability to tsunamis using definitions of: local (near-field) versus distant (far-field) tsunami hazard.

Aim 2a: Determine rationale for support or resistance to the idea that TR communities must have an effective evacuation strategy for tsunamis.

Aim 2b: Determine rationale for support or resistance to the idea that TR communities must have an effective vertical evacuation strategy for tsunamis when no natural high or inland ground is available.

Aim 3: Determine the community perceptions regarding the concept of quantifying the population that should be protected by tsunami preparedness planning, as a potential required action for a community to achieve TR recognition.

Aim 4: Provide data and recommendations to the original research team so that they may compile a final draft of the TR Community program guidelines for the NWS.

CHAPTER 2

LITERATURE REVIEW

Introduction

The TR Community program is a community-based emergency preparedness program specific to the tsunami hazard created and managed by the NWS. As the research described in this dissertation is interdisciplinary in nature, the following literature review has been constructed to ensure readers from each discipline are provided with background describing the major topics contributing to the development of the a community-based emergency preparedness program within the US: 1) emergency preparedness development within the US, 2) the NWS, 3) natural hazards, 4) tsunamis, 5) the TR Community program, and 6) the theoretical framework and methods guiding the research.

Emergency Preparedness

US Developments

The 1906 San Francisco Earthquake shook the city at 5:13am on April 16, 1906, taking claim as the worst earthquake in California History (Helquist, 2007; Hudson, 1976). The shock itself lasted approximately 2 minutes causing fires that raged uncontrolled for 3 more days (Hudson, 1976). In the aftermath of the earthquake and subsequent fire, 200,000 of the city's 450,000 citizens were rendered homeless with nearly 3,000 estimated fatalities (Helquist, 2007; Hudson, 1976). The economic loss for the city in terms of personal and public property was estimated at $5,000,000 in 1906 dollars (Hudson, 1976).

As the aftershocks of the earthquake subsided, military personnel stationed throughout San Francisco sprang into action. Although multiple military branches with bases in the area immediately responded to the disaster, the response was unorganized and without clear

management. The federal government had not declared martial law, yet troops went into action under their own command (Hudson, 1976; Livingston, 2006). The U.S. Navy, Army, Marine Corp, and Revenue Cutter service all began to provide aid under different orders and separate leadership (Livingston, 2006). There was no national Red Cross or federal agency prepared to coordinate or provide the needed emergency response (Helquist, 2007). The lack of organized response management did not facilitate effective or efficient help for public health needs such as urgent medical care, access to clean water, or sanitary living conditions (Hudson, 1976; Livingston, 2006). The situation dissolved into chaos in the weeks following the earthquake as branches of the military argued over authority and shared resources (Livingston, 2006).

During the confused and mismanaged emergency response following the earthquake, many citizens remained displaced from their homes without shelter or clean drinking water (Hudson, 1976). Instead of waiting for governmental resources to sort out responsibilities, many instead relied on their own families and friends for support (Henderson, 2006; Livingston, 2006). This public health disaster was complicated by the fact that with nowhere to go, many citizens set up unsanitary makeshift camps in fields outside the city (Henderson, 2006).With only one source of drinking water in the city, the Navy attempted to transport drinking water and milk into the city on ships (Livingston, 2006). This water had been sterilized to prevent disease, but there was no control over fair distribution to the people in need (Hudson, 1976). There was rampant looting, no functioning hospitals, and no clear means of communication (Livingston, 2006). On April 18, two days after the disaster, the mayor gathered many prominent citizens in the Hall of Justice and created several committees that put citizens in charge of disaster relief (Hudson, 1976). This is the first recorded creation of disaster relief committees including public health

related groups like “Relief of the Hungry”, “Restoration of City Water”, and “Sanitation” (Hudson, 1976).

The 1906 San Francisco Earthquake demonstrates a public health emergency in which neither local nor federal government were prepared to quickly implement an organized response to protect the health and safety of the affected citizens after a natural disaster. Although citizens and military personnel alike provided aid, a unified response was not available to prevent the chaos and misappropriation of services and resources resulting in further degradation of the public’s health (Hudson, 1976). The 1906 San Francisco earthquake and subsequent aftermath was a large scale natural disaster and public health emergency that has served, and continues to serve, as a reminder of the need for appropriate emergency preparedness and response.

The concept of national emergency preparedness occurred relatively recently; with the recognition of public health agencies as being vital elements of disaster preparedness and emergency response even slower to develop. Despite being overlooked by other agencies in the past, public health departments have played, and continue to play, key roles in emergency response and the development of emergency preparedness plans. Most commonly, public health agencies are recognized as leading the response against infectious disease outbreaks (Morse, 2006). Other examples of public health responding to emergencies include: inspecting and monitoring food supply and safety in restaurants after power outages, providing group shelters during heat-waves in areas where not all residents have access to air conditioning, and in some jurisdictions health departments are responsible for water supply safety during and after floods (Morse, 2006). Each of these examples demonstrates how the government has included health departments and public health into emergency preparedness and response planning.

The first emergency managers working for the US government were part of the Civil Defense program preparing for a possible nuclear attack from the Soviet Union in the 1950s (Morse, 2006). Over the course of the next 20 years, various agencies were developed with specific aims of creating operational plans and activities related to emergency preparedness and response (Morse, 2006). The Federal Emergency Management Agency (FEMA) was created when President Jimmy Carter signed an executive order in 1979 (Coyne et al., 2009). With this order, FEMA was created by merging several disaster-related agencies into a single operating organization. Agencies including the Federal Insurance Administration, the National Weather Service Community Preparedness Program, the Federal Preparedness Agency of the General Services Administration, the Federal Disaster Assistance Administration, and various activities undertaken by the US Department of Housing and Urban Development were brought together in an attempt to streamline emergency management activities into one single agency (Coyne et al., 2009).

The National Weather Service. Tracking and monitoring the weather has been important to United States citizens since the colonies were first founded. Early colonists recognized that weather affects all elements of life, from the agriculture and farming industries to the trade and transportation industries. President Ulysses S. Grant understood how important tracking the weather was for the country and prioritized nationwide weather monitoring when he signed into law a joint resolution of Congress in 1870 that authorized the establishment of a national weather service under the Secretary of War (National Weather Service, 2006). This law required the newly created national weather service to record meteorological observations at all military stations in the nation and combines that information with reports from other points in both the US and its territories. These observations would then be used to create weather

forecasting reports to warn of approaching storms and severe weather. The national weather service agency was housed within the War Department from 1870 -1890 with headquarters located in Washington DC. Several field offices were identified and linked with the headquarters via telegraph (National Weather Service, 2006).

In 1890 President Harrison and Congress signed legislation renaming and moving the national weather service to the newly created US Weather Bureau in the Department of Agriculture (National Weather Service, 2006). These legislative changes mark the transition of the national weather service from a military operation to a civilian agency. Agency reporting responsibilities grew with advancing technology and the improved understanding of weather systems. The Weather Bureau became responsible for providing flood warnings to the public, and also began tracking river flow and volume. To provide more accurate reports and warnings, weather forecasters began to include more sophisticated methods of monitoring and tracking weather observations using kites and air balloon experiments to measure air temperature, relative humidity, and wind (National Weather Service, 2006). With the advent of air travel and airports, the Weather Bureau realized how vital its role of accurate weather reporting and forecasting would be for the aviation community.

As the Weather Bureau continued to work collaboratively with the aviation industry, additional offices and field locations were established across the country (Friday, 1994). These additional offices assured more locations for both surface and upper-air meteorological observations and data to be transmitted and combined in larger forecasting efforts. The addition of these offices and weather data helped improve the accuracy and detail of weather forecasts and severe weather warnings. In 1940 President Roosevelt recognized that the role of the Weather Bureau was important not only within the aviation community but also for national

commerce. With this new understanding, the President officially transferred the Weather Bureau into the Department of Commerce, where it remains today (National Weather Service, 2006).

The US Army helped to continue the growth and development of the Weather Bureau in 1941 with the donation of 25 surplus radars to monitor and track weather systems (National Weather Service, 2006). With this donation, the army helped establish a network of weather surveillance radars, which are still in use today. At this time, the Weather Bureau was officially issuing multiple weather-related warnings to alert and ultimately protect the general public from weather-related threats. With the genesis of computer technology in the 1950s, more complex mathematical models were created that improved forecasting accuracy (National Weather Service, 2006). With new and improved technology, the Severe Weather Warning Center – a precursor to the National Severe Storms Center – was created and initiated operations in 1951 at Tinker Air Force Base in Oklahoma (National Oceanic and Atmospheric Administration, 2013). This center was responsible for providing forecast alerts of tornados, high winds, and large hail to the public. These "severe weather bulletins" were the precursors for today's weather advisories and warnings.

By the mid-1960s the Environmental Science Services Administration (ESSA) was created and housed within the Department of Commerce (National Weather Service, 2013). The ESSA, incorporating several agencies including the Weather Bureau, was purposed with overseeing the nation's weather and climate operations and forecasting. With this move in agency location, the Weather Bureau was officially renamed the National Weather Service (NWS). Just 5 years later President Richard Nixon called for another governmental reorganizing and the creation of NOAA (National Weather Service, 2013). NOAA then absorbed the ESSA

and added multiple other agencies engaging in environmentally-related activities. The NWS continues to be housed within NOAA today.

Currently, the National Weather Service is one operating agency within NOAA and the Department of Commerce. The NWS mission is to "Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy" (National Oceanic and Atmospheric Administration, 2013). With major advances in radars, satellites, improved information processing and communications systems, high-speed computers, and fully-automated weather observing systems, NOAA's NWS is able to provide more accurate and precise weather forecasts and warnings across the nation (i.e. forecasting dangerous storms, like hurricanes, with predictions of storm travel paths with relative certainty and accuracy several days in advance). With vast improvements in technology, NWS continues to work towards an agency vision of creating a Weather-Ready Nation. This vision aims at providing accurate and precise weather forecasts and warnings that will ensure that "[the US] society is prepared for and [able to] respond to weather-dependent events" (National Oceanic and Atmospheric Administration, 2013).

Developments in Federal Emergency Preparedness

During the initial years of operation FEMA was an independent entity within the US government with direct congressional oversight (Coyne et al., 2009). It was not until a series of major natural disasters in the late 1980s and early 1990s hit the US that some of FEMA's emergency preparedness and response limitations were brought to light. In 1989 Hurricane Hugo devastated the Virgin Islands and Puerto Rico before tearing across the Carolinas (Hollis, 2005; Schneider, 2008). Following quickly upon this devastation, the Loma Prieta earthquake shook the San Francisco Bay area (Schneider, 2008). It was during the response efforts to this

storm and earthquake that the nation learned how much more emergency management and coordination was required of FEMA, state, and local governments to effectively prepare for and respond to natural disasters.

In 1992 FEMA was once again tested when Hurricane Andrew overwhelmed southern Florida (Gresham, 1994). Hurricane Andrew left more than 160,000 people homeless as FEMA, state, and local governments were unable to organize and coordinate response efforts together (Coyne et al., 2009). Criticism abounded, causing the US government to initiate a comprehensive study of the FEMA's ability to plan for and respond to natural disasters. The National Academy of Public Administration (NAPA) – a nonprofit, nonpartisan, congressionally chartered think-tank was hired to examine the federal, state, and local levels of emergency preparedness and response (Gresham, 1994). NAPA provided FEMA with numerous criticisms and suggestions for improvement.

The number one suggestion for improvement, from both the NAPA and several senators following Hurricane Andrew, was the adoption of an all-hazards-preparedness response framework (Gresham, 1994). As Bill Clinton was elected into office, changes were instituted throughout FEMA and the emergency preparedness processes of the government. Aiming at a dramatic systems change, Clinton appointed James Lee Witt as the new head of FEMA (Witt & Morgan, 2002). Witt was not only the first director of FEMA to have emergency management experience; he was also the first to stop staffing the agency with political appointees (O'Brien & Mileti, 2003; Witt & Morgan, 2002). In doing this, Witt removed layers of bureaucracy and allowed the agency more maneuverability in emergency preparedness and response. Ultimately, Witt strove to instill every person working in FEMA with a spirit of preparedness, dedication, and service for the customer and a willingness to listen to ideas from all levels of government to

make the emergency preparedness and response system work together better (Witt & Morgan, 2002).

Under Witt's leadership, FEMA handled 373 major disasters, ranging from tornados and hurricanes to a terrorist bombing (Witt & Morgan, 2002). With Witt as director, FEMA was able to establish a reputation for delivering solid and reliable emergency management services. Despite demonstrated success in emergency preparedness and response, in 2003 FEMA lost its independent agency status and was merged into the Department of Homeland Security (DHS) where it is still housed today (Coyne et al., 2009). While FEMA continues to provide emergency management services, the onus of preparedness planning remains with local and state organizations and agencies. All disasters occur locally, so the first line of preparedness and response stands with the local community.

Recent Events: Hurricane Katrina. On August 29, 2005, Hurricane Katrina made landfall along the Gulf Coast, initiating what quickly became one of the worst natural disasters in the history of the United States (Eikenberry, Arroyave, & Cooper, 2007; Forgette, Dettrey, Van Boening, & Swanson, 2009; Johnson & Rainey, 2007; Kutner, 2007; Schneider, 2008). In total, the disaster covered an area of 90,000 square miles, displaced approximately 780,000 people from their homes, claimed over 1,800 lives, and caused an estimated $80 billion in economic loss (Forgette et al., 2009; Johnson & Rainey, 2007; Schneider, 2008).

Many of the immediate public health consequences of Katrina stemmed directly from extreme flooding and structural damage; hundreds of thousands of individuals lacked access to basic human needs such as shelter, food, and clean water (Johnson & Rainey, 2007). In addition, many people became stranded among the nearly 22 million tons of debris, thus exposing them to contaminants in the flood waters such as waste, fuel, pesticides, metals, and other toxic

chemicals (Johnson & Rainey, 2007). Perhaps most significantly, the destruction caused by Hurricane Katrina both exposed and reinforced existing health disparities, particularly in terms of poverty and racism (Johnson & Rainey, 2007; Kutner, 2007). Uninsured and underinsured individuals were unable to receive medical care, especially because the majority of clinics, hospitals, and other health care facilities were either destroyed or closed down due to inadequate numbers of physicians and nurses (Kutner, 2007). A disproportionate number of Katrina-related deaths occurred among poor, elderly African Americans due not only to lack of access to medical care but also to lack of transportation and limited social support (Johnson & Rainey, 2007; Kutner, 2007). Among survivors, long-term health consequences include physical injuries as well as mental health problems including posttraumatic stress disorder, anxiety, and depression (Johnson & Rainey, 2007; Kutner, 2007).

Although some of these public health issues may have been inevitable consequences of the disaster, other issues are clearly attributable to underlying social inequalities, and others may have been preventable if the intergovernmental response had been executed as originally planned. The general perception of Hurricane Katrina as an administrative failure stems from the discrepancies between the government's response policies and the way in which these policies were actually implemented (Eikenberry et al., 2007; Schneider, 2008). While local and state emergency preparedness plans and procedures had been created, those plans and procedures had not been practiced through exercises or drills (Schneider, 2008). Without practicing and engaging in emergency preparedness drills, the local and state emergency response managers missed identifying the greatest weakness to a unified and successful disaster response– the malfunction of necessary emergency structures (levee and flood wall failures). Emergency preparedness planning alone is not enough; any type of preparedness program must also include

regularly scheduled practice and drills to ensure that preparedness plans are updated and current with both personnel and technology.

Recent Events: South Pacific Tsunami. On September 29, 2009, a devastating tsunami swept over the small islands of American Samoa, a US territory located in the South Central Pacific Ocean. This local, or near-field, tsunami was generated by an 8.1-magnitude submarine earthquake that occurred at 6:58am (local time) that morning in the Samoan Islands region. The earthquake's epicenter was a mere 200 km south of the Samoan Islands and 350 km northeast of the main islands of Tonga (Okal et al., 2010). The ensuing tsunami was recorded as arriving on the shoreline of the hardest hit villages between 15-20 minutes after of the earthquake (Okal et al., 2010).

In total, this local tsunami directly affected Tonga, Samoa, and American Samoa; resulting in injury, death, and widespread loss of property and public services. The physical damage and economic costs caused by the tsunami to this region are estimated to exceed $200 million (Okal et al., 2010). A total of 189 individuals lost their life during this tsunami, with 9 individuals claimed in Tonga, 146 in Samoa, and 34 in American Samoa (Lay et al., 2010; Okal et al., 2010). During this event American Samoa suffered the highest tsunami death toll on US soil since 1964 (Fritz et al., 2011).

Choudhary et al. (2012) conducted a Community Needs Assessment for Public Health Emergency Response (CASPER) in American Samoa 5 days immediately following the 2009 tsunami, and again 3 weeks after the tsunami as a follow-up. Due to island location and topography in relation to the earthquake's epicenter, the capital city of Pago Pago and the western coast of Tutuila Island were the areas most affected in American Samoa by the tsunami. As the waves rushed inland, public utilities buildings and infrastructure were severely damaged,

resulting in immediate and wide-spread loss of electricity, water, and sanitation services throughout the island (Choudhary et al., 2012).

Many of the households in the affected areas (estimated to be roughly 600 households) were forced to evacuate for at least one night, many for several days and up to weeks, because of tsunami damage (Choudhary et al., 2012). While families were force to leave their homes, this evacuation was relatively successful with low mortality. Both the initial and follow-up CASPER demonstrated a significant portion of residence-related safety concerns, with a significant need for tarpaulins and other temporary sheltering materials. A significant portion of the population reported using relief agency-provided bottled water as a sole source of potable water and a severe need for clothing. The most common health symptoms and conditions immediately following the tsunami included: respiratory conditions, stress and/or sleep disturbances, stomach ache or diarrhea, lacerations, bruises, contusions, impalement or puncture wounds, and strains, sprains, or dislocations (Choudhary et al., 2012). Roughly 40% of those surveyed identified barriers preventing them from obtaining necessary medical care or supplies. These barriers ranged from lacking household financial resources to a strong fear of traveling after the tsunami (Choudhary et al., 2012). Adding to these barriers to health care access was the limited amount of medical resources available in American Samoa prior to the tsunami. This small US territory has a single 128-bed, hospital facility that was quickly overrun in the wake of the tsunami (Choudhary et al., 2012).

One significant reason cited for the mostly successful coastal evacuation and significantly low numbers of deaths caused by this local tsunami is the precedence of tsunami emergency preparedness planning, education, and drilling within this region (Choudhary et al., 2012; Fritz et al., 2011; Leong-Nowell et al., 2012). Many Samoans, American Samoans, and Tongans have

been educated and taught to immediately move to high ground after experiencing an earthquake. These islands within the South Pacific have prioritized education and evacuation exercises, with the island of Samoa participating in one such evacuation drill in the year preceding this earthquake and tsunami (Fritz et al., 2011). Local and regional emergency response teams were previously identified, trained, and drilled so that they could begin response activities throughout the islands of the South Pacific immediately after the tsunami (Leong-Nowell et al., 2012). Additionally, the CASPER assessments conducted in American Samoa helped identify health and safety priorities while also providing community member links to services both immediately after the tsunami and 3 weeks later during recovery efforts (Choudhary et al., 2012). While there is still room for improvement, without this regional dedication to tsunami preparedness planning, education, and drilling, the mortality and morbidity due to the 2009 tsunami event may have been much greater.

Learning from the Past: The Importance of Preparedness

The relatively recent events of both Hurricane Katrina and the South Pacific tsunami demonstrate the continued importance of comprehensive emergency preparedness. Over the course of our history as a nation, emergency preparedness has come to be recognized as a vital part of maintaining the safety and well-being of our country. Various agencies like the NWS have developed the technology and knowledge to forecast or predict some disasters before they occur. This allows emergency management to alert and warn communities and individuals of imminent threat so that mitigation and response activities may be initiated. Not all disasters can be predicted, some disasters can strike quickly providing little or no time for a warning to be issued. Emergency preparedness planning is vital for both of these types of disasters so that

communities in danger can react constructively and respond to the disaster quickly to minimize negative health and safety impacts.

Emergency preparedness should include a full range of prevention, mitigation, and recovery activities, rather than focusing solely on activities designed to enable the response to a disaster. Engaging in emergency preparedness planning is not a one-time action producing a single response plan; rather it is a process requiring continuing refinement, improvement, and adaptation. Emergency response plans are living documents, they must grow and change as communities grow and change over time. The threats facing a community change and technology systems for detecting and responding to those threats also change and must be accounted for in the community's emergency preparedness plan. Preparedness plans should be tested regularly through drills and exercises engaging all major community stakeholders. If any corrective actions or needs are identified through the drills or exercises, those needs must be addressed immediately and updated in the preparedness plan.

Natural Hazards

A natural hazard is most easily defined as a threat of some naturally occurring event (e.g. earthquake, tsunami, etc.) that may cause damage to the environment and/or individuals during and/or after the event (Perry & Lindell, 2003). A natural hazard is not the same as a natural disaster, though many use the terms interchangeably. Wisner et al (2004) explain that a natural hazard can only develop into a natural disaster when an event exceeds and overwhelms the affected community or population and supporting emergency services. This in turn leaves the social system unable to function or recover without external assistance (Wisner, 2004).

Natural disasters have substantially increased over the last several decades, causing significant losses of life and property. Much of this increase may be attributed to increasing

populations, changes in land usage, urbanization, and possibly global warming. During the course of the last decade, close to one million people world-wide have been killed and nearly 2.6 billion people affected by a natural disaster (United Nations International Strategy for Disaster Reduction, 2005). The most common disasters are severe storms, droughts, floods, and earthquakes. While other disasters, like tsunamis, are less common, they have the potential to cause significant damage, death, and injury to communities and individuals.

Natural Hazards Research

Research on the social implications of large-scale disasters (man-made or natural) was not seriously undertaken until the United States Army began investigating bombing effectiveness during World War II (Smith, 1977). Building on these initial studies and a fear of nuclear attack, in the 1950s the US government funded the construction of an early-warning system that was largely based on social science research (Fritz & Marks, 1954; Fritz & Mathewson, 1957; Moore, Bates, Layman, & Parenton, 1963; O'Brien & Mileti, 2003). As fear of nuclear war receded, the modern subfield of disaster social science research began to shift focus to natural disasters like earthquake, tornadoes, hurricanes, floods, mud slides, fires, etc. (Fritz & Marks, 1954; Fritz & Mathewson, 1957; Moore et al., 1963). The researchers studying these disasters used social science research methods to identify and understand the social dynamics before, during, and after a disaster. As research methods and theories have continued to develop so too has the depth and scope of natural hazards behavioral research.

Early Warning Systems. The creation of early warning systems is considered a hazard mitigation action against the effects of natural hazards. Hazard mitigation occurs when the risk posed by natural hazards is reduced through the institution and implementation of projects or procedures that reduce or prevent future damages (Wisner, 2004). Warning systems are

instituted to detect approaching and imminent disaster and provide information to individuals at risk, thus enabling those who are in danger to make appropriate decisions and take action (Mileti & Peek, 2000; Sorensen, 2000). While this definition may make warning systems sound simple, they are complex. Even small warning systems require the coordination and linking of multiple fields – science, technology, engineering, government, the media, and the public (Mileti & Peek, 2000; Sorensen, 2000; Wisner, 2004). There are three basic components, or subsystems, to any early warning system: emergency management, detection, and public response. The most successful early warning systems integrate all of these elements through the melding of scientific and technology monitoring and detection with an emergency management organization that can then disseminate an alert and notification message to the public (Mileti & Peek, 2000; Sorensen, 2000; Wisner, 2004).

Good communication, leading to good warning systems, does not rely on hardware and technology alone. Rather, an equal focus is placed on the linkages between people in the system and standard operating procedures for who will produce and share messages. Another good predictor of the warning system is the successful implementation of exercises. Early warning systems and the communication structure through which the emergency warnings are delivered to a community also play a significant role in how individuals define and perceive their individual risk (Mileti & Peek, 2000). Natural hazards and risk communication have been the focus of much previous research, with the development of both process and theoretical models to help improve risk warnings and communications.

Tsunami Early Warning Systems. An effective tsunami early warning system must include not only the scientific technologies that may accurately forecast or detect a tsunami but must also include a strong public notification system that allows the population at risk to receive

warning notification in a timely manner. The main function of a tsunami early warning system is to provide enough time for the population at risk to evacuate from a hazardous zone. Therefore, in addition to scientific technology and a communications system, a well-functioning tsunami early warning system relies on local tsunami disaster education and training. This requires collaboration between scientists, government, and local communities to ensure that those communities at risk are prepared and capable to respond appropriately should a tsunami occur.

There are several elements that comprise the "scientific technologies" described above. The technological elements within a tsunami warning system include: a seismographic network to monitor earthquake activity, a Deep-ocean Assessment and Reporting of Tsunami (DART) buoy and tide gauge network, computer modeling and analysis, all reporting to and working through a designated warning center (Jin & Lin, 2011). Working in the designated warning center are on-site scientists who interpret the data collected via those instruments described. It is the function of these scientists to determine if a tsunami has been generated and issue a warning to the country or countries that may be affected. It is common practice for a center to issue an assessment of any tsunami potential quickly after a significant earthquake and update that assessment as more information becomes available (Jin & Lin, 2011).

Short-term Response to Warnings. Some of the earlier natural hazards research focused on hazard warnings to the public and risk communication theory regarding how the public responds to those warnings (Mileti & O'Brien, 1992, 1993; Quarantelli, 1990). Mileti et al. (1992, 1993) describe the process, or stages, that individuals will most typically go through as they hear and internalize a warning of risk. Modeled as a sequence, the process includes these six stages: hearing – confirming – understanding – believing – personalizing – responding. To elaborate, the process begins with an individual hearing (or seeing) risk information that is being

communicated. People will then seek information to corroborate or confirm the warning message, either through conversations with other individuals or through seeking information from another source. Once the warning has been confirmed, a person will then develop an understanding of the risk. Next, a person will begin to believe and personalize the warning information, allowing that individual to begin forming a behavior or response action to take.

While this sequence is described in a linear fashion, Mileti et al. (1992, 1993) describe how the sequencing may vary between individuals. Personal characteristics can affect how one hears and comprehends risk communications, and the various stages of the sequence may also be directly affected by an individual's age, gender, level of education, etc. Additionally, individuals may skip some stages or move back into previous stages depending on the results of their processing (i.e. an individual has confirmed a warning, but is unable to move into understanding without additional confirmation and explanation of the risk).

After reviewing the research examining personal characteristics of people receiving warnings, Mileti et al. (1992, 1993) synthesized the most salient characteristics into a theory of public perception and response to risk information as shown below in Figure 2.

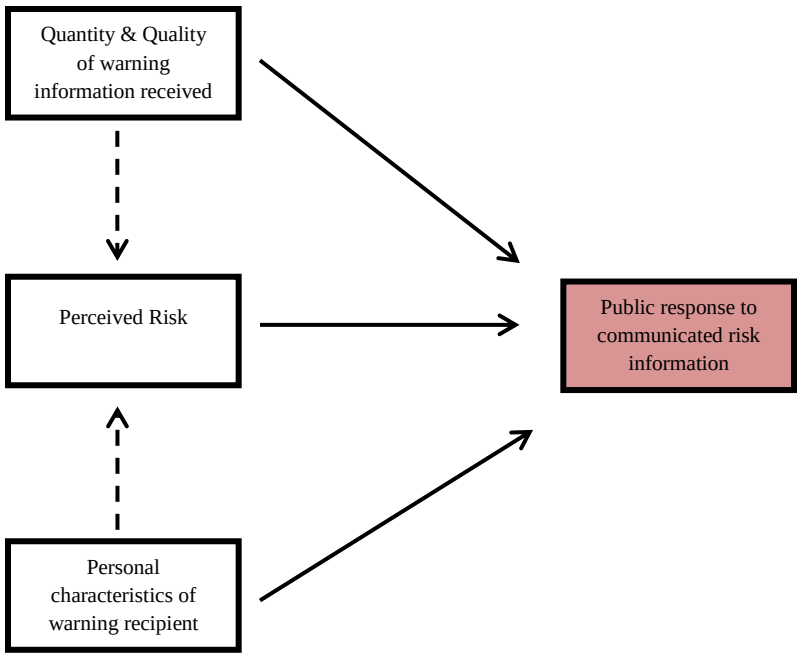


Figure 2. Theory of Public Perception and Response to Risk Information. Figure created by author based on Mileti & O'Brien's (1992, 1993).

According to this model a response to communicated risk information is directly affected by three factors, 1) the quality and quantity of warning information received, 2) the personal characteristics of the individual receiving the warning message, and 3) the individual's perceived risk. Of note, an individual's perceived risk is indirectly affected by both the warning message itself and personal characteristics. It is important for emergency managers and planners to understand this flow of information driving a response decision when preparing warning messages.

Lindell and Perry (1992, 2004, 2012) have contributed to this field with the development of the Protective Action Decision Model (PADM). This model, shown below in Figure 3, provides a framework for understanding how many different factors influence and inform an

individual's warning response and protective action decision making. This particular theoretical framework has been used to examine several different hazard and disaster situations including: flood, hurricane, toxic chemical release, environmental hazards and disasters, hurricane evacuation decision making, and hurricane re-entry decision making (Huang, Lindell, Prater, Wu, & Siebeneck, 2012; Lindell & Hwang, 2008; Siebeneck, Lindell, Prater, Wu, & Huang, 2013).

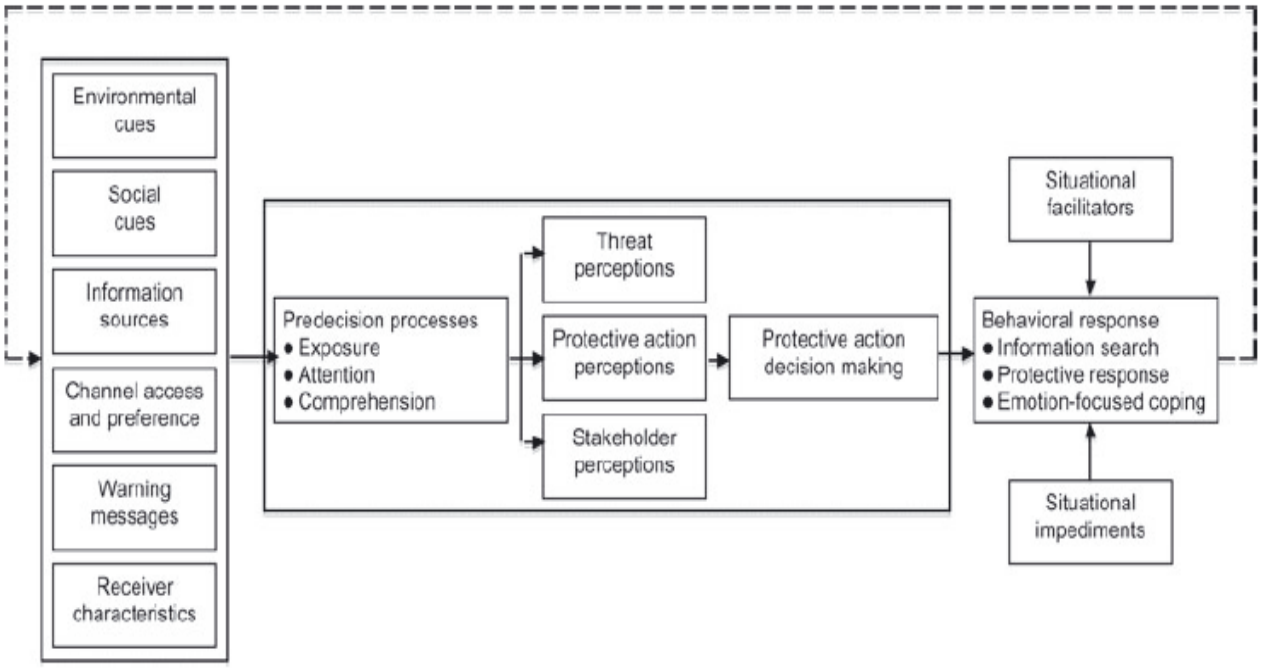


Figure 3. The Protective Action Decision Model (Lindell & Perry, 2012).

Lindell and Perry (2012) describe how the PADM is broken down into stages that characterize the process "typical" individuals will go through as they make the decision to adopt an action or behavior that will protect them against an environmental hazard. While this model is staged, the authors note that not everyone will go through all of the stages, or conversely, they

may cycle back and forth through different stages multiple times before making a final decision. Some individuals may even jump straight to making a protective action. The decision-making process is initiated by the interaction of a set of precursor variables: social and environmental cues, informational sources, channel access and preference, warning messages, and receiver characteristics. These precursor variables in turn begin to elicit three core perceptions: environmental threat perceptions about whether the hazard will cause them harm or injury or damage property; protective action perceptions regarding potential actions to increase safety (e.g. evacuation), and stakeholder perceptions regarding the media or authorities and the degree of influence they hold over an individual's protective behavior. These three perceptions together form the basis for an individual's decision making about how to respond to an imminent threat.

Thus, Lindell and Perry (1992, 2004, 2012) have highlighted the flow of an individual's behavioral response that is initiated through the perception of an environmental threat. The PADM model can help guide the emergency planning process by accounting for and providing training or education regarding appropriate behavioral responses and actions. Additionally, emergency managers should take into account the precursor variables and predecisional processes as warning messages are crafted and disseminated to the public.

Long-term Preparedness. Paton (2003) wanted to better understand why levels of disaster preparedness remain low when considerable effort and resources have been spent on public hazard education. Through expanding and building on previous natural hazards research and including health behavior research and theory, he created a social cognitive model of disaster preparedness. Paton's model explains the process through which a person reaches the decision to prepare for a hazard as seen below in Figure 4. The model begins with precursor variables by identifying the motivators that encourage people to prepare including: a critical awareness of the

hazard, personal perception of the hazard, and hazard-related anxiety. The next phase of the model moves into intention formation and those constructs that help facilitate creation of an intention. This phase allows that once individuals are motivated to think about a hazard, they will begin to make judgments about personal actions that can be taken to mitigate the effects of the hazard. These judgments, combined with the motivators, help lead an individual to developing an intention. Finally, there are several variables Paton identifies that may influence, or moderate, a person's ultimate intentions to engage in preparedness activities including: perceived responsibility, timing of the hazard activity, sense of community, and response efficacy. These variables may be used to explain why some people, despite having favorable preparedness intentions, fail to act. For example, if a person has developed the intention to prepare for a hazard, the link to preparedness may be broken because that person lacks the resources necessary to make the action (low response efficacy).

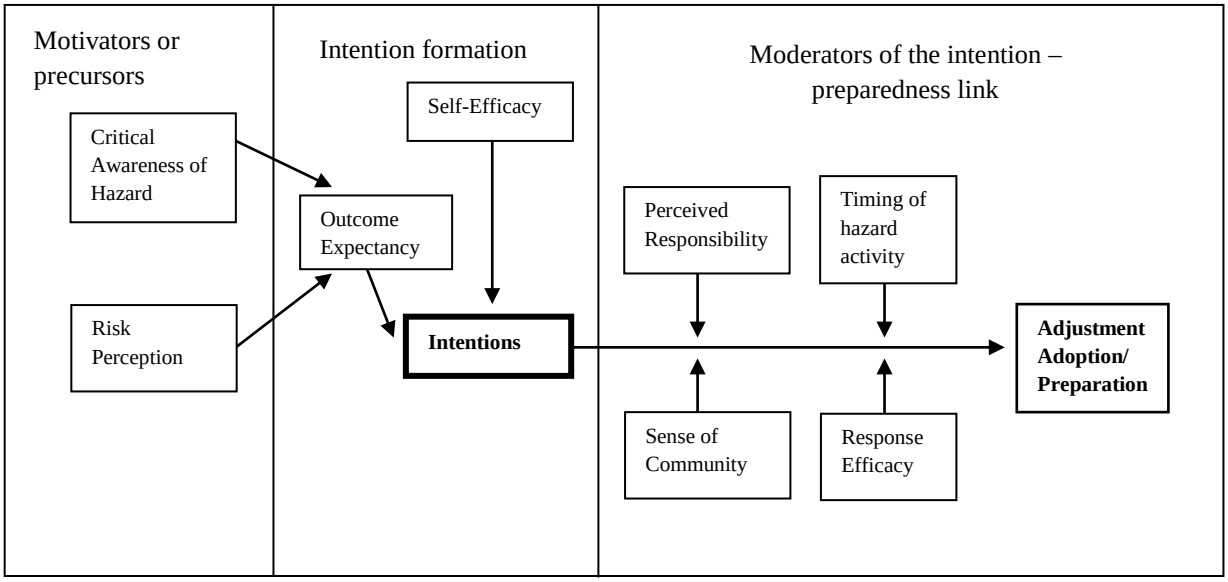


Figure 4. An Adapted Social-Cognitive Preparation Model (Johnston et al., 2005; Patton, 2003).

Paton's (2003) original model has since been successfully adapted to examine how people interpret their environment, understand and assign meaning to a hazard (volcano hazard, earthquake and flood hazard, heat-waves, household disaster preparedness, and tsunami hazard), and ultimately make a decision regarding preparedness actions (Becker, Paton, Johnston, & Ronan, 2012; McIvor, Paton, & Johnston, 2009; Mishra, Suar, & Paton, 2009; Paton, Frandsen, & Johnston, 2010; Paton et al., 2008; Paton et al., 2009). This model may also be applied to interventions and preparedness education programs. Paton's model implies that the intervention or education program should follow the same progression shown here: motivate people to prepare (precursor variables), assist with and facilitate the formation of intentions (intention formation variables), and then help individuals convert intentions into actions (moderator variables).

Community Emergency Preparedness

There are three critical components of community emergency preparedness for natural disasters: planning, training, and writing plans (Perry & Lindell, 2003). Defining a community as "prepared" for the event of a disaster implies a state of readiness to respond to environmental threats or natural hazards. To create this state of preparedness, a community must undergo a process of examination, assessment, and planning. First, a community must conduct a vulnerability analysis by assessing its susceptibility to a wide-range of environmental or natural hazards. It is only through examination of vulnerability that emergency planners can fully understand both the factors that will increase the vulnerability of a community as opposed to those factors that will increase the resilience (building adaptive capacity) of that same community (Paton, 2005). Second, community assets and resources (human, environmental, and material) available to manage these threats must be identified. And finally, the community must

delineate and define those organizations and local infrastructures through which a coordinated response will be made (O'Brien & Mileti, 2003; Perry & Lindell, 2003). It is important to note that vulnerability, assets, resources, and organizations all change over time. Without practice, performance skills and knowledge will decrease. Because of both of these factors, planning and training must become a continual process in order to maintain and sustain community emergency preparedness (Sinclair, Doyle, Johnston, & Paton, 2012). Without continual reassessment and standard updating of a community plan, the emergency preparedness and planning exercises will quickly become outdated and outmoded.

Emergency planning for natural hazards is driven by hazard assessment and risk reduction serving as the primary objectives for the community of interest (Perry & Lindell, 2003). As a community begins to identify potential threats and hazards, it is important for emergency planners to not only identify those threats previously experienced by the community. Rather, planners should incorporate new knowledge and technology that will help identify new or potential threats and hazards in addition to those hazards and threats known to have historically caused damage. Once the potential and probable hazards have been identified, planners should begin an assessment of the associated risks (Perry & Lindell, 2003). This process of identifying and assessing potential hazards and risks will require the collaboration and input of all the major community stakeholders. This will include inter-governmental partnerships among local jurisdictions and higher governmental authorities who may provide technical assistance and resources (O'Brien & Mileti, 2003; Perry & Lindell, 2003). This collaborative and iterative planning process is not only preparing a plan of action during an emergency, it is building relationships and capacity within a community that helps to strengthen that community's overall resiliency (Paton, 2005; Sinclair et al., 2012). Resiliency is the ability

of a person, community, or a society to absorb the impacts of a disaster and readily return to a predisaster state (Paton, 2005). In essence, the aim of all emergency preparedness activities is to adopt and foster a resilient community. This is especially true of community emergency preparedness programs and activities (like those described in the following sections).

Risk reduction requires communities to examine the required actions that will decrease the expected or projected levels of danger associated with each identified hazard or threat (Perry & Lindell, 2003). Risk reduction will also require planners to identify those resources that will be required for implementing the required actions. It is often the case that the resources available are rarely equal to, or greater, than the hazard. This inequality of available versus needed resources requires that all stakeholders examine the costs of mitigation and response. The resulting negotiation of resources versus required actions for a given risk among community planners defines the point at which the risk is considered to be acceptable for a community (Perry & Lindell, 2003). Ultimately, the processes of hazard identification and assessment are processes through which community's measure, monitor, and evaluate environmental hazards. Risk reduction encompasses the development and implementation of mitigation, preparedness, response, and recovery activities (O'Brien & Mileti, 2003).

Organizational-based Programs.

StormReady® Community Program. The NWS recognizes that severe weather affects the entire nation, with drastic numbers of events devastating communities each year. Both meteorologists and emergency managers across the country recognized there were inefficiencies and gaps in preparing both individual citizens and communities to respond to severe weather and the disasters severe weather may cause. The NWS StormReady® Community program was born out of conversation between two meteorologists contemplating the potential of a severe weather

certification or recognition program for communities (Rothfusz, 2013). Together with other emergency managers, NWS staff and other meteorologists, a program was conceptualized that provided a platform for communities to become more engaged and accountable for their severe weather preparedness. The newly created recognition program provided a set of guidelines for communities (towns, counties, etc.) that were interested in increasing and improving emergency preparedness capacity and engagement. These guidelines help lead communities through the emergency preparedness planning process, resulting in a final actionable community plan that responds to the threat of all types of severe weather (Rothfusz, 2013). The StormReady® Community program provides direct advice to city leaders, emergency managers, and the local media that will improve local hazardous weather operations.

To be officially recognized as StormReady®, interested communities must fulfill all of the requirements outlined in the program guidelines. This includes: 1) establishing or identifying a 24-hour warning point and emergency operations center, 2) demonstrating multiple methods of receiving severe weather forecasts and warnings, 3) demonstrating more than one method for alerting the public of weather forecasts and warnings, 4) facilitating community readiness through seminars and education, and 5) the development of a formal hazardous weather plan that includes training for severe weather spotters and mandatory plan testing exercises (Franklin, 2013). Once those actions are complete, each community is assessed by NWS and pronounced StormReady®. In 1999 Tulsa, OK was recognized as the first ever StormReady® community. Since then, over 2,000 more communities have successfully completed the guidelines to become officially recognized as StormReady®. As of September 2013 there are 2,117 StormReady® communities located throughout the United States (Franklin, 2013).

TsunamiReady™ Community Program. The NWS, meteorologists, and emergency managers were excited by the ready adoption by communities of the StormReady® Community program. Hoping to translate the success of the StormReady® Community program into a preparedness program specific to tsunami hazards, the NTHMP partnered with the NWS in early 2000 to craft the TR Community program (Bernard, 2001, 2005; National Tsunami Hazard Mitigation Program, 2000). The Director of the NWS Alaska Region, Richard Przywarty, initiated the process of converting the StormReady® Community program guidelines into an operational set of guidelines for tsunami preparedness (National Tsunami Hazard Mitigation Program, 2000). These original TR Community Program guidelines may be found in Appendix A.

To be designated as "Tsunami Ready™," communities would need to meet a minimum standard level of tsunami education, awareness, and preparation activities. The primary objectives of the program were defined as 1) promoting an active partnership between emergency management and the community of interest and 2) providing tsunami awareness education throughout the community (National Tsunami Hazard Mitigation Program, 2000). The TR Community program achieved formalization and establishment as a federal program in 2001with recognition of the program's first official communities, Ocean Shores and Grays Harbor County, Washington (C. Maier, personal communication, July 24, 2013). It was expected that the TR Community program would garner enthusiasm and community participation with the same speed as the StormReady® Community program, particularly in counties and communities along the Pacific coast in the western United States. Unfortunately, the dissemination successes between the two programs have been drastically different. In the 12 years the TR Community program has been operating, 132 total communities have gained

official recognition (C. Maier, personal communication, July 24, 2013), while the StormReady® Community program has collected 2,117 total communities with official recognition (Franklin, 2013). The slow and unsteady growth of communities participating in the TR Community program may be seen below in Figure 5.

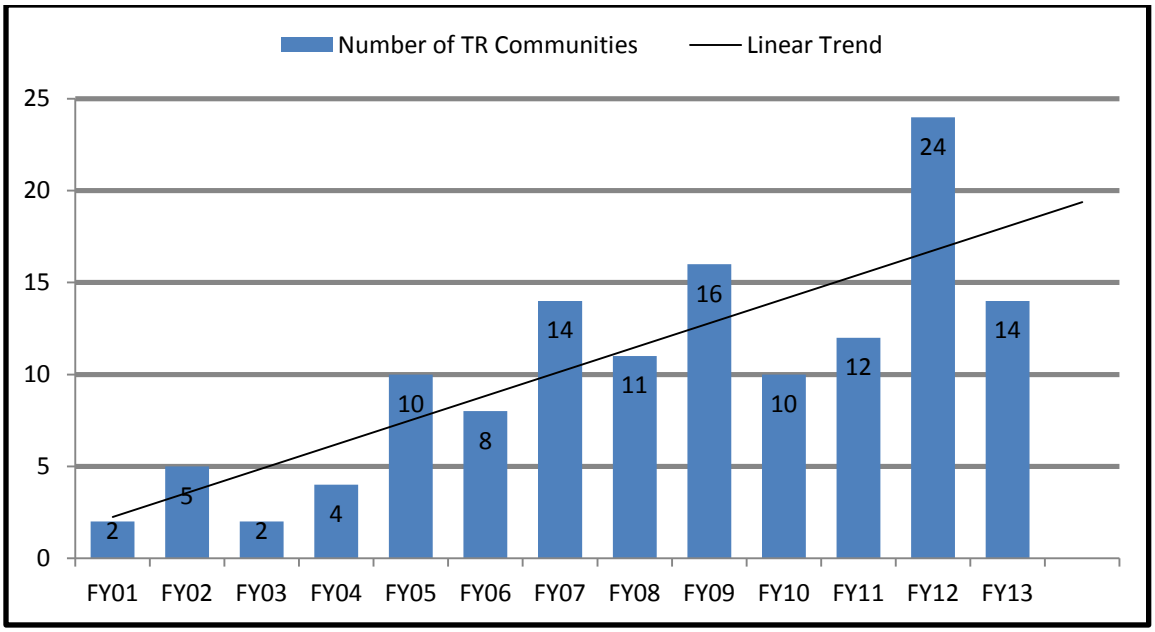


Figure 5. Number of Communities Achieving TR (TR) Recognition by Fiscal Year Budget (FY) (C. Maier, personal communication, July 24, 2013)

Community-based Programs.

Community Emergency Response Team. The Community Emergency Response Team (CERT) model was piloted by the Los Angeles City Fire Department in California (Federal Emergency Management Agency, 2012). The pilot program trained 30 leaders in a local neighborhood watch organization. These new CERT members were trained to perform basic fire suppression, light search and rescue, and first aid. After successfully completing the training program, the CERT team was tested through drills, exercises, and demonstrations. California

paved the way, demonstrating that training civilians to respond to their community's immediate needs after a major disaster not only quickened response and recovery after a disaster but also improved citizens understanding their personal role in preparing for a disaster. CERT training not only increased the volunteer's ability to safely help themselves but also to help their friends and neighbors. In 1993 FEMA picked up and expanded the CERT program to make it available to communities throughout the nation (Federal Emergency Management Agency, 2012).

Medical Reserve Corps. The devastating events of September 11, 2001, prompted spontaneous volunteers from across the country to stream into New York and attempt to provide aid and services for those individuals most affected by the destruction of the World Trade Center. Many of these spontaneous volunteers were medical and public health professionals, who wanted to provide technical services for the medical and response infrastructures that were being strained by the disaster. While most of these volunteers' intentions were good, their presence and engagement in medical and public health services posed problems for local emergency management because the volunteers were unaffiliated. Because of their unaffiliated status, spontaneous volunteers were unable to provide necessary documentation of technical or specialty credentialing and proof of liability coverage (Division of the Civilian Volunteer Medical Reserve Corps, 2013). The Medical Reserve Corps (MRC) was created as a network of local community-based units that are housed within a local health or emergency management agency. Each unit consists of both medical and nonmedical volunteers who work on local health initiatives and also provide supplemental support for local emergency responses. The MRC units provide the structure necessary to preidentify, credential, train, and activate medical and public health volunteers (Division of the Civilian Volunteer Medical Reserve Corps, 2013). The MRC

structure also allows these prequalified volunteers to be deployed and managed locally, regionally, and nationally.

Disaster Action Team. The American Red Cross trains community members in multiple facets of emergency preparedness and response. Volunteers with the Red Cross provide immediate response to close to 700,000 natural and man-made disasters throughout the US over the course of 1 year (American Red Cross, 2013). After receiving specific training, volunteers are coordinated into response teams for small and large-scale disasters ranging from fires to floods, tornadoes, hurricanes, earthquakes, transportation accidents, hazardous materials spills and explosions. As part of the Red Cross volunteer management system, many Red Cross chapters support a Disaster Action Team (DAT) that is composed of volunteers trained to provide local disaster response (American Red Cross, 2013). Each DAT team is tasked with working directly with the victims of a disaster and meeting their immediate emergency needs as quickly and fully as possible. Regardless of what caused the disaster, Red Cross will provide sheltering services, food preparation and delivery, and health services that address basic human needs. These services allow the victims of an event to resume their normal daily activities as quickly as possible. Also of note, the Red Cross includes emergency workers in its service provision plan. All emergency workers providing emergency response during a disaster are provided with food, sheltering services, health and medical services if needed, emergency worker family inquiries from outside the disaster area, and access to other needed and available resources (American Red Cross, 2013).

Tsunamis

The Mechanics

Originating from the Japanese word "tsu-nami," the original definition of a tsunami described a "big wave in a harbor." Between 90% - 95% of all tsunamis are generated by large-scale earthquakes (typically magnitude 7.5 or higher) occurring along a subduction zone (where one tectonic plate is being pushed or pulled under another plate) (Keim, 2006). Less frequently, the generation of a tsunami can be the result of landslides or volcanic eruptions (Keim, 2006; Wu, 1981).

Tsunami are most often created by the rapid shifting of large portions of the ocean floor (from hundreds to thousands of square kilometers) and the subsequent displacement of seawater during large submarine earthquakes (Wu, 1981). This displacement of seawater produces a wave that can travel at speeds up to hundreds of kilometers in the open ocean. These speeds allow the tsunami wave to reach distant shores in relatively short timeframes. Tsunamis are also known to have long wavelengths, with up to hundreds of kilometers between wave crests (Wu, 1981). This creates wave periods varying from just minutes to over 1 hour to reach those coastlines closest to the tsunami source. As the tsunami approaches the shore, the wave slows allowing the wave height to increase as the water piles up (Wu, 1981). Because of their speed and ability to travel inland, tsunamis have a significant capacity to destroy coastal infrastructure and buildings and erode the landscape. While tsunamis are relatively infrequent events, this wide-spread destructive ability makes tsunamis a significant natural hazard in terms of morbidity, mortality, and economic loss for coastal communities.

As a Natural Hazard

Between 1980 and 2008, 18 tsunamis have occurred worldwide (EMDAT, 2008). Over the course of these 18 years, 229,551 people were killed and another 2,481,879 individuals were recorded as being directly affected by one of those 18 tsunamis (EMDAT, 2008). Tsunamis directly affect coastal areas, placing those communities situated near a shoreline at-risk for a tsunami hazard. Prior to 2006 the NWS and NOAA prioritized US communities located along the Pacific coast, Hawaii, Puerto Rico, American Samoa, and the US Virgin Islands as having the highest risk for a tsunami. After the passing of the TWEA legislation in December 2006, the hazard was expanded to include all US coastal regions (specifically including the Atlantic coast, the Gulf of Mexico, and the Caribbean Sea region) ("Tsunami Warning and Education Act," 2005).

Coastal communities at risk of tsunami have the potential of experiencing one of three categories of tsunamis. These three categorizations of tsunamis are based on the time distance between the generation event (e.g. earthquake, landslide, etc.) of a tsunami and the community at risk, defined as a local, regional, or a distant tsunami. A local (also called near-field) tsunami threat occurs when the first wave arrives within 30 minutes of a generation event (e.g. earthquake). A regional (also called mid-field) tsunami threat occurs when the first wave arrives between 30 minutes and 2 hours after a generation event. A distant (also called far-field) tsunami threat occurs when the first wave arrives several hours after a generation event (National Tsunami Hazard Mitigation Program, 2013). Regional and distant tsunamis usually generally allow advance warning in at-risk communities. The most common advice provided in a tsunami warning message is directing individuals to evacuate the area expected to be inundated by the tsunami and move to areas of naturally occurring high ground.

According to the Intergovernmental Oceanographic Commissions (2012), almost 90% of the 600,000 tsunami-related deaths that have ever been recorded worldwide are attributable to local tsunamis. The greater risk posed to human life by local as compared to distant tsunamis is attributed to the close proximity of the tsunami-generating event (i.e. earthquake) and the short warning and response time available between the earthquake and the arrival of the tsunami wave (National Academy of Sciences, 2011). Additionally, due to such close proximity of the earthquake generating a tsunami, communities will also have a delay in their ability to begin evacuating to safety because of the earthquake. Complicating the evacuation process even more is the likelihood of infrastructure that is needed for community evacuation (roadways and bridges) being destroyed or damaged by the earthquake. Communities at risk of local tsunamis may only have a matter of minutes to respond and evacuate a coastal area without ever receiving an official warning. There are several communities in the United States at risk for one of these local tsunamis. Facing the risk of a local earthquake generating a local tsunami are the states along the US Pacific coast including Washington, Oregon, and California; Alaska; the US Virgin Islands; Puerto Rico, and the US Pacific territories of Guam, American Samoa, and the Northern Marianas (Dunbar & Weaver, 2008).

As the operating entity of the NOAA Tsunami Program, it is vital for the NWS to identify clear and translatable methods for educating US communities at risk of both local and distant tsunamis about both the risk they face and the available methods to mitigate a future tsunami. The TR Community program was identified as a program to link communities with local emergency management to strengthen a community's tsunami emergency preparedness ownership. With required planning, mitigation, response, and community education elements, the TR Community program has great potential to reduce the potential damage, morbidity, and

mortality of a tsunami by increasing the preparedness and resiliency of the most at-risk communities in the US. It is incumbent upon both the NWS and NOAA to ensure that the TR Community program guidelines and materials are current, relevant, and efficacious.

As a Public Health Concern

Immediately following a tsunami, the earliest priority of any public health response is to provide immediate provisions for survivors including: adequate potable water, sanitation, clothing, food and nutrition, shelter, and medical care for injuries (Guha-Sapir & van Panhuis, 2009; Guha-Sapir, van Panhuis, & Lagoutte, 2007; Hayashi & Tomita, 2012; Ivers & Ryan, 2006; Keim, 2006, 2011; Kouadio, Aljunid, Kamigaki, Hammad, & Oshitani, 2012; Llewellyn, 2006; Wada et al., 2012) For most tsunamis the majority of deaths occur immediately from drowning or complications causing drowning (e.g. blunt force trauma or penetrating injury that immobilizes or disables an individual). Several studies have been conducted to assess the most common injuries following a tsunami, bone fractures; near-drowning, immersion, and aspiration induced respiratory infections; and soft tissue injuries (Guha-Sapir & van Panhuis, 2009; Ivers & Ryan, 2006; Keim, 2006, 2011; Kouadio et al., 2012).

It is important to remember that a tsunami is composed not only of seawater, rather it includes a significant amount of debris, sand, mud, and other foreign materials collected by the swiftly moving seawater. Those individuals who are caught by the wave and survive are therefore exposed to injury from both the wave and the debris carried in the wave. There are reported cases of severe sinus and/or lung infection where massive amounts of debris, sand, mud, and foreign matter was removed from survivors (Guha-Sapir & van Panhuis, 2009; Guha-Sapir, et al., 2007; Ivers & Ryan, 2006; Keim, 2006, 2011; Kouadio et al., 2012). Additionally, complicating these lung and sinus infections are often unusual pathogens demonstrating high

antibiotic resistance. Similarly, open wounds caused during the tsunami are also typically contaminated with debris, soil, and foreign matter. Severe wound infections following a tsunami, and other natural disasters, are very common. It has been noted in the research following the recent tsunamis in both Indonesia and Japan that tetanus was a major public health problem among survivors with infected wounds (Ivers & Ryan, 2006; Kouadio et al., 2012).

Psychological disturbances are also commonly observed immediately following natural disasters (Akiba, 2011; Hayashi & Tomita, 2012). Due to the high mortality combined with missing persons during both the Indian Ocean and the Tohoku tsunamis, survivors were recorded as demonstrating immediate psychological symptoms. In most cases this immediate reaction, called an acute stress disorder, will resolve and disappear once the individual's immediate health and safety are stabilized. As survivors from each of these tsunamis continue to recover and rebuild, it has been noted that many of the initial diagnosis's of acute stress disorder are being converted to posttraumatic stress disorder to reflect continued psychological and mental health needs owing to the trauma of the tsunami (Hayashi & Tomita, 2012). Behavioral and mental health effects have proven to be some of the most long-term and debilitating health outcomes after a tsunami.

Following a tsunami, the immediate medical needs of the survivors have been shown to overwhelm local medical and health systems. As the local health system and infrastructure is overwhelmed, the disaster also causes disruption of routine local public health services that may lead to secondary adverse health effects developing among the disaster-affected population (Ivers & Ryan, 2006; Keim, 2006; Kouadio et al., 2012). Particularly in less developed countries, the disruption of public health services may produce severe repercussions among the surviving population. An overwhelmed health system may disrupt surveillance and health

provision services like immunization and tuberculosis (TB) care (Kouadio et al., 2012). Disruption of immunization campaigns and services may result in increasing numbers of vaccine-preventable illnesses (i.e. measles, meningitis, and influenza) following a tsunami. Disruption of TB treatment services may increase the prevalence rates of TB with an added danger of some patients developing resistant strains (Ivers & Ryan, 2006).

Looking beyond the medical and public health needs immediately following a tsunami, care must be taken to ensure that the health of the public is protected during the protracted recovery and cleanup phase as well. Wada et al. (2012) studied the sludge brought onshore following the Great East Japan or Tohoku earthquake and tsunami to assess the presence of potentially harmful pathogens for workers. While Wada et al. found no presence of pathogens requiring governmental notification, several types of bacteria were identified that could cause infection in tsunami cleanup workers or individuals attempting to return to their homes. Frequent hand washing, particularly among immunocompromised individuals, and avoidance of unprotected close contact with the sludge were recommended to prevent infections among cleanup workers and the returning population.

TsunamiReady™ Community Program

The Program

Modeled after the NWS StormReady® Community program, the TR Community program guidelines provide a guide for community emergency planners on how to apply the emergency preparedness planning process of hazard assessment and risk reduction specifically for tsunamis, to an individual community. There are five identified program objectives for the TR Community program: 1) provide a set of guidelines that identify a minimum standard for adequate tsunami readiness at a community level, 2) increase and expand the public's awareness

and understanding of the tsunami hazard, 3) encourage consistency across tsunami educational materials and response throughout the US and US territories, 4) improve community preparedness planning for tsunami disasters, and 5) create a formal recognition program for communities that have successfully adopted and implemented TR guidelines (Horan et al., 2010; Jonientz-Trisler et al., 2005). Communities working towards earning and maintaining TR recognition receive support and assistance through local NWS offices and weather forecast officers (Dengler, 2005).

TsunamiReady™ Community Program Guidelines Evaluation Process

The evaluation of key components of the TR Community program guidelines is one piece of a larger grant titled 'Incorporating Social Science into NOAA's Tsunami Program.' The purpose of this larger, grant-funded research is to provide program recommendations to improve specific components of NOAA's Tsunami Program (including the TR Community program specifically) through the use of social science methods. The social science methods proposed in this larger grant include community-based research eliciting feedback from end-users of the Tsunami Program. The current research focuses on assessing the acceptability and usefulness of key components within a revised set of draft national guidelines for the TR Community program. This is the second stage in an evaluation process and will include research methodology from Public Health; Psychology; Political, Social and Physical Sciences and Evaluation with an aim to revise and refine the program guidelines in an effort to help better prepare communities to reduce their risk to tsunamis.

The original TR Community program guidelines were implemented in 2001 with the recognition of the first two TR communities. As the program moved forward, the NWS recognized that the guidelines would need to adapt and change as the program evolved. Over the

course of several years, the NWS collaborated with the NTHMP to create a revised and modified set of guidelines. These guidelines were presented to the original East Tennessee State University-led research team for inclusion in the 'Incorporating Social Science into NOAA's Tsunami Program' research project. The original research team reviewed the guidelines and conducted a first round of community-based focus group discussions to assess community perceptions and opinions of the proposed revisions. To do this, the revised guidelines were taken to eight expert panels (from eight preselected community sites including: Alaska, Washington, Oregon, California, Hawaii, American Samoa, North Carolina, and the US Virgin Islands) for evaluation through focus groups. The data from each of the eight community sites were analyzed individually and then included in a composite analysis. The composite analysis was used to provide a set of recommendations for the NWS to consider as revisions for the guidelines.

The original research team shared their findings with the NWS and NOAA by providing draft research reports (Gregg, Johnson, & Johnston, 2012a, 2012b; Gregg, Wood, Johnson, & Johnston, 2012, 2013). The reporting and revision process were iterative through the following process: original report was created and submitted to the NWS Tsunami Program Director in January 2012, with revisions made in June, August, and October 2012 and January 2013. The June (dated June 8, 2012) progress report contained a revised set of TR Community program guidelines developed by the original research team. The revised guidelines then underwent an iterative revision process by the NWS and the research team. The revision process also included presentation of the suggested guidelines and telecom calls with the NTHMP and its Mitigation and Education Subcommittee, Executive Committee (NTHMP MES-EC) (e.g., Revised by the research team August 24, 2012; presented to NTHMP MES-EC: August 27, 2012; Revised by

NWS Tsunami Program: September 20, 2012; Presented to NTHMP-MES-EC: October-November, 2012); and revised by the research team a final time on January 28, 2013. This version of the guidelines was presented at the annual meeting of the NTHMP in Portland, Oregon in January 2013. The TR Community program guidelines revised in January 2013 provided the current draft of the TR Community guidelines used in this dissertation research (Appendix B). This evaluation is focused on collecting and elaborating local community perceptions regarding key components that are being considered for inclusion in the proposed revised guidelines.

Proposed Draft TsunamiReady™ Community Program Guidelines

The proposed draft TR Community program guidelines currently distinguish required actions based upon community vulnerability to local versus distant tsunami hazard. With this newly proposed subdivision it may be assumed that all coastal communities have a distant tsunami threat and are thus expected to meet a base standard set of required actions to receive recognition. For those communities that are exposed to both a distant and a local tsunami threat, they must complete additional protective actions to gain recognition. This distinction between the base standard set of required actions and those additional actions required for communities identified as having a local tsunami hazard is identified throughout the guidelines document. This distinction can also be seen in a checklist that was prepared by the research team to facilitate the review of a community's completion of required actions for TR recognition (see Table 1 below).

Table 1:

Draft Checklist for Determining Completion of TsunamiReady™ Recognition

Community Name:			**Reviewer Name & Date:**	
Code	**Action Short Name**	**Applicability**	**Achieved**	**Reviewer Notes**
Mit-1	Tsunami-hazard zones have been mapped	All		
Mit-2	Tsunami hazard and vulnerability are addressed in FEMA-approved Local Multi-Hazard Mitigation Plan	All		
Mit-3	Designated tsunami hazard areas, evacuation routes, safe zones, and assembly areas	All		
Mit-4	Signage to identify tsunami hazard areas, evacuation routes, safe zones, and assembly areas	All		
Mit-5	Availability of natural high ground and inland locations has been identified for at-risk populations. Or, (see Mit-4)	local threats only		
Mit-6	A plan for vertical-evacuation strategies has been established (e.g., berms, structures)	local threats only		
Prep-1	Tsunami exercise at least every three years, such as a tabletop, functional or full-scale	All		
Prep-2	Initial Responder training that includes tsunami hazard, warning and evacuation protocols	All		
Prep-3	Evacuation maps of tsunami hazard areas, evacuation routes, safe zones, and assembly areas	All		
Prep-4	Written materials that include tsunami information, hazard maps, evacuation routes, safety tips, and response protocols	All		
Prep-5	Events (at least 1 per year) to educate all citizens on local tsunami hazards, evacuation routes, safety and response	All		
Prep-6	Annual presentations to schools in tsunami-hazard zones	All		
Prep-7	Participation in NOAA/NWS Tsunami Warning Center communication tests	All		
Prep-8	Tsunami evacuation exercise for schools in the inundation zone	local threats only		

Table 1: (Continued)

Prep-9	Annual training, outreach or education that targets owners and staff for high-occupancy businesses	local threats only		
Prep-10	Annual training, outreach or education that targets residents living or working in tsunami-hazard zones	local threats only		
Resp-1	Tsunami hazard addressed in Emergency Operations Plan	All		
Resp-2	Emergency Operations Center (EOC)	All		
Resp-3	Redundant and reliable means for Communication/Dispatch Center and/or EOC to receive official messages	All		
Resp-4	Redundant and reliable means for Communication/Dispatch Center and/or EOC to disseminate official messages	All		
Resp-5	Public Alert Certified* NOAA Weather Radio receivers in critical facilities and public venues	All		
Rec-1	Plan for continuity of operations plan and/or continuity of government	All		
Rec-2	Plan for management of debris	All		

Mit = mitigation, Prep = preparedness, Resp = response, Rec = Recovery

The Need for Additional Community Input. While most of the elements in the existing draft guidelines have been discussed between the original research team, NWS, and the NTHMP; community level input has not been collected. This dissertation research is a collection of information regarding community stakeholder perceptions and opinions of the acceptability and usefulness of each of the key elements listed in the draft guidelines. This will provide additional community-based support for either inclusion or exclusion of particular elements in the revised TR Community program guidelines.

Subdivision of Communities by Vulnerability. The current TR Community program guidelines, instituted in 2001, require that the actions a community must take to achieve TR recognition are based on the community's population size – that is, the larger a community's

population, the more it has to do. There are four categories of community population identified in the current NWS guidelines: 1) populations of less than 2,500, 2) populations between 2,500 and 14,999, 3) populations between 15,000 and 40,000, and 4) populations of more than 40,000 (Current NWS TR Community program guidelines). This subdivision aspect of the TR Community program guidelines was discussed during the initial 2011 NOAA TR focus group discussions. Community members from all research sites agreed that this subdivision was not useful or equitable for all at-risk communities. Rather, community members preferred the idea of subdividing guidelines and required actions by some aspect of community vulnerability to tsunamis.

As the original research team drafted the revised TR Community program guidelines, consideration was given to how community vulnerability to a tsunami hazard could be assessed. It was determined to subdivide the guidelines based upon vulnerability to a local versus only a distant tsunami. In the revised guidelines, all coastal communities are assumed to have a distant tsunami hazard and as such must complete a standard set of required actions to receive TR recognition. For those communities determined to also have risk of a local tsunami, additional actions would be required for those communities to receive TR recognition. As an example, communities in the US Pacific Northwest would most likely need to fulfill the requirements for both distant and local tsunami hazards, while communities along the US East and Gulf Coast would likely have to fulfill the requirements for a distant tsunami hazard only.

As these definitions and subdivisions have not been previously used or shared widely with communities seeking or maintaining TR recognition, additional information regarding the acceptability and usefulness is needed from US communities. Because communities determined to reside in a higher-hazard zone would be required to complete additional mandatory

requirements before receiving TR recognition, it is important to gather community perceptions and opinions from both high-hazard (local tsunami hazard) and generally lower-hazard (distant tsunami hazard) community classifications. Gathering these data will help researchers understand perception and opinion differences between communities with varying tsunami hazard threats.

Proportion of Population to be Protected. While there is a dearth of literature currently available relating to quantifying the proportion of a population that should be protected through emergency preparedness and mitigation actions, the topic is highly relevant when discussing preparedness recognition programs like the TR Community program. Currently, completing inundation modeling is a mandatory action for communities seeking TR recognition. This mapping denotes only the area expected to be covered by flood water from a tsunami. While this mapping technique identifies those areas of a community most at risk to a tsunami, it does not quantify the number of individuals residing within the inundation area who must be provided protection through the planned mitigation and response efforts of the community. In fact, there are no specific regulations or guidelines for successfully providing timely warning to individuals residing in identified inundation zones.

Despite this lack of conceptual guidance, there are regulations for providing both communication and protective action in other disaster situations that may potentially be adapted to a tsunami. FEMA, in coordination with the Nuclear Regulatory Commission (NRC), has provided the NUREG-0654/FEMA-REP-1 guidance regulation for the development of radiological emergency plans, aiming to improve emergency preparedness and ensure the safety of populations living within a certain range of a nuclear plant (US Nuclear Regulatory Commission, 1986, 1996). Similar to inundation modeling for tsunami hazards, nuclear plants

are required to model "plume exposure pathways" depicting the potential flow of hazardous materials should a breach occur at a nuclear plant. These modeled pathways, referred to as emergency planning zones (EPZ), are used to quantify required timing of notifications and warnings to be provided to populations residing within the EPZ. The minimum community warning standards according to the NUREG-0654/FEMA-REP-1 are:

> a. *Capability for providing both an alert signal and an informational or instructional message to the population on an area wide basis throughout the 10 mile EPZ, within 15 minutes.*
>
> b. *The initial notification system will assure direct coverage of essential 100% of the population within 5 miles of the site.*
>
> c. *Special arrangements will be made to assure 100% coverage within 45 minutes of the population who may not have received notification within the entire plume exposure EPZ.*
>
> (US Nuclear Regulatory Commission, 1986, 1996)

In addition to these timing of notification regulations, the NUREG-0654/FEMA-REP-1 regulations also provide guidance for a siren alert system. "For rural areas (2000 people or less per square mile), the sirens must provide sound level coverage of a minimum of 60 decibels, or 10 decibels above ambient noise levels, whichever is higher" (US Nuclear Regulatory Commission, 1986, 1996). The sound level coverage required of nuclear plants is the same regardless of day or night status of activation. Used in conjunction with the sirens, are tone alert (TA) radios. By integrating two notification sources, nuclear plants are able to reach over 95% or essential 100% of the at-risk population (Sorensen, 1992).

While both a nuclear plant disaster and a tsunami could equally benefit from similar notification and warning communications systems, a warning system alone does not provide

protection to populations at-risk to a tsunami. Once individuals are warned, they need to identify or know of evacuation methods and strategies to move out of the inundation zone and to a safe location. If an at-risk community is also closely located to a subduction zone, it is reasonable to expect that the tsunami-generating earthquake would cause extensive damage and destruction to local infrastructure and buildings. The damage caused by the earthquake will most likely slow an individual's response; reducing the amount of time that individual will have to evacuate the inundation zone to safety. Roadways may also be rendered unusable due to damage or debris from the earthquake. This may force the majority of individuals in the inundation zone to evacuate on foot.

Emergency managers and planners must understand the potential need for individuals residing within the inundation zone to evacuate on foot and plan for safe evacuation routes and structures. Four communities in Pacific County, Washington that were involved in Project Safe Haven used standardized and published walking speeds (LaPlante & Kaeser, 2007) to determine how many people would reach a constructed vertical evacuation structure. Two walking-radius circles were created and overlaid at the community identified site to build the constructed vertical evacuation structure. One circle represented a radius of 3,600 feet with the constructed vertical evacuation point in the exact center. This is the distance an individual traveling at average walking speed might be expected to cover in 15 minutes (calculated at four feet per second, 3,600 feet in 15 minutes) (LaPlante & Kaeser, 2007; "Project Safe Haven," 2011). The second circle represented a radius of 2,700 feet with the constructed vertical evacuation point in the exact center. This is the distance an individual traveling at less than average walking speed might be expected to cover in 15 minutes (calculated at three feet per second, 2,700 feet in 15 minutes) (LaPlante & Kaeser, 2007; "Project Safe Haven," 2011). This method of calculating

individual transit time during an evacuation allows emergency managers and planners to identify the proportion of a population that could reach a safe location before the tsunami arrives. These calculations will also help communities identify the potential need for creating safe evacuation sites closer to certain areas of need within the community. Because these methods have not been tested, additional information regarding the acceptability and usefulness of these types of actions is needed from US communities facing a local tsunami hazard.

Vertical Evacuation. When a community with a local tsunami hazard lacks horizontal evacuation access to naturally occurring high or inland ground above or beyond the inundation zone, emergency planners and managers are challenged to find alternative evacuation recommendations ("Project Safe Haven," 2011). In several at-risk communities, researchers and emergency managers have been investigating alternative evacuation methods including the potential for creating a vertical evacuation strategy. A vertical evacuation strategy requires vertical evacuation structures. A vertical evacuation structure is an area of man-made high ground made by creating a berm (an appropriately reinforced earthen mound) or a building that allows individuals to evacuate above the level of tsunami inundation (Applied Technology Council, 2012). Designated vertical evacuation structures must be built to resist the forces of large-scale earthquakes and tsunamis. FEMA together with NOAA have produced the FEMA P-646 guidance document for communities interested in creating safe vertical evacuation structures within their communities (Applied Technology Council, 2012). The FEMA P-646 provides detailed background information on tsunami hazard and risk, rational for considering a vertical evacuation structure, the decision making and design process, and methods of construction. The FEMA P-646 provides construction and building guidance for vertical evacuation structures that is unavailable anywhere else, including building and fire codes.

Insight into the effectiveness of alternative tsunami evacuation strategies, specifically the use of vertical evacuation using existing buildings, may be gained by reviewing the 2011 Tohoku earthquake and tsunami. Fraser et al. (2012) conducted a reconnaissance-level analysis of evacuation preparedness and actions taken in response to the tsunami. While the data collection included tsunami awareness, official warning times and dynamics, evacuation timing, mechanics and other issues related to evacuation, it also included questions regarding observations and response to natural and informal warnings and vertical evacuation (Fraser et al., 2012). Fraser et al.'s study identified and visited 37 buildings used for vertical evacuation (some officially designated as vertical evacuation sites and some not) during the tsunami, which provide refuge to 5,428 people from the six cities included in the study. It is estimated that roughly 260 officially, and unofficially, recognized buildings were used during the tsunami; offering protection to around 50,000 individuals (Fraser et al., 2012).

While there were many lessons learned about local Japanese vertical evacuation during the Tohoku tsunami, some of the most notable lessons are valuable for other communities considering vertical evacuation as well, including: 1) the importance of inundation mapping providing a scientific basis for required building height for structures serving as vertical evacuation sites, 2) clear and accurate signage and community education about vertical evacuation sites, 3) clear memoranda of understanding (MOU) with building owners regarding necessary use of buildings as vertical evacuation sites, and 4) the consideration of night-time lighting to help indicate evacuation routes to and within vertical evacuation buildings (Fraser et al., 2012). Overall, the community engagement in identifying vertical evacuation structures, and the extensive community education surrounding the tsunami hazard and evacuation procedures provided a strong platform for community protective actions. This model of community

emergency preparedness was found to be successful as demonstrated by a 96% survival rate of those living within the inundated regions of the cities included in Fraser et al.'s (2012) study.

Other countries around the globe have also shown interest in vertical evacuation for tsunamis. Following the 2004 Sumatra Earthquake and Indian Ocean Tsunami, researchers from India intensified their research and evaluation of vertical evacuation structures (Patel, Patel, & Singh, 2011). In their study Patel et al. (2011) looked specifically at those concrete-reinforced buildings that survived the 2004 Indian Ocean Tsunami. They then translated their understanding of those buildings to Dwarka, West Gujarat, India. Their research continues, with the hope of providing viable and reliable tsunami preparedness efforts for one of the cities in India with the highest risk of tsunami (Patel et al. 2011).

The use of alternative evacuation methods, specifically vertical evacuation, for emergency planning for tsunamis is currently very low or almost nonexistent within the US. One potential reason for this low use of vertical evacuation planning is a lack of appropriately constructed buildings or structures in communities with a local tsunami hazard. Colloquially, people believe that building a tsunami-resistant structure would be cost-prohibitive to communities, and thus unacceptable as a mitigation activity. Four coastal communities in Pacific County, Washington are leading the way in proving these colloquial misgivings wrong and demonstrating a need for vertical evacuation education in at-risk communities

The Safe Haven team worked with the towns of Long Beach, Ilwaco/Seaview, Ocean Park, and Tokeland/North Cove each located in Pacific County to initiate a community empowerment and engagement project to discuss each city's tsunami risk and the options available for vertical evacuation planning. Each of these communities was specifically selected because of local geography with little or no natural high ground and the level of risk associated

with a tsunami hazard. The project was organized using a six-phased community engagement methodology: 1) selection of a community steering committee, 2) site survey and development of approach, 3) identification of preferred strategies with some alternatives, 4) community mulling process and acceptance of preferred strategy, 5) reassessment of preferred strategy, and 6) community design charrettes ("Project Safe Haven," 2011). The first discussion in each community used a case-study analyzing the effects of a worst-case scenario tsunami tailored to demonstrate the effects on each of the communities included in the project. In reviewing these scenarios, the concept of vertical evacuation was included and explained, thus initiating conversations around developing and constructing man-made structures for providing a safe haven to those unable to effectively evacuate in other ways.

After several months of community discussions and debates, each of the four communities identified the location and type of vertical evacuation structures that would be constructed as a part of their tsunami preparedness plans. Ultimately, Pacific County has identified the need to protect 6,300 high-risk residents from a tsunami through the construction of 13 berms, 5 towers, and 2 parking garages, all estimated to cost roughly $11 million ("Project Safe Haven," 2011). While these structures have not been built yet, these communities are in the process of identifying and allocating the required funds to begin the construction process.

The current draft TR Community program guidelines require that communities with a local tsunami threat establish a plan for vertical evacuation strategy in areas where no natural high or inland ground exists. This action, identified as a “Mitigation” (Mit-6) activity in the guidelines, includes several actions: 1) designating vertical evacuation structures or potential locations, 2) identification of the at-risk populations these structures would serve, 3) identification of funding considerations and sources, 4) researching and identifying land use

considerations, and 5) a proposed timeline for implementation (Revised TR Community program guidelines, January 2013). While the vertical evacuation data gathered from the Tohoku tsunami, continued research like that occurring in India, and the county-level adoption of a vertical evacuation plan in Pacific County provide evidence of the efficacy and acceptability of nontraditional tsunami evacuation strategies in local communities; the inclusion of mandatory vertical evacuation planning in the TR Community program guidelines remains controversial. Additional information regarding the acceptability and usefulness of these actions is needed from US communities facing a tsunami hazard.

Evacuation Drills. With encouragement from the NTHMP, the state of Oregon passed the 1995 Oregon State Senate Bill 378 mandating that all Oregon schools that were located in potential inundation zones must teach all students grades kindergarten through eighth about tsunamis with the added requirement of evacuation drills (Dengler, 2005). While the timing and number of school evacuation drills are not described in the bill, mandating required evacuation drills is a strong platform for creating tsunami prepared communities along the Oregon coast. After Oregon received an Award in Excellence for the tsunami school education program from the Western States Seismic Policy Council (WSSPC) in 1999, Washington State began working on an adaptation to implement in Washington schools. After developing a two-booklet curriculum set, Washington State was also recognized with a WSSPC Award in Excellence (Dengler, 2005). Both Oregon and Washington states have identified mandatory evacuation drills as important local tsunami hazard mitigation practices.

While there are no readily available data describing state-wide adherence or efficacy for either the Oregon Senate Bill or the educational curriculums and the school evacuation drills, the creation of these programs provides support for the TR Community program inclusion of

mandatory annual evacuation drills for all schools located within an inundation zone for a local tsunami threat. Before the proposed guidelines can be adopted, additional information regarding the acceptability and usefulness of these mandatory evacuation drills is needed from US communities facing a local tsunami hazard.

Theoretical Framework for Evaluation

The Elaboration Likelihood Model (ELM) has been successfully used as a framework for understanding attitude formation and change with regard to products and services (Bitner & Obermiller, 1985). The ELM has also been adapted and applied in various industry settings via survey methodologies and focus group approaches to measure attitudes toward and preferences for specific products and services (Cacioppo & Petty, 1979). This theoretical framework lends itself well to the evaluation of the key components of the NWS TR Community program guidelines. In the context of this model, the NWS is providing the guidelines as a community product and the recognition as a service for communities that successfully complete the actions laid out in the guidelines. For this evaluation research, prediscussion and focus group questions were created to evaluate both peripheral and central perceptions regarding the revised TR Community program guidelines and additional key concepts, as described in the conceptual framework in Figure 6.

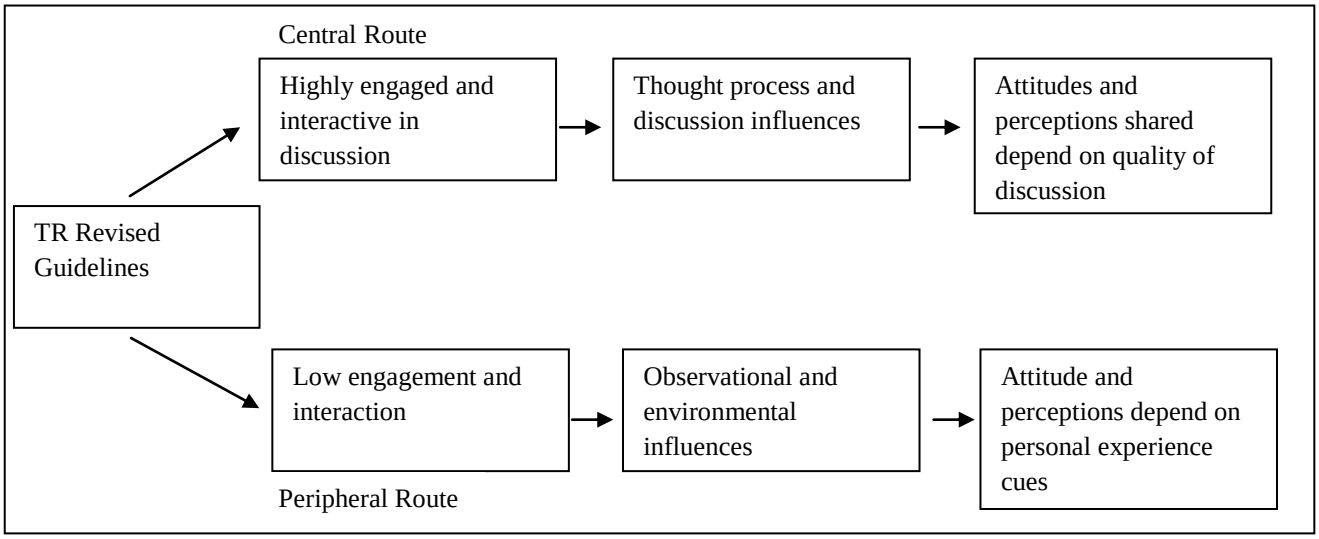


Figure 6: Adapted by the author from the Elaboration Likelihood Model (Bitner & Obermiller, 1985)

Peripheral perceptions are formed and changed without formal thought, rather through the association of the product or service with positive or negative cues. Prediscussion survey questions were created to tap into participant perceptions prior to group discussions. Through asking certain questions before the formal focus group discussion, it is hoped that personal associations and perceptions about the TR Community program and the revised guidelines will be collected. These perceptions and opinions will give insight into how participants individually digest tsunami program information and associate that information to their own community investment and use of the TR Community program. This will allow researchers to draw conclusions on how well individual-level distribution of program information is accepted, understood, and used by expert community stakeholders.

Central perceptions are formed and changed through consideration and integration of information relevant to the product or service through discussion and interaction with others.

Group participatory processes are very important in the development or the changing of an individual's central perceptions about a product or service. Focus group questions were created with the aim of generating discussion and colearning among focus group participants. The perceptions and opinions observed during the discussion process will give insight into how expert community stakeholders collectively integrate tsunami program information and incorporate new information perspectives to their own community investment and use of the TR Community program. This will allow researchers to draw conclusions on how well group-level distribution and discussion of program information is accepted, understood, and used by expert community stakeholders. Data from both central and peripheral perceptions will be analyzed regarding the acceptability and usefulness of the revised TR Community program guidelines and potential key elements to be added.

Group Participatory Process. The Central route of the ELM framework relies on interaction and discussion between individuals. This reliance on collaboration provides an avenue for the blending qualitative research methods together with group participatory processes as a potentially useful research framework. The group participatory processes can be adapted from the basic principles of Community-Based Participatory Research (CBPR). The following definition of CBPR was originally developed and adapted based upon the article by Israel et al (1998) by the WK Kellogg Foundation Community Health Scholars Program. The program defines CBPR as:

> *"A collaborative approach to research that equitably involves partners in the research process and recognizes the unique strengths that each brings. CBPR begins with a research topic of importance to the community and has the aim of combining knowledge with action and achieving social change..."*
>
> - Community Health Scholars Program (Israel, 1998; Kellogg Health Scholars, 2003)

The terms and phrases of most importance within this definition are: *collaborative*, *equitably*, *partners*, *combining knowledge with action*, and *achieving social change*. The primary purpose of CBPR is to transform the research process from researcher's conducting research on a community to answer a research question, to one where researchers work and collaborate with community members throughout the research process. The group participatory processes will be facilitated through the application of as many of the nine key principles of CBPR as possible as the expert panels explore the most debatable elements of the current draft TR Community program guidelines and the potential elements for inclusion in the guidelines. The nine key principles of CBPR include:

1) recognize community as a unit of identity,
2) build on strengths and resources within the community,
3) facilitate collaborative, equitable partnership in all research phases and involves an empowering and power-sharing process that attends to social inequalities,
4) promote co-learning and capacity building among all partners,
5) integrate and achieve a balance between research and action for the mutual benefit of all partners,
6) emphasize public health problems of local relevance and also ecological perspectives that recognize and attend to the multiple determinants of health and disease,
7) involve systems development through a cyclical and iterative process,
8) disseminate findings and knowledge gained to all partners and involves all partners in the dissemination process, and
9) require a long-term process and commitment to sustainability.

(Minkler & Wallerstein, 2008, p. 49-52)

Conclusion

The face of emergency management in the US has changed considerably since the first conception of emergency response. As science and technology advance, so too does the capability of advance preparedness and warning for many natural hazards. As all disaster situations affect a local population first, emergency managers are moving towards requiring that

community's at risk be educated and involved in hazard mitigation and preparedness activities. The TR Community program was created to improve public safety and resiliency, specifically for community response and action during tsunami emergencies. In principle, when a community receives TR recognition, both the community and wider-public can be assured that when a tsunami warning is issued for that community, they will get the warning and know what to do and how to take appropriate protective action to save lives. However, there is debate between researchers and practitioners alike as to how well the implementation of the actual TR Community program is accomplishing these aims through the current guidelines. Just as the emergency management and planning cycle requires practice, testing, and revisions, so too does emergency preparedness policy and programs like the TR Community program. It is imperative that programs like the TR Community program undergo program evaluation and integrate science and technological advances with local community input to ensure a strong and relevant community preparedness program that meets its aims of community preparedness.

Research Questions

The following research questions were developed to guide the evaluation research of specific key components of the proposed revised set of TR Community program guidelines.

Question 1: How should the requirements for TR recognition be subdivided to account for differences in tsunami risk between individual communities (specifically examining local versus distant definitions of tsunami hazard)?

Question 2: What would an effective evacuation strategy need to look like for a community to be considered TR?

Question 3: What are the perceptions of a vertical evacuation strategy for tsunamis when no natural high, inland ground or vertical evacuation structures exist as a requirement for TR recognition?

Question 4: What proportion of a community population (e.g. resident, seasonal worker, visitor) needs to be provided with evacuation sheltering (e.g. inland to high ground or vertical evacuation) and thus considered protected by the preparedness planning to achieve TR recognition?

CHAPTER 3

METHODS

Study Design

This study evaluated the acceptability and usefulness of selective components of a proposed revised set of TR Community program guidelines that contributed data and recommendations to be presented to the NWS and the NTHMP for use in possible program revisions and updates. Data for this study were qualitative in nature. Two qualitative research methods, specifically 1) prediscussion questions and 2) focus group discussion protocols, were used in tandem with group participatory processes to elicit qualitative data from expert panels of participants from each study site. Qualitative data allowed participants to share perceptions and opinions of key concepts and questions with the researchers. This allowed the researcher to evaluate the acceptability and usefulness of a set of revised national guidelines for the TR Community program directly from a community of expert stakeholders within each of the study sites.

Qualitative research methods can be used to understand the attitudes, perceptions, and culture of a research topic in a way that quantitative research methods alone cannot. In particular, qualitative research is particularly suited to understanding research questions that ask "how" and "why". Qualitative research methods can provide insight and understanding of people's personal experiences (i.e., the emic or insider's viewpoint). Qualitative data can also describe phenomena and experiences in rich detail as they are situated and embedded in local community and organizational contexts (Patton, 1990; Ulin, Robinson, & Tolley, 2005). Specifically, in the case of this research, qualitative focus group data provides a rich context explaining why or why not expert stakeholders believe certain TR Community program

guidelines are acceptable or useful in their particular community. Qualitative data delves further into the "why" than the dichotomized yes/no quantitative research question; providing for more in-depth descriptions and a clearer understanding of the broader community factors influencing the "yes" or "no" response.

Sample Selection

Initial 2011 Project Sample

Only coastal communities of the US and its Territories were included in this study because tsunamis directly affect coastal areas. The communities identified for inclusion in this research were selected to provide a mix of recognized and nonrecognized as TR communities. Additionally, communities were selected because of their locations within identified tsunami hazard zones, ranging from high to moderate to low tsunami hazard risk (Table 2). The eight selected communities provide a cross-section of coastal and/or island communities within the U.S. with representation of both TR recognized and nonrecognized communities.

Table 2:

Names of 2011 Communities, TsunamiReady™ Recognition Status, and Degree of Hazard Exposure

#	Community	State/Territory	Tsunami Ready™	Degree of Tsunami Hazard
1	Ocean Shores	Washington	Yes	High
2	Seaside	Oregon	Yes	High
3	Kodiak	Alaska	Yes	High
4	Coronado	California	No	Intermediate
5	Kauai County	Hawaii	Yes	High
6	New Hanover County	North Carolina	Yes	Low
7	Leone, Vailoatai, Maleloa Itulagi, Maleloa Ituau, Taputimu, Amaluia, Asili, Afao, Seetaga, Agugulu, Amanave, Poloa, Fagali'l, Maloata, Fagamalo, Fagasa, Tula	American Samoa	No	High
8	Frederiksted, St Croix, Charlotte Amalie, St Thomas	US Virgin Islands	No	High

The initial NOAA TR focus groups were conducted between May and October 2011 at a central location within each individual site: Alaska, Hawaii, Washington, Oregon, California, North Carolina, American Samoa, and the US Virgin Islands. However, the turn out for focus groups in both American Samoa and the US Virgin Islands was very low. Focus group participants were selected using a nonprobability, purposive or criterion-based approach to ensure representation from a variety of perspectives within each community (LeCompte & Preissle, 1993; Patton, 1990). Invitation to participate was based on a variety of factors including but not limited to an individual's role as a formal or informal community leader (e.g., in business, government, civic organizations), or their organization or agency affiliation working in emergency management. Participants were primarily local city and county government employees but also included some state and federal partners. The following table (Table 3) provides a sample distribution of people and agency representatives invited to participate in the TR focus group discussions.

Table 3:

Sample Distribution of People and Agency Representatives Invited to Participate in TsunamiReady™ Focus Groups

	Agency
1	Coast Guard Commanding Office
2	State Emergency Management (State Tsunami Program Coordinator)
3	State Park Ranger
4	City and County Emergency Management Director
5	City or County Public Works
6	City or County Planner
7	City or County Police
8	City or County Fire Chief
9	Chamber of Commerce Rep
10	Port Manager
11	Harbor Master
12	Industry Rep
13	School Superintendent
14	Mayor's Office Rep
15	Convention Visitor's Bureau Rep
16	Tribal
17	One other at determination of lead Emergency Management contact

Current 2013 Project Sample

The primary sampling frame for this research consisted of the list of original participants from six of the original eight 2011 NOAA TR focus group discussions as identified in Table 4 below. This research included six sites rather than the original eight due to budget restrictions and travel costs associated with data collection. The original research team was consulted regarding potential site exclusion and identified the priority sites for inclusion. It was determined that all of the original distant tsunami hazard sites would be included: North Carolina, California, and Hawaii. To keep an equal representation of tsunami hazard, it was determined to include three local tsunami hazard sites as well: US Virgin Islands, Alaska, and Oregon. Additional participants were recruited at each site to overcome any attrition or inability

to reach prior participants. All additional participants were also recruited through a nonprobability, purposive or criterion-based approach using the methods described for the original 2011 NOAA TR focus group discussions. This involved both secondary recruitment through 2011 NOAA TR participants and contacting current expert community stakeholders to obtain contact information for new employees who replaced the unreachable prior participants. These additional participants were included to satisfy additional sample size requirements to produce robust qualitative data (the gold standard focus group size is between 8-10 participants (Patton, 1990)). Once participants confirmed their attendance at their site's focus group discussion, they were then included in the prediscussion survey invitation list as well.

Table 4:

Names of 2013 Communities, TsunamiReady™ Recognition Status, and Degree of Hazard Exposure

#	Community	State/Territory	Tsunami Ready™	Degree of Tsunami Hazard
1	Seaside	Oregon	Yes	High
2	Kodiak	Alaska	Yes	High
3	Coronado*	California	No	Intermediate
4	Kauai County	Hawaii	Yes	High
5	New Hanover County	North Carolina	Yes	Low
6	Frederiksted, St Croix, Charlotte Amalie, St Thomas	US Virgin Islands	No	High

* This community announced TR recognition status during the course of the grant project

Research Measures and Tools

Draft TsunamiReady™ Guidelines

A revised current draft TR Community program guidelines document was created after the conclusion of the 2011 NOAA focus group discussions. All of the original focus group data were transcribed and rigorously analyzed, providing vital feedback for content, structure, and format of the revised guidelines. The revised document (Appendix B) used for this research was

finalized in January 2013 after multiple iterations and reviews from the NWS Tsunami Program, NWS Weather Forecasting Officers, and the Mitigation and Education Subcommittee, Executive Committee (MES-EC) of the National Tsunami Hazard Mitigation Program (NTHMP).

Prediscussion Survey

A qualitative prediscussion survey was created adapting the ELM (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979) as a framework for question development (Appendix C). The survey questions focused on eliciting information, perceptions, and attitudes from participants through the peripheral route of the ELM. Peripheral perceptions are formed and changed without formal thought or discussion rather through the association of the product or service with positive or negative cues (Cacioppo & Petty, 1979). This allowed the researcher to better understand the preconceptions and understanding of individual participants regarding the TR Community program prior to the focus group discussions. Gathering this prediscussion data also allowed the researcher to better understand misconceptions and/or misunderstandings of the revised proposed TR Community program guidelines. The prediscussion survey specifically explored beliefs regarding six topics formed through observations and personal experiences with tsunami hazards and the NWS TR Community program, including: 1) the requirement of additional actions for those communities with a local tsunami hazard, 2) the appropriateness of subdividing the TR Community program guidelines based on the local versus distant tsunami hazard of a community, 3) vertical evacuation requirements, 4) annual tsunami evacuation exercises for schools located within a tsunami inundation zone, 5) annual training for local business owners and staff, and 6) annual training and education for residents living within a tsunami inundation zone. The themes found within these topics provided guidance for the researchers to help facilitate and guide the focus group discussions of the topics.

Focus Group Guide

The focus group guide (Appendix D) and discussion agenda (Appendix E) were created by adapting the ELM (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979) as a framework for question and probe creation. Using this framework, the focus group discussion guide was centered on creating an interactive discussion between participants. The primary objective of each focus group discussion was to evaluate the acceptability and usefulness of the revised TsunamiReady™ guidelines for community recognition by the NWS. Each focus group discussion explored six main topics related to the TR Community program guidelines and tsunami emergency preparedness at the community level: 1) effective community evacuation strategies, 2) vertical evacuation strategies and requirements, 3) potential for a required proportion of a population to be protected through evacuation measures, 4) annual tsunami evacuation drilling for schools, 5) annual education and training for businesses and staff located or working within a tsunami inundation zone, and 6) annual education and training for residents (owners, renters, seasonal, military, etc.) within a tsunami inundation zone.

Group Participatory Process

For this research the community of interest was composed of both informal and formal community leaders (e.g., in business, government, civic organizations) currently working or engaged in the emergency management field. Community members were invited from a variety of agencies and organizations, representing local, state, and federal levels of interest in tsunami hazard preparedness within the selected communities. While state and federal partners were invited, the vast majority of participants were local community members. As with any community, relationships and resources shared between individual stakeholders are vital for programs. Each sampled community may have had some prior experience working with and

interacting with each other, which allowed the current research to build and elaborate on those previous experiences to evaluate the revised TR Community program guidelines and the addition of potential program elements. All of the emergency management community expert stakeholders participating within each of the selected communities provided information and aspirations supporting and potentially expanding their local tsunami emergency preparedness infrastructure.

Using the ELM as a framework for evaluating the revised TR Community program guidelines, the researchers aimed at facilitating colearning among participants using Community Based Participatory Research (CBPR) methods and group participatory processes. The prediscussion surveys provided peripheral route information regarding the understanding and perceptions of the TR Community program guidelines by individual participants. The survey results also provided the researchers with information to prepare for each individual focus group discussion. Some general information derived from all prediscussion surveys included the need to provide more in-depth background discussion and definitions of terms used in the proposed changes to the TR Community program guidelines. Using this finding, researchers opened the focus group discussions with detailed background and definitions to allow all participants to begin the conversation on the same page. Participants were encouraged to ask questions, and researchers encouraged colearning among participants throughout the discussion.

Each focus group discussion began with an introduction by the researchers and a self-introduction by each participant. All participants were provided with a name and agency identifier, allowing participants to address comments or questions directly to other participants by name. During self-introductions, participants were encouraged to share both their

professional connection to tsunamis and their personal interest in emergency preparedness; setting the groundwork for colearning from professional counterparts.

The focus group discussions provided a platform for shared discussion of key questions between participants. Each individual stakeholder had both something to teach and something to learn from the wider emergency management community as they discussed the proposed guidelines. Some of the group participatory processes used by the researchers included tailored focus group facilitation skills, reflective listening, and consensus building methods to guide the flow of each focus group discussion and elicit feedback from all participants. Together, the researchers worked with the expert stakeholders to assess the proposed guidelines. Findings will be translated into recommendations for the NWS to use to develop stronger guidelines that strengthen TR recognized communities more so than the existing population-based guidelines. Given the extensive involvement of community stakeholders with the development of these guidelines, it is hoped they will be found to be acceptable and useful at the community level.

Data Collection

Recruitment

It was important that focus group participants were representative of a broad range of community, state, and federal stakeholders who may be impacted by the TR Community program guidelines revision. Participants included, but were not limited to, local emergency responders (fire, police, military, etc.), local and regional Emergency Management, local and regional NOAA and/or NWS, and local Emergency Communications Management. By ensuring the inclusion of a broad range of community, state, and federal stakeholders, this research would have less chance of undue qualitative influence due to over representation of one particular office or occupation. Additionally, using a wide range of community, state, and federal stakeholders

allowed for better representation of the potential stakeholders from other communities who are also at risk to tsunamis and may benefit from participation in the TR Community program.

A local emergency manager was identified within each of the study sites and contacted to confirm contact information for participants from the initial 2011 NOAA TR focus groups. Once the contact information was verified, potential participants were first contacted via email to introduce the current research, confirm and update contact information, and elicit participation in the second round of focus group discussions. For those participants who did not respond within 1 week of the initial email, a second email was sent, followed by a phone call the next week from the researcher. If the original participants were unreachable by either the two emails or the telephone call, they were removed from the sampling frame. The recruitment and participant commitment breakdown can be seen below in Table 5.

Table 5:

Recruitment Breakdown by Study Site

#	Study Site	Individuals Contacted	Confirmed Participants	Attended Focus Group Discussion
1	Kodiak, Alaska	18	8	8
2	Coronado, California	21	9	13
3	Seaside, Oregon	17	9	7
4	Kauai County, Hawaii	20	9	9
5	New Hanover County, North Carolina	15	8	8
6	US Virgin Islands	11	4	5

Data collection was scheduled to take place between October and early December 2013. The study site and focus group discussion date breakdown can be seen below in Table 6.

Table 6:

Study Site and Focus Group Discussion Date

Study Area	Date of Focus Group
Kodiak, Alaska	October 15, 2013
Coronado, California	October 28, 2013
Seaside, Oregon	October 30, 2013
Kauai, Hawaii	November 8, 2013
New Hanover County, North Carolina	November 14, 2013
US Virgin Islands	December 4, 2013

Prediscussion Surveys

The prediscussion surveys were administered through the Survey Monkey website. The survey link was emailed to all confirmed participants 1 week prior to each scheduled focus group discussion. A reminder email with the survey link was emailed to each confirmed participant 3 days prior to each focus group discussion. Surveys were composed of seven open-ended qualitative questions concerning participants' perceptions and attitudes regarding the TR Community program guidelines and one multiple choice question identifying in which state or territory the participant currently works. Survey responses were collected through the Survey Monkey website, allowing the researcher to review responses and conduct initial analyses prior to conducting each of the focus group discussions.

Focus Group Discussions

Focus group discussions were held at a central meeting location within each of the identified communities. Each focus group discussion was led by either the researcher with assistance from the original research team primary investigator (Alaska, California, Oregon, Hawaii) or by a trained member of the original research team (North Carolina, US Virgin Islands) with a note-taker present. The focus group facilitator used a semistructured discussion guide to identify key concepts and questions for participants to discuss. The facilitator aimed to

encourage equal contribution among participants to ensure all stakeholder voices were heard. Discussion notes were recorded both manually by the note-taker throughout the focus group and by digital audio recorder. Both the discussion notes and the audio recording were created and used for transcription, quality checks, and analysis. Focus groups ranged in length between 1.25 hours and 2.25 hours.

Data Analysis

Prediscussion Surveys

Prediscussion surveys were initially reviewed and analyzed by the researcher to help facilitate the focus group discussions. After completing the focus group discussion, the researcher fully analyzed the prediscussion surveys by focusing primarily on creating a theme analysis and dichotomizing agreement or disagreement with each question (Patton, 1990; Ulin, Robinson, & Tolley, 2012). Consistencies and idiosyncrasies between participants regarding the specific concepts related to the TR Community program guidelines were identified by topic (which can also be referred to as a question or closely aligned set of questions). A series of response matrixes were created to help the researcher visualize and enumerate the acceptability and usefulness of specific program elements more clearly both within and across survey sites. In using the matrix format for this analysis, characteristics within and between surveys were more easily identified for use in isolating important concepts and themes (Patton, 1990). A final integrated results matrix was created by coding site-specific participant responses into concern categories or a coding tree of participant concerns as seen in Figure 7 below.

Should communities with a local-tsunami threat take more actions to protect human life?
- ***Implementation concerns**
- ***Planning**
- ***Standardization**

Would sub-dividing community vulnerability by local versus distant tsunami hazard be appropriate in your community?
- ***New subdivision**
  - **Local hazard community**
- ***Planning**
- ***Unnecessary complexity**
- ***Implementation concerns**

Should communities be required to identify natural high or inland ground for at-risk persons to use for self-evacuation?
- ***Planning**
- ***Helpful activity**
- ***Standardization**
- ***Implementation concerns**
- ***Training**
- ***Required**

Should communities be required to identify or build berms or other structures for evacuation?
- ***Cost concerns**
- ***Planning**
- ***Implementation concerns**
- ***Helpful activity (identification, not building)**
- ***Required (identification)**
- ***Optional (building)**
- ***Restrict communities**
- ***Resident risk tolerance**

Should annual tsunami evacuation exercises be mandatory for schools located within an inundation zone?
- ***Helpful activity**
- ***Required**

Should annual training, education, or outreach be mandatory for owners/staff of high-occupancy businesses located in a tsunami inundation zone?
- ***Planning**
- ***Required**
- ***Inclusive**
- ***Implementation concerns**
- ***Helpful activity**

Should annual training, education, or outreach be mandatory for residents living in an inundation zone?
- ***Required**
- ***Inclusive**
- ***Implementation concerns**
- ***Helpful activity**
- ***Cost concerns**
- ***Optional**

Figure 7: Prediscussion Survey Theme Tree by Survey Question

Focus Group Discussions

Audio recordings of focus group sessions were transcribed by a subcontractor trained in transcription. Transcripts were reviewed, quality checked, and edited by the researcher who

listened to each recorded focus group audio file while reading the electronic transcript to identify any discrepancies. Any necessary corrections were made during the quality review process to ensure overall accuracy of the final transcripts for analysis. A list of participants was maintained until the end of the study, allowing the researcher to recontact participants if a need for clarification or elaboration during the data analysis and report writing process arose.

Focus group discussion transcripts were analyzed using the computer-based qualitative software package, ATLAS.ti. Analysis and coding of transcripts followed standard protocols for qualitative data analysis, using a coding process focused on topics specific to the program guidelines being evaluated (Auerbach & Silverstein, 2003; Hesse-Biber & Leavy, 2006; Patton, 1990). Similar to the prediscussion survey analysis, focus group discussion data analysis were first conducted by location to determine site-specific opinions and reactions to the proposed guidelines. Next, a between-site (integrated) analysis was conducted to provide the overall community-based input regarding the proposed TR Community program guidelines.

Starting with a line-by-line analysis and coding process, the initial coding procedure was used to identify higher-level codes or topics determined by specific questions on the focus group discussion guide (Friese, 2012; Patton, 1990). As a second round of the initial coding process, the researcher conducted open and exhaustive coding of emergent themes and subcodes found within each topic. Next, the researcher created code families for each of the topics. Code families were used to filter subcodes, allowing the researcher to aggregate similar codes while expanding unique codes. An integrated focus group coding tree containing five primary topics, three subtopics, and 40 data themes was created; as seen in Figure 7 below.

***EVACUATION**
- ****DRILLS & EXERCISES**
  - **other facilities**
  - **schools**
  - **state laws**
- ****EVACUATION EFFECTIVENESS**
  - **definition of evacuation**
  - **delayed evacuation notice**
  - **determining population to save**
  - **effectiveness**
  - **evacuation exercises**
  - **evacuation plans**
  - **evacuation signage**
  - **evacuation time**
  - **sub-populations**
  - **transient seasonal population**
  - **worst case scenario planning**
- ****VERTICAL EVACUATION**
  - **building vertical evacuation structures**
  - **costs**
  - **false sense of security**
  - **risk acceptance**
  - **vertical evacuation planning**
  - **vertical evacuation requirement**
  - **vertical evacuation signage**
  - **zoning issues**

***PROPOSED GUIDELINES**
- **additional mandatory actions**
- **implementation concerns**
- **local vs distant subdivision**
- **proposed new mitigation activity**
- **standard actions**

***TRAINING, EDUCATION & OUTREACH**
- **community engagement**
- **defining mandatory**
- **education**
- **inundation mapping**
- **proposed mandatory education**
- **TR business**
- **warning communication**

***UPDATED FORMAT**
- **TR checklist**
- **useful**

***TR PROGRAM**
- **TR benefits**
- **TR maintaining recognition**
- **TR purpose**
- **TR tiered recognition**

Figure 8: Focus Group Discussion Code Tree

The integrated focus group coding tree was used to describe the site specific focus group results. A final round of thematic analysis was conducted reviewing each of the site specific topic descriptions to consolidate and finalize the coding tree above into an integrated matrix depicting major topics and their associated supporting or opposing themes. This process provided a final parsimonious coding system describing the qualitative focus group data (Friese, 2012; Patton, 1990).

To protect the identities of participants, names and other identifiers were removed from any written reports or presentations of findings. Based upon final analysis, recommendations have been drafted and will be used in conjunction with other information to provide the NWS Tsunami Program Director.

Ethical Considerations

Institutional Review Board (IRB) Approval

IRB approval was granted through the East Tennessee State University Office for the Protection of Human Research Subjects IRB (Appendix F).

Human Subjects Protections. The participant recruitment process began 1 month prior to focus group discussions. Each participant was provided with an official invitation email (Appendix G) and an informed consent document (Appendix H) during recruitment. Informed consent was obtained immediately before the beginning of each focus group discussion. The researcher houses the signed informed consent documents in a locked cabinet in the PIs office in Ross Hall, on the ETSU campus.

Summary

Prediscussion surveys and focus group discussions were initiated after IRB approval was granted. Data collection began on October 15, 2013 and concluded on December 4, 2013. Prediscussion survey data and focus group audio files were transcribed concurrently as additional focus group discussions were conducted to streamline the data collection and analysis phases of this research. Prediscussion survey data provided the researcher with a set of concerns identified by expert community stakeholders at each study site location. Having identified these concerns prior to the focus group discussions allowed the researcher to provide more in-depth explanation of additional actions and terms related to the proposed TR Community program guidelines for the discussion. More in-depth analysis of the prediscussion survey data was conducted after the completion of all focus group discussions. All focus group transcripts were first quality-checked against both the notes taken during each focus group discussion and the audio file, initiating the analysis segment of this research. Data analysis of the focus group transcripts was conducted

first by individual study site with a final integrated analysis between sites using the ATLAS.ti qualitative analysis computer software program.

CHAPTER 4

RESULTS

Qualitative prediscussion survey data and focus group discussion data were collected and analyzed to produce the following results. The prediscussion survey data are discussed first, followed by the focus group discussion data.

Prediscussion Surveys

Prediscussion surveys were used to explore participant beliefs formed through observations and personal experiences with tsunami hazards and the NWS TR Community program using the peripheral route of the Elaboration Likelihood Model (ELM). These individual perceptions were collected after providing all participants with the TR Community program revised guidelines to review and consider on their own without consulting others.

For all study sites, an email inviting the confirmed focus group discussion participants to complete a prediscussion survey administered through the Survey Monkey website was sent 1 week prior to the scheduled focus group discussion. Due to a low initial response rate, an additional reminder to complete the prediscussion survey email was sent to all confirmed participants 3 days prior to the scheduled focus group discussion.

An initial analysis of site-specific prediscussion survey data was used to help facilitate and guide each focus group discussion. After the completion of each site's focus group discussion, a more in-depth analysis was conducted for presentation here. The following subsections describe an individual level analysis of each study site followed by final integrated summary between sites.

Site Specific Findings

Kodiak, Alaska. Of the eight prediscussion survey invitations sent, four responses were logged in the Survey Monkey system. This provided a prediscussion survey response rate of 50% for the Kodiak, Alaska study site. Each of the four surveys was completed in its entirety, no questions were skipped by any participants.

Three participants agreed that communities with a local tsunami hazard should be required to take more actions to protect human life. One participant was undecided, identifying concerns that small communities with high tsunami hazard might be prevented from achieving TR recognition because of "unnecessary mandatory actions." In Kodiak 100% of respondents agreed that the proposed subdivision of the guidelines by community vulnerability would be appropriate in their community. Three of the participants described how Kodiak would be considered vulnerable to both local and distant tsunami threats, requiring them to adhere to the more stringent guidelines for the communities with a local tsunami hazard. All respondents agreed that communities should be required by the TR Community program guidelines to identify high or inland ground where at-risk persons could self-evacuate. Two participants also stated that the identification of high or inland ground for self-evacuation should be a part of local planning and included in the Emergency Operations Plan. The vertical evacuation question received a mixed response, with no participants in complete agreement with the proposed actions. One participant began their response to this question by stating, "All of the necessary steps must be taken to protect the population." Three participants agreed that the identification of berms or potential evacuation structures should be identified by communities; though each couched their responses by describing the costs of building such structures would be cost-prohibitive for communities. One participant described the cost restrictions, offering that grants

could be identified to help fund the construction of vertical evacuation structures if the community had a hazard mitigation plan. One participant was against communities being required to do anything related to vertical evacuation, citing that it would be "more cost effective if local residents assisted at-risk populations instead." Requiring annual evacuation exercises for all schools located within an inundation zone was supported by 100% of Kodiak respondents. One participant furthered the requirement by stating, "Once a year is the minimum that should be required." Similarly, 100% of participants agreed that the TR Community program guidelines should require annual training, education, or outreach targeting owners and staff of high-occupancy businesses located in the hazard zones for local tsunamis. Though two respondents questioned how this would be accomplished and tracked both at a local level and by the NWS. Finally, 100% of respondents agreed that requiring annual training, education, or outreach targeting residents living in the inundation zone would be good for communities, but two added concern that it may be an unrealistic requirement to actually attain. See Appendix I1 for the Kodiak, Alaska final survey response matrix organized in tabular format.

Coronado, California. Of the nine prediscussion survey invitations sent, three responses were logged in the Survey Monkey system. This provided a prediscussion survey response rate of 33%. Additionally, one of the three respondents opted not to respond to the first two questions of the survey and another opted not to respond to the last two questions of the survey.

One participant (50% of the participants who responded to this question) disagreed that communities vulnerable to local tsunamis should have to take additional actions to protect human life, stating "the standards should be the same for all tsunami prone areas." One participant responded that whether a community is required to take additional actions to protect human life should depend on the geography of the community. Of those participants who

responded, 100% agreed that subdividing the TR Community program guidelines by vulnerability to local tsunamis would be appropriate in the Coronado, California community. Three participants responded favorably to requiring communities to identify natural high or inland ground for at-risk persons to use for self-evacuation. Respondents noted, "all tsunami vulnerable areas should identify evacuation routes to higher elevations and inland safe areas," and "city government has the responsibility to provide a written plan identifying areas of risk and areas of safe evacuation." All respondents agreed that communities should be required to identify berms or other structures available to serve as vertical evacuation sites. While 100% of participants agreed with the identification of berms and structures, two provided reservations with adding this requirement to the TR Community program guidelines. One participant cited that construction of such evacuation structures is not always feasible, while the second added that requiring communities to "construct vertical evacuation structures relies on many variables that may not be affordable in small communities." All participants responded favorably to the recommended requirement of annual tsunami evacuation exercises for schools located within an inundation zone. Two of the respondents felt that this requirement could even be expanded by sharing, "all jurisdictions (first and emergency responders, schools, and public works) located in tsunami vulnerable areas should exercise emergency plans at least once a year similar to the Great Southern California Shakeout exercise coordinated by the Earthquake Country Alliance and other California and Federal stakeholders," and "tsunami evacuation exercises for schools in inundation zones should be held at least twice per year." Of the two participants who responded, one respondent felt that annual training, education, and outreach for owners and staff of high occupancy business located within an inundation zone would be a good requirement. The second respondent noted that "public outreach and education workshops should be available to

the entire community – including residents and businesses located both in and outside the inundation zone annually." Finally, while both of the participants who responded agreed generally with requiring annual training, education, and outreach for residents living in an inundation zone one offered that "training all residents would be quite difficult to both administer and track." The second respondent also added to this by stating, "public outreach and education workshops should be available to the entire community – including residents and businesses located both in and outside the inundation zone." See Appendix I2 for the Coronado, California final survey response matrix organized in tabular format.

Seaside, Oregon. Of the nine prediscussion survey invitations sent, four responses were logged in the Survey Monkey system. This provided a prediscussion survey response rate of 44%. No questions were skipped by any participants.

Two participants agreed that communities vulnerable to local tsunami hazards should be required to take more actions than those communities that are vulnerable to only a distant tsunami hazard. One participant noted, "Not taking those extra actions places human life in potentially more jeopardy." Conversely, two participants disagreed with the proposed subdivision between local and distant tsunami hazards. Of those who disagreed with the new subdivision, one participant explained "the threat may be slightly different, but both local and distant tsunami hazards can cause significant impacts." This respondent continued to explain how preparedness, education, and outreach are essential activities for either hazard. When asked if subdividing community vulnerability by local versus distant tsunami hazards would be appropriate in the Seaside, Oregon community, two respondents strongly disagreed. One of the respondents explained that, "the division is useful for inundation mapping only." Alternately, one participant (25% of Seaside survey respondents) agreed that the subdivision would be

appropriate. Of the participants who responded to the prediscussion survey, 100% agreed that requiring communities to identify natural high or inland ground for at-risk persons to evacuate to would be a good requirement for TR recognition. While agreeing this was a good requirement, one participant did question how this requirement would be monitored and enforced. Three of the participants agreed that communities should be required to identify or build berms or other structures for vertical evacuation, though 100% of these respondents also added that communities should not be required to build or create these structures if they are not currently present. One respondent disagreed completely with vertical evacuation structures, stating instead that "building or identifying structures for vertical evacuation stops people from thinking about how best to save their lives, they rely on a building which most likely will fail and not be safe." Two respondents agreed that schools located within an inundation zone should be required to conduct annual tsunami evacuation exercises. The other 50% of respondents explained that the State of Oregon already requires all schools located in tsunami inundation zones to conduct these annual drills. One of these respondents added that "[he] prefers the idea of moving schools out of inundation zones completely." When asked about annual training, education, or outreach for high-occupancy businesses located within the inundation zone, two respondents agreed with making it a formal requirement. Another respondent likes the idea of this requirement but does not want to see it as a "required" element of the TR Community program guidelines. Similarly, 100% of respondents liked the idea of requiring annual training, education, or outreach for residents living within the inundation zone but questioned how realistic it would be on the ground. One participant added, "I prefer to keep the requirement more generic to the entire community who lives, works, shops, recreates, and visits a tsunami hazard zone." See Appendix I3 for the Seaside, Oregon final survey response matrix organized in tabular format.

Kauai, Hawaii. Of the nine prediscussion survey invitations sent, two responses were logged in the Survey Monkey system. This provided a prediscussion survey response rate of 22%. No questions were skipped by any participants.

One participant (50% of Kauai respondents) agreed that communities with a local tsunami threat should be required to take additional actions to protect human life. One participant disagreed that communities should have any additional actions, saying "the requirements should be the same – a tsunami is a disaster regardless of the source." When asked if subdividing community vulnerability to local versus distant tsunami hazards would be appropriate in Kauai, 100% of participants agreed. Both respondents noted that Kauai is vulnerable to both local and distant tsunami hazards. Requiring communities to identify natural high or inland ground for at-risk persons to use for self-evacuation was supported by both participants, but one participant identified some complications to this requirement by stating "private ownership of land make[s] access by the public difficult." Respondents were split when asked if communities should be required to identify or build berms or other structures for vertical evacuation. One agreed that there should be a plan in place to identify these safe locations, while the second participant shared that "constructing unnatural berms for an 'unlikely' tsunami event seems wrong." Requiring annual tsunami evacuation exercises for schools located within inundation zones was supported by 100% of respondents, noting that "Hawaii has been doing this for all schools for many years." Similarly, 100% of respondents agreed that there should be a requirement for annual training, education, or outreach for owners and staff of high occupancy businesses and residents located within the inundation zone. See Appendix I4 for the Kauai, Hawaii final survey response matrix organized in tabular format.

New Hanover County, North Carolina. Of the eight prediscussion survey invitations sent, five responses were logged in the Survey Monkey system. This provided a prediscussion survey response rate of 63%. No questions were skipped by any participants.

Four respondents (80% of New Hanover County participants) agreed that communities with a local tsunami threat should be required to take more actions to protect human life. One participant added that, "each community should be recognized as TR if they are prepared for the expected impact to their specific community." Conversely, one respondent (20% of participants) disagreed, explaining "common sense tells me any community at risk should be equally prepared." When asked if subdividing the TR Community program guidelines by community vulnerability to local versus distant tsunami hazards would be appropriate in the New Hanover County, North Carolina community, three respondents said no. Two respondents were unsure explaining, "how a community perceives risk determines how well it prepares – I'm not sure our community would understand the concept of being 'a little prepared' as opposed to 'fully prepared.'" Four respondents supported requiring communities to identify natural high or inland ground for at-risk persons to use for self-evacuation. One respondent was unsure about making this action a requirement, sharing "identifying tsunami shelters or tsunami free zones might prove difficult in coastal areas where elevation changes are slight and gradual." While three respondents agreed that communities should be required to identify berms or other structures for vertical evacuation, 50% were concerned with the costs associated with requiring communities to build those structures. One participant explained, "vertical evacuation is a good idea when structures are available. The cost to build a structure for vertical evacuation for an event that might never occur would be cost prohibitive and politically unpopular – a waste of funds." All participants, 100% of respondents, agreed that requiring annual tsunami evacuation exercises for

schools located within a tsunami inundation zone was a good addition to the recommended program guidelines. One participant reasoned, "I think this is a reasonable requirement, we do fire and lockdown (active shooter) exercises, so why not tsunami evacuation exercises??" Finally, all respondents unanimously agreed that annual training, education, or outreach for owners and staff of high-occupancy businesses and residents located within a tsunami inundation zone would be good requirements for the TR Community program. See Appendix I5 for the New Hanover County, North Carolina final survey response matrix organized in tabular format.

US Virgin Islands. Of the four prediscussion survey invitations sent, only one response was logged in the Survey Monkey system. This provided a prediscussion survey response rate of 25% for the US Virgin Islands study site. No questions were skipped.

The respondent agreed that those communities having a local tsunami threat should be required to take more actions in order to protect human life. This respondent noted that in the US Virgin Islands, the main concern is a regional earthquake generating a local tsunami. This local tsunami would arrive on the shore within minutes, leaving little or no time for an official alert to those people within the inundation zone. When asked about requiring communities to identify natural high or inland ground for at-risk persons self-evacuation, this respondent agreed. Building on the previous answer, the respondent also agreed that communities should identify or build berms or vertical evacuation structures for individuals. However, this respondent noted that building these berms or structures would be very expensive and potential cost prohibitive for communities. This participant agreed that any school located within an inundation zone should be required to conduct annual tsunami evacuation exercises, expanding the requirement to include an evaluation of each drill or exercise conducted. The recommendation to require annual training, education, or outreach to both high occupancy businesses and residents located within

the inundation zone was also favorable to this respondent. While agreeing with the general requirement, the respondent added that these types of activities may be costly both in time and money. Additionally, each community should ideally have a comprehensive plan accounting the training, education, or outreach of all community businesses and persons. See Appendix I6 for the US Virgin Islands final survey response matrix organized in tabular format.

Integrated Summary

Across the six study sites, all confirmed focus group participants were invited to participate in the prediscussion survey component of the research study. This resulted 47 prediscussion survey invitations being sent via email 1 week prior to each scheduled focus group discussion. Reminder emails were sent to all participants 3 days prior to each scheduled focus group discussion. Twenty individuals completed the prediscussion survey through the online Survey Monkey system. This provided an overall prediscussion survey response rate of 43% for the entire study.

Prior to conducting each focus group discussion, the researcher conducted a preliminary review of each set of prediscussion survey responses. This review provided insight into the depth and scope of understanding demonstrated by the participants who assessed the newly proposed TR Community program guidelines and responded to the survey. Across all sites, it was evident from prediscussion survey data that a full review of definitions (local, regional, and distant tsunami, etc.) and a programmatic background of the development of the TR Community program guidelines evaluation would be necessary to ensure all participants had a clear understanding of the concepts being discussed during the focus groups. The prediscussion survey data also allowed the researcher to prepare for site-specific questions regarding the program, while also guiding the discussion to include both site-specific and national

programmatic aspects of the proposed guidelines. Overall, the prediscussion survey data provided insight into individual perceptions and beliefs regarding the TR Community program, which provided the researcher with a starting point to encourage discussion and colearning between participants for the focus group discussions.

When asked if communities with a local tsunami threat should be required to take more actions to protect human life than those communities with only a distant tsunami threat, slightly more than half (55%) of all participants agreed. Twenty-five percent of all participants were unsure this was a necessary requirement; leaving 20% who disagreed outright. Overall, regardless of agreement status, the largest concern among participants was how this subdivision would be implemented by communities and the TR Community program. Participants also described their desire for a standardized set of requirements, sharing frustration or dissatisfaction with adding unnecessary complexity to the program.

Similarly, only 50% of participants agreed that subdividing community vulnerability to local versus distant tsunami hazards would be appropriate in their community of residence. The remaining participants were evenly split with 25% disagreeing and 25% unsure or providing no response to the question. While the majority of participants identified whether their community would be easy to classify through the proposed subdivision, many were concerned with how their community would be required to plan for the specific hazard type. Again, participants shared their concerns regarding unknown implementation aspects of the proposed subdivision.

Ninety percent of all participants strongly supported the proposed requirement for communities to identify natural high or inland ground for at-risk persons to use for self-evacuation. Across all six study sites, participants recognized that this activity would be very helpful in the planning process. While the majority of participants supported this requirement,

there was concern expressed regarding private versus public ownership of land. One site brought up very specific concerns because the government would not be able to require private landowners to "donate" their land for public evacuation usage.

When asked to consider a new requirement for communities to identify or build berms or other structures for use in vertical evacuation, participants had a split response. Seventy-five percent of participants felt that the identification of berms or other structures would be a helpful activity for communities but did not agree with requiring communities to build such structures. Across all sites, participants were very concerned about the cost implications of such a requirement, and how lacking resources would prohibit many communities from engaging in the TR Community program. Two of the study sites felt that recommending this activity, rather than requiring mandatory action, would be better received and more conducive to community participation in the program.

The newly proposed requirement for annual tsunami evacuation exercises for schools located within an inundation zone of a community with a local tsunami hazard was well received by participants, with 95% supporting this requirement. Participants in all sites agreed that this type of activity would be very useful for schools. Participants in two study sites even asserted that the once a year requirement should be the minimum level requirement. Participants at one site also added that an evaluation of this mandatory evacuation exercise would be a useful addition to the required action for TR recognized communities.

Across all sites, requiring annual training, education, or outreach for owners and staff of high-occupancy businesses located within an inundation zone was also favorably received with 85% of participants supporting this activity. While participants from all sites agreed that this type of required action would be very helpful in communities, several participants also

questioned how such a requirement would be mandated or implemented by the NWS Tsunami Program. Participants at one site agreed with some kind of annual training, education, or outreach activity but added that it should be a comprehensive plan. Participants from another site were concerned that all businesses, not just those located within an inundation zone, should be included in all education and outreach activities.

Similarly, 85% of participants supported the proposed requirement of annual training, education, or outreach for those residents living within an inundation zone. Again, several participants shared their concern regarding how this type of mandatory action would be implemented and monitored by the NWS Tsunami Program. Participants also shared their concern regarding the cost requirements of engaging in these types of outreach programs. Finally, participants from two sites reemphasized that any training, education, or outreach activities should be community inclusive, providing information to all community residents. The final prediscussion survey integrated response matrix (Table 7) organizes the described data into tabular format below.

Table 7:

Integrated prediscussion survey results matrix

	Kodiak, Alaska[H] (n=4)	**Coronado, California[I] (n=4)**	**Seaside, Oregon[H] (n=4)**	**Kauai, Hawaii[H] (n=2)**	**New Hanover County, North Carolina[L] (n=5)**	**US Virgin Islands[H] (n=1)**

Should communities with a local-tsunami threat take more actions to protect human life?	• Yes (3)
	• Depends (1)
	  • Implementation concerns
	  • Planning
		• No (1)
		• Depends (1)
		• N/A (2)
		
		• Standardization
		• Implementation concerns
			• Yes (2)
			• No (2)
			  • Implementation concerns
			
			• Planning
			• Standardization
			  • "worst case scenario"
				• Yes (1)
				  • "Different levels of threat = different levels of response"
				  • Implementation
				• No (1)
				  • Standardization
					• Yes (4)
					  • Planning
					• Unsure (1)
					  • Implementation concerns
					
					• "Community risk should equal community preparation"
						• Yes (1)
						  • Planning
						  • "Regional local earthquake and tsunamis are our main concern"

Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• Yes (4)
	  • New subdivision
	  • Local hazard community
		• Yes (2)
		  • New subdivision
		  • Local hazard community
		  • Planning
		• N/A (2)
			• Yes (1)
			  • New subdivision
			  • Local hazard community
			• No (2)
			  • Planning
			• N/A (1)
			  • Standardization
				• Yes (2)
				  • New subdivision
				  • Local hazard community
					• No (3)
					  • Unnecessary complexity
					• Unsure (2)
					  • Implementation concerns
						• Yes (1)
						  • New subdivision
						  • Local hazard community

Thoughts about requiring communities to identify natural high or inland ground for at-risk persons	• Yes (4)
	  • Planning
	  • Helpful activity
		• Yes (3)
		  • Planning
		  • Training
		  • Required
		• N/A (1)
			• Yes (4)
			  • Helpful activity
			  • Planning
			  • Implementation concerns
				• Yes (2)
				  • Requirement
				  • Implementation concerns
				  • "Private ownership of land = difficulties"
					• Yes (4)
					  • Planning
					  • Helpful activity
					  • Requirement
					• Unsure (1)
					  • Cost concerns
					  • Implementation
						• Yes (1)
						  • Planning

Table 7: (Continued)

Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• Yes (3)
	  • Helpful activity
	  • Cost concerns
	• Unsure (1)
	  • Optional
	  • Building structures
		• Yes (3)
		  • Requirement for identification
		• N/A (1)
		
		• Cost concerns
		  • Optional
		  • Building structures
			• Yes (3)
			  • Identification yes, building no
			• No (1)
			  • Cost concerns
			  • Implementation concerns
			  • Resident risk tolerance
				• Yes (2)
				  • Planning
				  • Cost concerns
				  • "Constructing unnatural berms for an "unlikely event seems wrong"
					• Yes (3)
					  • Helpful activity
					• Unsure (1)
					  • Cost concerns
					  • Restrict communities
					• N/A (1)
						• Yes (1)
						  • Cost concerns

Thoughts about requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Yes (4)
	  • Requirement
	  • Helpful activity
	  • "Once a year is the minimum that should be required"
		• Yes (3)
		  • Requirement
		  • Helpful activity
		  • "Tsunami evacuation exercises for schools in inundation zones should be held at least twice per year"
		• N/A (1)
			• Yes (2)
			  • Requirement
			  • Helpful activity
			  • Oregon already does this (2)
			  • State law
				• Yes (2)
				  • Requirement
				  • Helpful activity
				  • Hawaii has been doing this for all schools
					• Yes (5)
					  • Requirement
					  • Helpful activity
					  • "we do fire and lockdown (active shooter) exercises, so why not tsunami evacuation exercises??"
						• Yes (1)
						  • "There should also be an evaluation of the drill or exercise"

Thoughts about requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	• Yes (4)
	  • Helpful activity
	  • Requirement
	  • Implementation concerns
		• Yes (2)
		  • Helpful activity
		  • Requirement
		• N/A (2)
		
		• Inclusive
		  • All businesses – not just those in inundation zone
			• Yes (3)
			  • Helpful activity
			  • Optional
			  • Implementation concerns
			• N/A (1)
				• Yes (2)
				  • Requirement
					• Yes (5)
					  • Helpful activity
					  • Requirement
						• Yes (1)
						  • Planning
						
						• Inclusive
						  • "Should have a comprehensive plan"

Table 7: (Continued)

Thoughts about requiring annual training, education, outreach for residents living in the inundation zone	• Yes (4)
	  • Helpful activity
	  • Requirement
	  • Implementation concerns
		• Yes (2)
		  • Implementation concerns
		• N/A (2)
		
		• Inclusive
		  • All residents – not just those in inundation zone
			• Yes (3)
			  • Helpful activity
			  • Optional
			  • "Cannot be mandated or required"
			• No (1)
			  • Implementation concerns
			
			• Inclusive
			  • All residents – not just those in inundation zone
				• Yes (2)
				  • Requirement
					• Yes (5)
					  • Helpful activity
					  • Requirement
						• Yes (1)
						  • Cost concerns

The number in parentheses indicates the number of individual respondents providing a particular response
[H] Indicates communities with a high degree of tsunami hazard exposure
[I] Indicates communities with an intermediate degree of tsunami hazard exposure
[L] Indicates communities with a low degree of tsunami hazard exposure

The above matrix (Table 7) was used to quantify the acceptability of the various proposed TR Community program guidelines recommendations by all survey participants, as seen below in Table 8. While the unsure or N/A category is the smallest response category of acceptability, it stands to reason that these participants were unsure or failed to answer individual questions because they did not have enough information to form an opinion. The unsure or N/A category appears to demonstrate a need for providing more information and background at the beginning of each focus group session so that those unsure participants may form or develop opinions regarding the proposed guidelines over the course of the discussion.

Table 8:

Acceptability of Proposed TsunamiReady™ Community Program Guidelines Changes

	Yes (%)	No (%)	Unsure or N/A(%)
Should communities with a local-tsunami threat take more actions to protect human life?	11 (55)	4 (20)	5 (25)
Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	10 (50)	5 (25)	5 (25)
Requiring communities to identify natural high or inland ground for at-risk persons self-evacuation	18 (90)	0 (0)	2 (10)
Requiring communities to identify berms or other structures for vertical evacuation	15 (75)	1 (5)	4 (20)
Requiring annual tsunami evacuation exercises for schools located within the inundation zone	19 (95)	0 (0)	1 (5)
Requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	17 (85)	0 (0)	3 (15)
Requiring annual training, education, outreach for residents living in the inundation zone	17 (85)	1 (5)	2 (10)

Focus Group Discussions

Focus group discussions were used to explore participant beliefs formed through discussion, debate, and colearning among peers regarding tsunami hazards and the TR Community program using the central route of the Elaboration Likelihood Model (ELM). Central perceptions are formed and changed through consideration and integration of information relevant to the product or service gained through discussion and interaction with others (Cacioppo & Petty, 1979). Participant perceptions and beliefs were collected through focus group discussions which encouraged participant colearning and sharing of information regarding the revised guidelines for the TR Community program. The following subsections describe an individual level analysis of each study site followed by the final integrated summary between sites. Information for each site is described by topic and the associated theme(s) identified in the analyses.

Site Specific Findings

Kodiak, Alaska. Eighteen individuals were contacted to participate in the Kodiak, Alaska TR focus group discussion. Of those invited, eight individuals confirmed their participation. Eight individuals attended and participated in the focus group discussion held in October 2013. This provided a focus group discussion participation rate of 100% for the Kodiak, Alaska study site.

Topic: Subdivision of communities by vulnerability. Theme: Prioritize local event for activities: In reviewing the proposed guidelines, Kodiak participants compared the new subdivision of guidelines by community vulnerability to the tsunami hazard directly with the old guidelines based on population. One participant explained, "I believe that the population of an area shouldn't have anything to do with its readiness – it should be the local threat that they are

exposed to…I think you are going in the right direction." Participants unanimously agreed that it is necessary for a national program like the TR Community program to subdivide required guidelines. Summing up the discussion, participants agreed that the proposed subdivision separating those communities with a local threat, communities requiring preparation for immediate action to save lives, makes sense when some communities are only at risk to a distant tsunami with more time to respond.

Subtopic: Four standard actions. Theme: essential: When Kodiak participants were asked to consider the proposed four standard actions to be required of all communities, regardless of tsunami hazard distinction, all participants agreed with the described actions. One participant likened the four standard actions to a "formula" or process of creating a preparedness plan for the various communities located within Kodiak Island. This same participant continued to describe how one could use the "formula" as a performance measure of the TR Community program.

Topic: Guidelines document. Theme: NIMS formatting: When asked to discuss the updated format of the TR Community program guidelines, all participants unanimously agreed it was greatly improved. In following the National Incident Management System (NIMS) formatting propagated by FEMA, the TR Community program guidelines follow a standardized format. Participants agreed that using this format makes the guidelines more understandable and translatable across emergency management professionals. One participant summed it up saying, "This is a pretty common format these days. It matches our emergency response plans."

Topic: Evacuation: As a currently recognized TR community, Kodiak has an existing evacuation strategy, evacuation signage, and identified and accessible evacuation routes. All participants agreed that even though there is a current plan in place, continued evaluation of the

plan has provided for the creation of improved maps with updated information. All current planning is based off of a "worst case scenario" that was created using six or seven different local tsunami scenarios with the inundation zone based on the 1964 earthquake and tsunami which greatly impacted Kodiak.

Topic: School evacuation drills or exercises. Themes: Useful and necessary: Emergency drills and exercises are currently used in preparation against various threats throughout the Kodiak community. Community-wide testing of the tsunami warning sirens takes place every Wednesday afternoon at 2pm. While this test is done weekly, it was acknowledged by all participants that no community-wide tsunami evacuation drill has ever been conducted and is probably needed.

The proposed addition of mandatory annual school evacuation exercise was well received by the Kodiak participants. All participants agreed that this type of required action would be very appropriate, particularly for communities with a local tsunami hazard and schools located within an inundation zone. One participant even felt that annual evacuation exercises would help with population turnover saying, "…it's educating kids, it's a start, they will carry that home with them…" Consensus among participants was that one mandatory evacuation drill per year would be very achievable and very useful as a required community preparedness activity. Participants indicated that communities with a distant tsunami hazard should not be required to have a full-scale exercise annually. Rather, those communities should focus on having an evacuation plan in place and include an annual discussion or table-top exercise.

Topic: Vertical evacuation. Theme: Missing step or action: In considering the various additional requirements for those communities who would be designated as having a local tsunami hazard, the Kodiak participants felt there was potentially one missing action in the

Mitigation section of the guidelines. Participants thought that before communities began planning and building vertical evacuation structures, they should first allocate resources to ensuring that evacuation routes were clear and structurally sound. Most participants agreed that priority should be placed on providing secure and clear evacuation routes before trying to build additional structures.

Theme: Need education: Participants were interested in learning more about vertical evacuation and other TR recognized communities that were engaged in preparing for a vertical evacuation strategy. All participants agreed that they don't know much about other communities' experience in seeking or earning TR recognition. Generally, participants agreed that while in some cases building vertical evacuation structures might provide needed areas of safe refuge for community members, the construction would also raise additional concerns and issues. One significant concern would be the structural integrity of the building or structure. All participants agreed that the resources needed to build and maintain such vertical evacuation structures could be significantly cost prohibitive and restrict some communities from ever engaging in the TR Community program.

Theme: Costs: Over the course of the vertical evacuation discussion, participants continuously offered potential alternatives to building vertical evacuation structures. Unanimously, all participants agreed that money would be better spent strengthening current evacuation routes and providing additional evacuation signage and education.

Theme: Protection of human life: Participants generally agreed that regardless of any other concerns, requiring communities to build vertical evacuation should be reserved for only those communities that have no other options for providing safe evacuation for their population as a last resort. However, only one participant was willing to answer the direct question

regarding a community's ability to provide safe evacuation for all of its people by saying, "I would have to say if you don't have the means to evacuate your people to safety, you can't be TR."

Topic: Evacuation effectiveness. Themes: Testing plan elements and evaluation: As the discussion shifted into how a community could determine evacuation effectiveness, participants referenced the recommended four standard actions as "benchmarks" for effectiveness. One participant even shared, "[the four standard actions are] in our operations plan, it's a formula in our evacuation plan to determine how long it will take to evacuate downtown Kodiak for example." Participants generally agreed that communities could apply the recommended four standard actions to determine the timeframe and the route and then evaluate actual evacuation exercises against the expected outcome. If a community were able to achieve the minimum requirements identified by the four standard actions, that community's evacuation plan could be considered effective.

Additional discussion regarding evacuation effectiveness centered on the local canneries in Kodiak and plant safety operations plans and exercises. All participants agreed that the canneries have a need to evacuate, not just for tsunamis but for hazardous materials releases and fires too. Therefore, all canneries engage in evacuation exercises that are observed by local emergency management. Though, it was noted by several participants that the canneries typically conduct evacuation exercises during the "off season" when the transient or seasonal fishing population are not working at the canneries and the evacuation exercise only moves employees out of the cannery building itself and not out of the tsunami evacuation zone.

Theme: Communication flows: Further discussion shared that evacuation effectiveness is based on coordination throughout the emergency management operations sector of a given community.

Topic: Proportion of the population to be protected. Theme: Seasonality: All participants agreed that the number of people at risk to a tsunami in Kodiak changes seasonally. The largest numbers of staff or workers at the canneries (located in the inundation zone) is during the production season. Additionally, there are seasonal fluctuations of tourists, hunters, and fishermen resulting in higher population numbers during the summer and fall months.

Theme: 100% of population unrealistic: All participants agreed that expecting to save 100% of the population from a local tsunami would be unrealistic. One participant explained, "I don't think 100% is realistic. Not under any circumstances. I'm speaking from practical experience – from hurricanes. There are people who won't leave the village bar – they'll say no, I'm not going anywhere."

Theme: No mandatory state evacuation law: There is no state law providing for a mandatory evacuation, so expert community stakeholders in Kodiak hope to educate the community as best as possible so that they will self-evacuate when necessary.

Theme: 100% of at-risk population: Participants agreed that evacuations should be prioritized, with greater time spent helping special needs populations that are unable to help themselves. Special needs populations were described as school children, daycare or nursery facilities, and nursing home or elder care facilities.

Topic: Education. Themes: Useful and necessary: Participants acknowledged that, collectively, expert community stakeholders in Kodiak "could do a better job with preparedness outreach – with regards to evacuation outreach, with regards to preparedness kits, everything

across the board." One particular participant recommended that as a group they "should be looking towards homeland security grants that could aid [them] in that education…" Overall, the discussion supported general education recommendations.

Topic: Education of businesses. Theme: Lack of cooperation: Conversely, participants were wary of the proposed requirement for mandatory annual training or education of high occupancy or high volume businesses located within the inundation zone. The overall sentiment was best summed up, "I think you are going to be hard-pressed to get buy-in from the business community also with regards to the cost association with that…we have got a lot of small businesses here that are on the edge and just to include more government bureaucracy or whatever you want to call it with regards to tracking this training and reporting and paying staff for the training – I just don't think you'd get buy-in from the local community." Participants did not want to be required to conduct activities that ultimately they are not responsible for implementing (businesses can say no and refuse to conduct trainings). Throughout the course of this discussion, participants focused on all local businesses rather than on the specification of high occupancy or high volume businesses.

Topic: Education of residents. Themes: Useful and necessary: The proposed mandatory annual education of residents living within the inundation zone was better received by the participants. One participant shared, "I think [education] is important because one of the metrics we always hear in the hurricane part of the country was that 90% of the population that lives in a hurricane vulnerable zone has never experienced a hurricane in their life. And that's probably more true of tsunamis. Probably higher. So education is important because people do forget." Additionally, residential turn-over and transient or seasonal populations within Kodiak are currently a significant concern for tsunami education efforts. A matrix depicting the Kodiak,

Alaska discussion topics with their supporting and opposing themes can be seen below in Table 9.

Table 9:

Kodiak, Alaska Discussion Topics with Supporting and Opposing Themes

Major Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability [subtopic: Four standard actions]	• Prioritize local event for activities	
Proportion of the population to be protected	• 100% of at-risk population	• 100% of population unrealistic • No mandatory evacuation laws
Education of residents	• Useful • Necessary	
Education of businesses	• Useful • Necessary	• Lack of cooperation • Private businesses
Evacuation effectiveness	• Communication flows • Testing plan elements • Four standard actions • Evaluation	• Seasonality
School evacuation drills or exercises	• Useful • Necessary	
Vertical evacuation	• Protection of human life	• Missing a "step" or action • Secure & clear evacuation routes first • Costs • Time & money • Limitations • Need education
Guidelines document	• NIMS formatting	

Coronado, California. Twenty-one individuals were contacted to participate in the Coronado, California TR focus group discussion. Of those invited, nine confirmed their participation. Thirteen individuals attended and participated in the focus group discussion held in October 2013. This provided a participation rate of 144%. Four participants attended even though they did not confirm their participation.

Topic: Subdivision of communities by vulnerability. Theme: Prioritize local event for activities: The newly revised TR Community guidelines document was examined in great detail,

focusing on the most notable differences in required actions based on the proposed subdivision between community vulnerability to tsunami hazard. Coronado participants agreed that tsunami hazard would be different between communities and that those communities with a higher hazard should engage in additional activities to protect the people. One participant described the subdivision, "I like the way it's framed. We [Coronado] are going to do them both [local and distant tsunami activities]." General consensus among the group indicated that the subdivision was easy to understand and that Coronado as a community would probably be classified as having both a local and a distant tsunami hazard. This classification would require emergency management to undertake the actions stipulated for both local and distant tsunami activities.

Theme: Four standard actions: One participant also noted that delineation between local and distant tsunami hazard identification should include more than just the expected inundation level. This supports the inclusion of a set of standard actions required by all communities, regardless of a community's tsunami hazard classification. Several participants agreed that it would be a reasonable requirement for all communities located along a coastline to determine the four standard actions proposed by the research team. While most participants were in favor of these additional actions, one noted that if the program made "the criteria hard and fast, [communities] may not be able to achieve it."

Topic: Guidelines document. Theme: NIMS formatting: After reviewing the TR Community guidelines document, Coronado participants unanimously agreed the changes in formatting were well made and followed "emergency management standards to deal with an all-hazards approach, including tsunami."

Themes: Checklist and definitions: All participants scrutinized the formatting, and pointed out the benefits of a checklist to facilitate tracking of completion of program

requirements. Concern was expressed by several participants that activities could only be identified as "planned" and not "in progress" in the current draft of the checklist. One participant summed up the conversation saying, "I think in general all the work that you've done, all the work that you are doing, and – I know more about tsunamis now than I did two years ago and the community is better prepared today than they were two years ago and so if we can keep moving forward and including people and getting things more like this NIMS compliant with standardization – I think we are heading in a good direction."

Topic: Evacuation. Theme: Communication flows: Expert community stakeholders in Coronado have spent considerable time creating evacuation maps and providing outreach and education to their community. One participant described the benefits of pursuing TR recognition regarding evacuation planning, "…it encourages you to achieve the best possible solution that you can achieve…we are continuously looking to better what we have and we educate the public, we drill with our disaster preparedness folks and we outreach to our community…" It was also noted by participants that it would be useful and helpful to hear about other communities' experiences working with the TR Community program.

Topic: Evacuation effectiveness. Theme: Full-scale test unrealistic: To date, no full-scale drill has been conducted of the entire tsunami evacuation plan in Coronado. Participants identified multiple barriers to conducting a full-scale evacuation exercise, acknowledging that the second best alternative would be testing as many of the plan elements as possible. Several tests have been, and continue to be, conducted throughout the community. Emergency communications tests have been run in San Diego, evacuation modeling has been conducted, and the siren system is tested at least twice per year.

Theme: Signage: The Navy base has also conducted a "reduction of population exercise," similar to an evacuation drill. Several local communities reside along the beach, both on Coronado Island and along the San Diego coast. Discussion concerning creating effective evacuation strategies focused on coordinated efforts between these communities. To do that expert community stakeholders are working to ensure a common language and symbology for all cities and communities. All evacuation maps and educational material use the same language and symbols so that tourists, visitors, or residents are not confused when moving from one beach to another.

Theme: Testing of plan elements: Participants discussed the importance of public education and notification triggers in creating an effective tsunami evacuation plan. During the course of this discussion, some participants referenced the four standard actions described above as potential "criteria" for evaluating the effectiveness of a community's plan. If a community has adequately addressed each of the four standard actions, that community's plan might be considered effective through testing. One participant also discussed the importance of signage, "I am a strong believer in the signage and I think that's a…form of effectiveness." Consistent signage also provides an outreach and education tool for tourists and visitors to the community. It is vital that signage is provided from the beach all the way along the evacuation route.

Topic: *School evacuation drills or exercises. Theme: Useful:* Over the course of the discussion, several types of drills and exercises were discussed. Particularly regarding the proposed requirement for annual evacuation drills for schools located within an inundation zone, the discussion focused on the potential for table-top exercises. When pressed to discuss the potential for full-scale evacuation exercises, participants argued amongst themselves regarding bussing needs, parent reactions, and comparability between an exercise and a real event. When

the discussion returned to the community plan of moving people "inward and upward," most participants agreed that the definition of evacuation needed to be clarified within the guidelines between long-term evacuation and housing and immediate evacuation to a safe location from the hazard. Ultimately, participants agreed that due to various events across the country in the last few years, school systems are placing more emphasis on emergency drills and exercises. While no one present at this particular discussion could speak directly for the school system, participants all agreed that "the school district has…changed their dynamics to push for a lot of drills…today they'll play a lot more than they ever have, they will continue to do that."

Topic: Vertical evacuation. Theme: Protection of human life: Due to the infrastructure within the community of Coronado, collectively the community is currently operating with a vertical evacuation strategy in the event of a locally-generated tsunami. With only two-lane roads leaving the island in two locations, emergency management has decided to focus on strategies to move people "inward and upward." Evacuation maps have been distributed to the local resident community, and evacuation route maps are currently being created to be placed along all beach fronts. While all people, whether residents, tourists, or seasonal workers, are advised to move to a higher structure with multiple stories in the event of a tsunami, no designated or approved structures are officially identified as vertical evacuation points. Participants did describe how most one-story homes have been torn down and rebuilt in accordance with recommendations providing for a second-story for vertical evacuation purposes. The Coronado community was described as "highly engaged in preparedness."

Theme: Costs: When asked to discuss the proposed requirement for communities with a local-tsunami hazard to build vertical evacuation structures if they are unable to get people into a safe area located in natural high or inland ground, participants became quiet. All participants

agreed that requiring communities to build such structures would be unrealistic. When pressed if communities with no natural high or inland ground should be required to build vertical evacuation structures in order to earn TR recognition, one participant emphatically responded "no." This same participant continued, "…this community wouldn't build – if the elevation was really like 40 feet, and our island was coated with water – this community wouldn't tolerate building a football stadium in the center that is 60 feet high for something that may or may not occur…you can keep your signs, we'll do other stuff." Consensus among participants agreed that requiring communities to build vertical evacuation structures would be cost-prohibitive and "a lot of places aren't going to become TR" with such a requirement.

Topic: Proportion of the population to be protected. Theme: 100% of population unrealistic: When discussing how to determine the population that would need to be provided protection in the event of a tsunami, the Navy described how they evaluate its jurisdiction and the population residing within the inundation zone. Currently, the plan is to house the Navy population from the inundation zone up in what they identified as "North Island." Knowing the population on-base who would require housing, the Navy base also recognizes that they would open their doors to provide safe haven to the civilian community as well (with room for up to 7,000 individuals, but not everyone who would need refuge) – providing rudimentary care and shelter until after the tsunami.

Theme: 100% of at-risk population: Discussion regarding the civilian population needing protection revolved around area hotels with multiple stories who could "be a good neighbor" in the case of a tsunami and allow tourists or visitors to seek refuge within the upper floors of the hotel. Priority would be placed on moving tourists and visitors to safe refuge because they are

some of the most at-risk people during a tsunami. The majority of residential homes are two-stories, which will hopefully provide vertical evacuation for the resident population.

Theme: Seasonality: Currently, the greatest concern rests on providing protection for the drastically fluctuating tourist population dependent upon the season.

Topic: Education of businesses and residents. Theme: Useful: Participants all agreed that the community of Coronado is very engaged and interested in preparedness education and activities. Overall, the community supports all activities aimed at increasing preparedness response, including tsunami education. Discussion regarding the proposed requirements for providing annual training, education, or outreach to both high occupancy businesses and residents located within the inundation zone were determined to be beneficial activities. Despite the value of said education activities, participants unanimously agreed that making such activities mandatory or required for earning TR recognition would not be beneficial. Rather, it was discussed that these activities could prevent communities from earning recognition because private businesses may not agree to receive or provide annual trainings. All participants support making these training, education, and outreach activities optional or recommended but not mandatory. A matrix depicting the Coronado, California discussion topics with their supporting and opposing themes can be seen below in Table 10.

Table 10:

Coronado, California Discussion Topics with Supporting and Opposing Themes

Major Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability	• Four standard actions • Prioritize local event for activities	• Need education • Implementation questions
Proportion of the population to be protected	• 100% of at-risk population	• 100% of population unrealistic
Education of residents	• Useful	• Seasonality
Education of businesses	• Useful	
Evacuation effectiveness	• Communication flows • Signage • Testing plan elements • Four standard actions	• Full-scale test unrealistic • Seasonality
School evacuation drills or exercises	• Useful	
Vertical evacuation	• Protection of human life	• Costs • Time & money
Guidelines document	• Checklist • NIMS formatting	• Definitions

Seaside, Oregon. Seventeen individuals were contacted to participate in the Seaside, Oregon TR focus group discussion. Of those invited, nine individuals confirmed their participation. Seven individuals attended and participated in the focus group discussion held in October 2013. This provided a participation rate of 78%.

Topic: Subdivision of communities by vulnerability. Theme: Prioritize local event for activities: When discussing the proposed subdivision of guidelines based upon community vulnerability to a tsunami hazard, participants generally agreed that it would make sense to divide communities into one of two categories because the preparation and planning for a local tsunami would be very different from preparation and planning for a distant tsunami. Several participants were concerned regarding a community designation of being vulnerable to both a local and a distant tsunami. Discussion regarding the classification of various Oregon coastal communities focused around how each community might be required to plan for both a local and

a distant event – requiring different inundation maps, different evacuation route planning and signage, and different educational programs. Despite agreeing that the subdivision would be useful at a national level for the TR Community program, participants continued to share their desire for greater consideration within the program for the local tsunami rather than the distant event. Particular attention was directed at separating out a Cascadia subduction zone-generated event from all other local-source tsunami events as well. All participants agreed that the tsunami hazard is greatly amplified by the potential of a Cascadia earthquake.

Theme: Four standard actions: When asked to respond to the four standard actions proposed for all communities regardless of tsunami hazard classifications, the discussion between participants became more heated. Being situated along a coastline facing the Cascadia subduction zone, participants shared concern regarding the size of the event for which they should plan. The response to the four standard actions would vary greatly depending on both the size of the earthquake generating a local tsunami and the season of the year for many Oregon beach communities. Participants shared their concern for adding these four standard actions to the TR Community program, saying that providing those answers would be very hard for communities in the Pacific Northwest.

Over the course of the discussion a few participants discussed how political influence within a community could bolster or suppress tsunami activities. In discussing political sway, one participant said "…we are all bound by our elected officials as far as policy is concerned…these guys are only in office for four years…" This participant explained how many of these elected officials do not engage in any tsunami programming because their term is too short to see tangible benefits within the community before the next election. This lack of local

political and governmental support can “hamstring” a community’s efforts to achieve TR recognition.

Topic: Guidelines document. Theme: NIMS formatting: All participants agreed that in revising the format of the TR Community program guidelines, making it more aligned with the FEMA required Hazard Mitigation Plans the language has become more standardized and useful.

Themes: Checklist and definitions: Participants also agreed that the checklist was a useful tool in the planning and implementation process but were concerned with only having an option to identify activities once they were achieved. Several participants discussed how a community engaging in longer-term projects or activities, such as a tsunami exercise every 3 years for example, allowed the community to only denote “when” that 3-year activity was “achieved” and not “planned”. It was recommended that a column be added to the checklist to denote when an activity was “planned” in addition to the “completed” column.

Topic Evacuation. Participant discussion regarding evacuation plans and drills focused on the perceived challenges faced by communities that would be designated as having both a local and a distant tsunami hazard. Several participants agreed that currently, Seaside and other coastal Oregon communities have been preparing separate evacuation plans, routes, and signs for either a local or a distant tsunami. Local events are designated by yellow inundation maps while distant events are designated by orange inundation maps. Frustrations were shared among participants concerning this practice. It was felt by all participants that it would be more effective for both expert community stakeholders and community members if only the worst-case scenario was used for planning and education purposes. One participant explained, “I would rather just stick with the yellow. It is less confusing and if you are prepared for the yellow, you sure as hell are going to be prepared for the orange."

Topic: School evacuation drills or exercises. Themes: Useful and necessary: Current Oregon state law requires all schools to conduct an evacuation exercise at least once per year. In addition to the required exercise, there is also a certain amount of core school curriculum dedicated to earthquake and tsunami preparedness. Participants shared that these requirements seem to be upheld at all schools. One participant shared, "What really helps is that state law also requires all public schools in the state of Oregon to do monthly fire drills so students and staff are already queued up to getting out of a building quickly, so the next piece is just getting them to high ground."

Participants agreed that even in states where no law exists, including the newly proposed mandatory annual evacuation exercise for schools located in an inundation zone would be a good mandatory action for those communities with a local tsunami hazard. Additionally, participants all agreed that consideration should be given to requiring other care facilities located within an inundation zone (hospitals, residential care facilities, day cares, etc.) to engage in similar annual evacuation exercises. It was noted that those schools located within an inundation zone of a distant tsunami hazard community should at minimum have a plan, and ideally have a regularly scheduled table-top exercise too.

Topic: Vertical evacuation. Theme: Costs: A significant proportion of time was spent discussing vertical evacuation and the newly proposed actions for communities identified as having a local tsunami hazard. All participants agreed that building vertical evacuation structures would be a misuse of community resources. Some of the activities preferred to building vertical evacuation structures included: evaluating evacuation routes and infrastructure integrity (roadways, bridges, etc.), strengthening or "hardening" evacuation routes and infrastructure (roadways, bridges, etc.), and evaluating already existing structures as potential

vertical evacuation structures. All participants agreed that if any requirement to build vertical evacuation structures was added to the TR Community program, then commensurate resources would also need to be provided.

Theme: Zoning laws: One final concern regarding vertical evacuation centered on zoning laws and regulations. All participants agreed that zoning restrictions could pose another significant barrier to communities building vertical evacuation structures and achieving TR recognition.

Theme: Missing a "step" or action: During the review of the additional actions that would be required by communities identified as having a local-tsunami hazard, Seaside participants agreed that one significant action and use of resources was missing from the Mitigation section of the guidelines. A lengthy discussion was devoted to the addition of a new Mitigation activity that was recommended to be placed before the required action of planning for vertical evacuation. All participants agreed that communities should first dedicate resources to evaluating evacuation routes for reliability and strengthening or "hardening" those routes as indicated by the evaluation. Consensus among participants was that once evacuation routes were evaluated, upgraded, and strengthened; only then should communities begin looking at vertical evacuation strategies and building structures.

Theme: False sense of security: One participant mentioned an "unofficial vertical evacuation" message that is discussed during some outreach and education activities in Seaside: "If you are in the downtown quarter and you are injured [from the earthquake] and you know you can't make it to high ground…look around at any concrete reinforced structure that is available and try to get as high as you can…" While this is an unofficial message, Seaside participants were very concerned that promoting vertical evacuation would give people a false

sense of security. It was surmised that community members would prioritize vertical evacuation (into potentially structurally unsound buildings) over following evacuation routes during a local tsunami.

Topic: E*vacuation effectiveness. Themes: Testing of plan elements and evaluation:* In order to evaluate evacuation effectiveness, Seaside assessed levels of community awareness and knowledge of the tsunami hazard. Seaside participated in early research activities that focused on these issues. Information gained from that research has provided detail for current and future community education and outreach activities. Additional means for assessing evacuation effectiveness included drills and the review of prior evacuations. By testing plans and evaluating previous evacuations, participants all agreed that future plans could be modified to correct for any mishaps experienced and ultimately make the plan more effective.

Theme: Seasonality: Several participants noted the significant challenges posed to evacuation planning and education in communities with significant seasonal and transient populations like Seaside and other coastal Oregon communities. One participant explained, "…if you just look at average summer populations, more than 50% of our homes in this town are second homes and so those second homes get a disproportionate amount of use in the summer months and yeah, the population instead of being 6,500 people is well over 10,000 on average…" One concern is that regardless of base population and seasonality, the municipalities never receive any increased funding to support regular public safety much less funding to expand tsunami education, outreach, and emergency service activities.

Topic: Proportion of the population to be protected. Themes: 100% of population unrealistic and no mandatory evacuation laws: As participants discussed the populations most at risk of a tsunami, those people who would be located within the inundation zone, the

conversation intensity increased. All participants agreed that creating an evacuation plan that was accessible and useful to 100% of the population was ideal, though several participants emphasized that there is no mandatory evacuation law in Oregon, and it is unrealistic to expect the current plan to save 100% of the people. Participants unanimously agreed that the purpose of the TR Community program is to educate community members and help them understand and plan for self-evacuation in case of a tsunami.

Theme: 100% of at-risk population: Understanding this perception, participants agreed that striving to protect 100% of the community population was best, but in actuality 100% would never be expected to self-evacuate. Though, it could be expected that 100% of certain vulnerable populations could be protected. All participants agreed that students, young children, and other care facilities should be prioritized for evacuation support.

Topic: Education of residents. Themes: Useful: One participant acknowledged that current expert community stakeholders have never asked the Seaside community residents what their plans would be if there was a tsunami. He proposed conducting an outreach activity to better understand how many community members actually intend to evacuate, particularly in the case of a local tsunami.

Theme: Seasonality: In discussing annual mandatory training, education, or outreach activities for those residents located within the inundation zone, participants unanimously agreed that this requirement would be largely unachievable. A significant proportion of the homes located within the inundation zone and throughout the Seaside community are second homes for people living in other areas for the majority of the year. Expert community stakeholders never know when these second home owners will be in-residence in Seaside (as compared with renters

or standing empty), so conducting any kind of outreach specifically to these homes would result in a substantial waste of both time and money.

Topic: Education of businesses. Themes: Useful and necessary: Conversely, participants were highly supportive of adding mandatory annual training, education, or outreach activities for high occupancy business owners and staff located within an inundation zone. Currently, the City of Seaside is working on creating a "Business Ready" program for businesses based on the TR Community program. As this program has been developed, it would be focused on providing a set of guidelines listing tsunami preparedness activities businesses could voluntarily engage in to earn community recognition as being a tsunami ready business. There has been some discussion of passing legislation to include language requiring businesses to engage in this program, but as of the focus group discussion date no laws had been formally drafted or considered. The main goal of the "Business Ready" program is to educate businesses in ways they can make tsunami awareness and education a positive aspect of their business management. A matrix depicting the Seaside, Oregon discussion topics with their supporting and opposing themes can be seen below in Table 11.

Table 11:

Seaside, Oregon Discussion Topics with Supporting and Opposing Themes

Major Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability	• Prioritize local event for activities	• Need education • Implementation questions
Proportion of the population to be protected	• 100% of at-risk population	• 100% of population unrealistic • No mandatory evacuation laws
Education of residents	• Useful	• Seasonality
Education of businesses	• Useful • Necessary	
Evacuation effectiveness	• Testing plan elements • Evaluation	• Signage • Seasonality
School evacuation drills or exercises	• Useful • Necessary	

Vertical evacuation		• Missing a "step" or action
		  • Secure & clear evacuation routes first
		• Costs
		  • Time & money
		• Zoning laws
		• False sense of security

Guidelines document	• Checklist • NIMS formatting	• Definitions

Kauai, Hawaii. Twenty individuals were contacted to participate in the Kauai, Hawaii TR focus group discussion. Of those invited, nine individuals confirmed their participation. Nine individuals attended and participated in the focus group discussion held in November 2013. This provided a participation rate of 100%.

Subdivision of communities by vulnerability. Theme: Prioritize local event for activities: Participants began by discussing the applicability of the newly proposed subdivision of the TR Community program guidelines to communities on the Island of Kauai. Participants discussed the most likely hazard classification that would apply to Kauai and agreed that they would be vulnerable to both local and distant tsunamis. As the discussion continued, participants

unanimously established that this type of programmatic subdivision would be both useful and appropriate for the communities in Kauai. All participants agreed that those communities with a local tsunami hazard should do more to prepare for a tsunami but added the caveat "I wouldn't want the federal government to require us to build the high structure [for vertical evacuation]."

Theme: Four standard actions: Next, participants discussed the proposed four standard actions for all communities regardless of hazard classification. It was noted that the community of Hanalei along the Kauai coast may take longer to evacuate than a tsunami wave arrival would allow for a locally generated event. General consensus showed that asking all communities to identify the answers to the four standard actions would help communities to be better prepared for a tsunami. Additionally, it was mentioned that the Kauai school district currently uses actions similar to the described four standard actions to help plan local school evacuations from tsunamis.

Topic: Guidelines document. Theme: NIMS formatting: Kauai participants unanimously agreed that the updated NIMS format of the TR Community program guidelines was a good modification. Discussion focused on how the newly proposed guidelines follow the same language and format of the incident command system used by both police and fire departments. One participant stated, "We are getting a logic that actually plug and plays in different localities so it's modular and affected, expands and contracts – we are getting used to that play book... It's very useful and standardization across the board, it should be maintained."

Topic: Evacuation. Theme: Communication flows: Participants spent a significant portion of time discussing warning notification and evacuation complexities for the island. All participants agreed that classifying a community's tsunami hazard by vulnerability has some inherent limitations. The largest concern was in regards to notification time of an impending

tsunami and the subsequent time needed to alert the Kauai community. Participants discussed the erosion of warning time through the notification system. For example, 1) the time it takes the PTWC to confirm a local tsunami after the generating event before notifying Hawaii Civil Defense, and 2) the time between a receiving a PTWC notification and the local Kauai Civil Defense activating local notification systems (i.e. the Blackboard system). Several participants asked if other TR recognized communities shared this concern.

Topic: School evacuation drills or exercises. Themes: Useful and necessary: As a state, Hawaii currently mandates that all schools located in a tsunami inundation zone must engage in annual tsunami evacuation exercises. This aligns well with the proposed action requiring all schools located in the inundation zone to conduct annual tsunami evacuation exercises. Several participants discussed the various local school evacuation exercises (one was conducted the day prior to the Kauai focus group discussion at Hanalei) and the different routes and strategies in place. Generally, participants agreed that all schools assess the recommended four standard actions as part of their planning process for each individual school. Based on the answers to those questions, the schools most often practice for a regionally-generated tsunami but also have plans in-place for local and distant events as well.

Topic: Vertical evacuation. Themes: Need education and zoning laws: While there is no current strategy for vertical evacuation using buildings in Kauai, discussion involved the potential for using the standard operating procedures currently in place in Honolulu. There is only one hotel over four stories high on the entire island of Kauai, so those particular standards in Honolulu would be unenforceable in Kauai. Additionally, there are specific zoning laws in-place to protect the natural beauty of the various beaches in Kauai. Those laws would prohibit the construction of very high buildings for use in vertical evacuation.

Theme: Costs: There has been prior discussion of integrating vertical evacuation within various communities on Kauai Island, but participants agreed those discussions were terminated because of the "astronomical costs" associated with building the necessary vertical evacuation structures. After much discussion regarding the costs versus benefits of vertical evacuation structures, all participants agreed that Kauai has enough natural high ground that building a structure would never be needed.

Theme: Protection of human life: All participants expressed concern for those communities that would be excluded from the TR Community program if they were unable to fund the building of such structures. It was preferred that other options be put forward for communities to engage in as a means of providing safe evacuation to people, particularly for smaller communities who would not have the necessary resources to build vertical evacuation structures.

Theme: False sense of security: The final comment regarding community perceptions of vertical evacuation included concern for the false sense of security people may feel by having structures identified for evacuation during a tsunami and those structures are not guaranteed to withstand a tsunami.

Topic: Evacuation effectiveness. Themes: Communication flows and evaluation: Kauai participants agreed that multiple means of notification are necessary for ensuring evacuation effectiveness. Additionally, participants supported learning from previous evacuations as a means of improving current evacuation strategy and planning efforts. For example, the last two events (the Japan and the Chile earthquakes and subsequent tsunamis) occurred at night. These events allowed the expert community stakeholders in Kauai to initiate and run through their entire evacuation plan successfully within 3 hours. All participants agreed that those two

evacuations were successful, admitting that there was still plenty of fine-tuning needed. Ultimately, participants unanimously agreed that having a strategy in place to evacuate a given population within the given timeframe of wave arrival (while accounting for special populations) would ensure a community's evacuation effectiveness – using the recommended four standard actions as a baseline.

Topic: Proportion of the population to be protected. Theme: Seasonality: Participants discussed the seasonality of tourism in Kauai, describing both the family vacationers and the "snow birds." It was agreed that there is a dual peak season in Kauai, with family tourists visiting during summer and winter vacations from school. "Snow birds" also add to the winter peak preferring to travel to Kauai during the coldest months at home. Expert community stakeholders currently use estimates of the tourist population based on the number of rental cars in use and the hotel maximum bed capacity figures. For planning purposes, this puts between 20-22,000 tourists on the island at the height of the two peak seasons. Additionally, calculations of at-risk persons are reached by using census track data and the current inundation zone. These estimations identify those people and populations in most need of education and protection in the event of a tsunami.

Theme: 100% of population unrealistic: When asked what percentage of the population should be assured safe evacuation for a community to be considered TR recognized, participants agreed that 100% would be a very unrealistic ideal. Unanimously, all participants agreed that not all people will evacuate in the event of a tsunami and emergency services cannot force anyone to evacuate. Additionally, participants agreed that they would not want to put a specific number on the required amount of people to be saved. By citing a required percentage of people

to be saved as a requirement for TR recognition, participants felt that the community would feel hurt and question how important their individual life is to city government.

Theme: 100% of at-risk population: Participants did agree however, that 100% of school and hospital populations located within an inundation zone should always be saved.

Topic: Education. A significant proportion of the discussion regarding education was directed towards focusing educational efforts on a local tsunami. Participants recognized that both tourists and community members needed to receive education to help them understand the difference between a local and a distant tsunami, and that in a locally-generated tsunami they would be on their own to respond quickly. Warning time and warning communication routes dominated this discussion, with participants agreeing that a clear communication plan is the backbone of a strong tsunami education program. It was also noted that the community of Kauai is very strong and closely bonded with community-wide education efforts, "as a community neighborhood [residents] talk about [tsunamis], plan for [tsunamis] and talk about [tsunamis] every year and so on and so that it is refreshed in their minds in case it happens."

Topic: E*ducation of businesses and residents. Themes: Useful and necessary:* When asked to discuss the proposed mandatory annual training, education, or outreach to both businesses and residents located within the inundation zone; participants strongly supported the need for wide-scale education efforts. "You need education and outreach to communities, businesses and the hotel industry in addition to all branches of government, primary non-governmental partners – wide sector dissemination!" The Kauai community is already working closely with the hotel associations and the security guard organizations from every hotel to create and organize tsunami response plans. Participants unanimously agreed, "That sort of procedure would be very useful for a short notice locally-generated event. A good requirement for your

TsunamiReady™ program." A matrix depicting the Kauai, Hawaii discussion topics with their supporting and opposing themes can be seen below in Table 12.

Table 12:

Kauai, Hawaii Discussion Topics with Supporting and Opposing Themes

Major Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability	• Four standard actions • Prioritize local event for activities	
Proportion of the population to be protected	• 100% of at-risk population	• 100% of population unrealistic
Education of residents	• Useful • Necessary	• Seasonality
Education of businesses	• Useful • Necessary	
Evacuation effectiveness	• Communication flows • Evaluation	• Seasonality
School evacuation drills or exercises	• Useful • Necessary	

Vertical evacuation	• Protection of human life	• Costs
		  • Time & money
		• Zoning laws
		• Limitations
		  • Need education
		• False sense of security

Guidelines document	• NIMS formatting	

New Hanover County, North Carolina. Fifteen individuals were contacted to participate in the New Hanover County, North Carolina TR focus group discussion. Of those invited, eight individuals confirmed their participation and attended the focus group discussion held in November 2013. This provided a participation rate of 100%.

Topic: Subdivision of communities by vulnerability. Themes: Prioritizing local event for activities and need education: Participants described having a distant-tsunami hazard only. As such, they discussed the applicability of the newly proposed subdivision of the TR Community program guidelines. All participants agreed that moving to a more risk-based type of criteria for

required actions was a good idea. One participant described, "I think that risk-based makes sense because it is certain warning mechanisms and response procedures are going to have to be different based on whether it's a local or distant [tsunami]." Another participant described the major differences between population based guidelines and the new hazard vulnerability guidelines, "…doing it by population, if there's not a real perceived risk then people aren't likely to make any preparations for it, take it seriously. There has to be some element of risk before anyone pays any attention to it." Several participants questioned how these changes would affect a community like New Hanover County, which would have only a distant hazard.

Topic: Guidelines document. Theme: NIMS formatting: All participants agreed that the NIMS format makes sense. The new format is easy to follow and understand.

Topic: Evacuation. New Hanover County is currently considered to have a low tsunami hazard. As a low hazard community, the current inundation maps indicate that evacuation is required only beyond the beachfront. Once people are evacuated back behind the sand dunes, the elevation is enough to have removed them from the inundation zone. All participants agreed that they are comfortable with the agreed upon wording for evacuation messaging and education.

Topic: School evacuation drills or exercises. Themes: Useful and necessary: Generally, participants agreed that schools that are located within an inundation zone should undergo some type of training or preparation for a tsunami. Supporting the recommended action, participants stated "A school residing inside a threat zone – certainly they should be prepared just like a tornado, hurricane or any other weather event. How can you say you are TR and not do at least that?" Reference was also made to American Samoa and the utility of school evacuation drilling and education saving lives. Another participant agreed, stating "…they [schools] do all sorts of other drills – hurricane drills, tornado drills – what's one more?" All participants agreed that for

those communities with a distant tsunami hazard only, the exercise does not need to be physical; rather it could be a table-top exercise or a discussion detailing the evacuation plan.

Topic: Vertical evacuation. Themes: Costs and need education: All participants agreed that those communities who are determined to have only a distant tsunami threat should not be required to include vertical evacuation in their tsunami evacuation plan. Discussion surrounded how communities could try to make multipurpose buildings that could serve as vertical evacuation points for some communities but agreed that cost would be the limiting factor. One participant explained community perception of such a mandatory requirement by saying, "The taxpayer certainly would not support it, building a structure that is going to sit on the beach – vacant – for the rest of my life!" Participants were curious how other TR communities felt about the proposed vertical evacuation requirements and if there were other activity options available. Ultimately, all participants agreed that they could support the recommendation for communities to have a vertical evacuation plan and identify vertical evacuation structures but they could not support requiring communities to build such structures.

Topic: Evacuation effectiveness. Theme: Testing plan elements: New Hanover County participants only briefly discussed the concept of evacuation effectiveness, mostly focusing on the idea of drills or exercises. All participants agreed that for a community to ensure the effectiveness of their evacuation plan, testing of that plan should occur – whether table-top or full-scale exercises. Generally, those communities with a distant-tsunami threat should only be required to provide a plan and a table-top type exercise.

Theme: Seasonality: Participants agreed that there is an appreciable influx of tourists in the warmer months to the beach, increasing the general population of the county. This influx

would increase the number of people who would need to be provided with information and assisted with evacuation should there be a tsunami.

Topic: *Proportion of the population to be protected. Themes: 100% of population unrealistic and 100% of at-risk population:* Discussion regarding how a community could quantify the number of people requiring protection was focused on subpopulations requiring the most assistance with evacuation. All participants adamantly agreed that there would be no way any community could guarantee 100% of the population would be safe in the event of a tsunami.

Topic: Education. Theme: Useful: As a community expecting only a distant tsunami hazard, New Hanover County participants acknowledged that the mandatory annual education requirements would not be necessary in their community. Participants agreed that tsunami education provided in the school setting has been very beneficial for getting information dispersed to both children and parents. Several participants highlighted the effectiveness of using videos (referencing YouTube) as an educational tool regarding tsunamis and youth. Emphasis was placed on the content of educational messages, like natural cues and recommended actions to take in case of a tsunami. All participants were supportive of tailoring educational materials and messages to the local conditions and settings but agreed there should be some generally standardized terminology and language across the entire TR Community program. A matrix depicting the New Hanover County, North Carolina discussion topics with their supporting and opposing themes can be seen below in Table 13.

Table 13:

New Hanover County, North Carolina Discussion Topics with Supporting and Opposing Themes

Major Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability	• Prioritize local event for activities	• Need education • Implementation questions
Proportion of the population to be protected	• 100% of at-risk population	• 100% of population unrealistic
Education of residents	• Useful	
Education of businesses	• Useful	
Evacuation effectiveness	• Testing plan elements	• Seasonality
School evacuation drills or exercises	• Useful • Necessary	

Vertical evacuation		• Costs
		  • Time & money
		• Limitations
		  • Need education

Guidelines document	• NIMS formatting	

US Virgin Islands. Eleven individuals were contacted to participate in the US Virgin Islands TR focus group discussion. Of those invited, four individuals confirmed their participation. Five expert community stakeholders attended and participated in the focus group discussion held in December 2013. This provided a participation rate of 125%.

Topic: Subdivision of communities by vulnerability. Themes: Prioritizing local event for activities and need education: As participants in the US Virgin Islands are currently working towards an application for TR recognition, much of the discussion centered on definitions and the significant changes between the prior guidelines and the newly proposed guidelines. Several participants questioned where a regional tsunami hazard would fall within the new guidelines with adding to the required actions communities must take to earn recognition. Generally, the participants agreed that all of the Caribbean would be determined to have a local tsunami hazard. This would require all communities to conform to the new guidelines specific to planning for a

local tsunami hazard, raising the concern that smaller communities would be restricted from engaging in the program due to limited resources. Another significant concern was shared, questioning if US Virgin Island communities would be required to prepare separate plans (evacuation routes, signage, and education) for both the local and the distant tsunami hazard scenarios. These concerns were raised by citing the current practices of planning for both local and distant events within the TR recognized communities of the Pacific Northwest. Participants asked how other communities handled the dual-hazard distinction and discussed the utility of sharing information between communities that are currently seeking program recognition.

Theme: Four standard actions: All participants accepted that communities should answer the questions posed in the four standard actions that would be required of all communities regardless of hazard status, but questioned the incentives for communities to engage in a program with such stringent program guidelines. One participant stated, "There are a lot of requirements here, when you start reading them…there's particular things here that could make it somewhat challenging…what's reasonable and what is important for survival…?" The largest concern participants shared was that the added, more stringent required actions (i.e. required construction of vertical evacuation structures) might "disinterest people from even attempting to make application."

Topic: Guidelines document. Themes: NIMS formatting and definitions: Participants agreed that the updated format for the TR Community program guidelines was useful. There were no objections to the changes proposed, with several participants sharing their support for the shift to NIMS formatting. One particular participant clarified the importance of the format shift, "…in fact that is what we are advocating and we are forcing all agencies or anybody in

emergency preparedness to abide by that one [NIMS]…not only is it a really good framework, but it's also – it becomes a lot of money if you don't do it. It will cost you funding not to do it."

Topic: Evacuation. As a community currently working towards achieving TR recognition, the US Virgin Islands participants explained that the greatest challenges for communities attempting to join the program are monetary. There is a significant financial investment required to meet the current TR Community program guidelines – primarily administrative support, purchasing and placing appropriate signage, and procuring and reproducing accurate inundation and evacuation maps. [Note: The comment regarding the costs associated with the purchase of TR Community program signage indicates a misunderstanding, as the TR Community program provides signs for free. The only costs to the community are associated with placing those signs]. One significant concern is that with all the additional mandatory actions, the costs of participation may have increased enough to de-incentivize the program for many communities.

Topic: S*chool evacuation drills or exercises. Themes: Useful and necessary:* In discussing evacuation exercises, participants supported the proposed requirement for annual tsunami evacuation exercises for schools located in the inundation zone of communities determined to have a local tsunami hazard. One participant described the situation of a local school which should be required to conduct a tsunami evacuation exercise, "…[high ground] is extremely close and the kids at those schools, what I would require of them is exercises..." Another participant acknowledged that some schools are already engaging in tsunami evacuation exercises but was unsure how often these exercises occur.

Theme: School buy-in: Concern was shared regarding the requirement and whether the requirement would apply to both private and public schools. Participants agreed that it would

not be a problem to engage public schools, but this requirement would be a big issue for the numerous private schools operating in the US Virgin Islands. It was generally agreed that the local government would be unable to oblige any private schools to comply and would therefore lose their ability to earn TR recognition.

Topic: V*ertical evacuation. Theme: Costs:* All participants agreed that the newly proposed requirement for communities to build vertical evacuation structures if no natural high or inland ground is available is very extreme. Construction costs money and participants shared their concern for the ability of communities to afford such costs. Additionally, participants believe that the process of building vertical evacuation structures will be lengthy and time-consuming. These additional complications will add to general resource costs (evacuation assessments, modeling, labor, bureaucracy, etc.) to the already monetarily expensive requirement of building vertical evacuation structures. Participants shared that if the government provides funding to assist with this type of programmatic requirement, then the requirement would be acceptable.

Topic: Evacuation effectiveness. Themes: Signage, testing plan elements and evaluation: Participants agreed that community participation in placing evacuation signs and other planning elements contributes to overall community evacuation effectiveness. Expanding on this, several participants acknowledged that there are always pieces and parts of plans that will have room for improvement. As long as those improvements are made and plans are not left static, the community is continually increasing and improving the overall evacuation effectiveness.

Theme: Communication flows: The final thoughts regarding evacuation effectiveness centered on the TR Community program guidelines themselves and terminology. Participants all agreed that the language used in the guidelines document should be defined and consistent,

particularly concerning the various maps (hazard, hazard zone, evacuation, safe zone, inundation zone, etc.).

Topic: *Proportion of the population to be protected. Themes: 100% of population unrealistic and 100% of at-risk population:* Participants agreed that ensuring the safety of 100% of the community population would be impossible. Participants generally agreed that each community should aim to secure as much of the population as possible, though priority should be given to the most at-risk populations.

Topic: Education of businesses and residents. Theme: Useful: Participants discussed the costs associated with mandatory annual training, education, and outreach to both businesses and residents located within the inundation zone. The majority of participants agreed that general education, going out and giving talks, was acceptable for this requirement. As long as these activities were identified in the community preparedness plan, they most likely could be funded through resources that are already available. During the discussion, the question was raised as to how these required activities would be tracked and recorded. Emphasis was made that the current guidelines only require that training be conducted, there is no identification of the number of people required to be trained. A matrix depicting the US Virgin Islands discussion topics with their supporting and opposing themes can be seen below in Table 14.

Table 14:

US Virgin Islands Discussion Topics with Supporting and Opposing Themes

Major Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability	• Four standard actions • Prioritize local event for activities	• Need education • Implementation questions
Proportion of the population to be protected	• 100% of at-risk population	• 100% of population unrealistic
Education of residents	• Useful	
Education of businesses	• Useful	
Evacuation effectiveness	• Communication flows • Signage • Testing plan elements • Evaluation	• Signage
School evacuation drills or exercises	• Useful • Necessary	• School buy-in (public & private)
Vertical evacuation		• Costs • Time & money
Guidelines document	• NIMS formatting	• Definitions

Integrated Summary

Across all six study sites, 102 individuals were contacted for inclusion in this research study. Forty-seven individuals confirmed their participation and attendance at one of the six scheduled focus group discussions. This provided a participant confirmation rate of 46% for the study. Fifty individuals attended the focus group discussions. Five participants who were invited but did not confirm participation attended the focus group discussions, increasing the total number of discussion participants above the expected confirmation number. This provided an overall focus group discussion participation rate of 106% for the study. In reviewing the attendance records for each focus group discussion, there were two sites that had multiple individuals who did not confirm their participation attend the discussion. These nonconfirmed attendants pushed the participation rate over 100%. Overall results and findings for the focus group discussions have been broken down by major topic below.

Theoretical Framework and Group Participatory Process. After introductions and preliminary ground-setting, each focus group discussion was initiated by asking all participants if they had the chance to review the proposed TR Community program guidelines document before attending the discussion. The vast majority of participants acknowledged at least skimming or viewing the document after confirming their participation in the focus group. Following this, all participants were asked if they discussed the proposed TR Community program guidelines with anyone before attending the discussion. Out of the 50 discussion participants, only one acknowledged that he had very briefly discussed the proposed guidelines document with someone else prior to attending the focus group discussion. These responses support the fidelity of the ELM peripheral route as a data collection method for individual-level perceptions and opinions of participants. These responses also support the conclusion that most community-level emergency responders may have inadequate information regarding the program definitions and guidelines changes of the TR Community program to form personal opinions and perceptions.

The ELM theoretical framework process for the central route blended smoothly with CBPR group processes used to guide and structure the focus group discussions. During all focus group sessions, participants actively engaged in the discussions deliberating both opinions and perceptions regarding the various topics proposed by the researcher. High quality and active discussions are the gold standard for eliciting strong central route attitudes and perceptions from participants. In combining CBPR tailored facilitation skills, reflective listening and consensus building methods; the researchers and participants fully engaged in collaborative colearning. Some of the identified topics elicited tension and more heated debate as participants became more comfortable and animated over the course of each discussion. The most common "trigger" for all focus group discussions was the proposed revision regarding vertical evacuation. All sites

and participants increased intensity and animation during the vertical evacuation discussions; discussing associated time and monetary costs as major barriers to this action. Similarly, all sites became uncomfortably quiet and required additional probing by the researchers before engaging in discussions that only obliquely addressed the questions regarding the proportion of the population to be protected by evacuation planning. Regardless of topic, participants were fully-engaged and invested throughout the focus group discussion process. It was also noted that after several focus group sessions various participants engaged in community relationship strengthening by exchanging business cards, or agreeing to follow up with each other regarding some point raised earlier in the discussion. The use of both the ELM theoretical framework in conjunction with CBPR participatory group processes helped engage the expert panel participants and build connections with each other.

All focus group discussions were well-received by participants, with keen interest in the outcome of the focus group discussions and any changes that might be effected with the TR Community program. Several sites requested a copy of the report describing the findings of the research study. The sharing of findings and further information was agreed upon, and all sites demonstrated clear investment in continued collaboration with the researchers and with the NWS.

Subdivision of Communities by Vulnerability. Participants at all sites agreed that population should not have anything to do with preparedness or readiness requirements associated with earning TR Community program recognition. Participants from several sites shared negative perceptions associated with the population-based guidelines which may be summed up by one participant's quote, "The population thing probably left a bad taste in the

people's mouths because it made it seem as if the higher population areas would have higher casualty rates so they are more important than lower population communities."

Discussion surrounding the newly proposed subdivision of the TR Community program guidelines by local tsunami hazard vulnerability was largely positive and well received across all sites. Generally, participants agreed that those communities with a local tsunami hazard should be required to do more activities that are aimed at protecting human life. Emphasis was made by participants from several sites that there was a need for additional actions and activities that result in protection of human life and the TR Community program should focus more strongly on preparing for local tsunami hazards. Accordingly, participants from all sites also recognized that those communities with only a distant tsunami hazard do not need to meet as many requirements for earning program recognition. Those requirements should be focused on preparing the community for the eventuality of a distant tsunami that generally includes more orderly evacuation, securing of ports and harbors, and other coastal zone infrastructure.

It was noted by the researchers that while the subdivision between local and distant-tsunami hazard vulnerability would be useful for most communities, there are still those communities that take longer to evacuate their population regardless of the time allowed with either hazard designation (local or distant tsunami hazard threat). To overcome this limitation of the subdivisions, each participant community was asked to evaluate the utility of requiring all communities, regardless of tsunami hazard classification, to engage in four standard actions to provide protection to the people living within each community. The four standard actions would include identifying and providing information regarding the following points: 1) the expected extent of inundation, 2) the time it would take the wave to arrive, 3) how many people are in the

inundation zone, and 4) the time needed to evacuate those people from the inundation zone (described hereafter as the "four standard actions").

Discussion of the recommended four standard actions was mixed between participants at all sites, with some participants supporting the addition of these actions to the guidelines while other participants were more reticent regarding their inclusion. It was noted in all discussions that the second action, the time it would take the wave to arrive, would be different depending on each actual tsunami event. It was generally agreed that the remaining three actions would most likely be achievable activities for communities seeking TR recognition. Participants from a few sites shared concern about providing an answer to question three, explaining that because of seasonal tourism changes the number of people in the inundation zone will vary depending on the time of year. Regardless of concerns, participants from all sites conceded that communities should be able to provide the details required by each of the proposed four standard actions.

Participants from all study sites unanimously agreed that the proposed TR Community program guidelines format is much more useful and aligns well with current NIMS hazard mitigation and emergency planning templates. Similarly, all participants agreed that this format is acceptable and preferred to the guidelines current format. Though one significant concern raised by all sites was that with the additional mandatory actions, the costs of participation may have increased enough to deincentivize the TR Community program for many communities.

Proportion of the Population to be Protected. Of all the topics raised, asking participants to identify the proportion of their population that should be protected through the tsunami evacuation plan was the most challenging. Across all sites, participants were hesitant to provide a direct number, choosing to explain the complexities of this issue instead. Most sites identified transient or seasonal population fluctuations as the most significant challenge to this

question. Depending on the site location and the time of year, the local population that would need to be provided with protection could increase by the thousands.

Over the course of each discussion, participants from most sites would not provide a numeric proportion of the population to be protected. Instead, participants from several sites admitted that the goal or aim of any community tsunami plan should be to save 100% of the community population. While that is the ultimate aim, all communities agreed that saving 100% of the people would never be possible. Emphasizing this point, participants from multiple communities highlighted that there is no mandatory evacuation law in place for any of the study sites and community members may choose to evacuate or not. As the participants continued this discussion, participants from several sites homed in on the concept of protecting 100% of certain populations within the community. Participants from most sites agreed that it would be possible, and necessary, to ensure as close to 100% protection as possible to subpopulations most at-risk to a tsunami (schools, care facilities, or other special needs populations located within an inundation zone).

Participants from two of the study communities expanded the conversation by discussing the evaluation of evacuation plans over time. One participant summed this concept up saying, "I would want to start with a baseline and say ok, this is what we have for evacuation potential right now. If we do these other things or if we keep working on this we can up that percentage." Participants from both of these communities agreed that monitoring and evaluating the plans as additional actions would allow expert community stakeholders to better quantify the numbers of people they could protect and describe the improved quality of the evacuation plan.

Evacuation Effectiveness. Participants agreed that an effective evacuation strategy for any community seeking TR recognition would involve many different actions or activities, with

continual evaluation and evolution over time. Participants at multiple sites felt that the recommended four standard actions (described by some participants as a "formula") could be a potential metric for determining the effectiveness of a community evacuation plan or strategy. Another component of an effective evacuation strategy identified by participants was a well-defined communications plan. This communications plan would include details for the emergency managers receiving, understanding, and taking actions based on official NWS communications, and the dissemination of those messages to the general public. Participants felt it was important for emergency managers to have a plan in place for the receipt of an emergency notification and the actions to be taken based on that message. Once a notification is received and emergency managers move into actions based on message content, a plan must be in place describing how to notify and work with the public. Distribution of that emergency message to the public should include consistent language and directions, and should be provided through multiple modes and sources.

Another component of an effective evacuation strategy identified by participants was testing the plan or strategy for effectiveness. While all communities agreed that a full-scale, community-wide test of all elements of a tsunami evacuation plan would be unrealistic or impossible; testing the various components of the plan would be possible and highly recommended. For example, emergency sirens should be (and in most study sites are) tested regularly throughout the year. Participants also agreed that table-top exercises or full-scale drills of smaller populations (for example, school populations) would also be useful for testing evacuation plans. Regardless of the component being tested, participants from one site highlighted the need to evaluate the test for effectiveness and the need to identify areas needing improvement.

Evacuation Drills and Exercises. Two of the states represented in this research (Oregon and Hawaii) currently have state legislation requiring mandatory annual school tsunami evacuation exercises for schools located within an inundation zone. Participants from both of these communities shared their experiences conducting school evacuation drills, and emphasized its importance. Participants from the other sites, without current legislation, agreed that those communities designated as having a local tsunami hazard should be required to conduct similar school evacuations annually for those schools located within the inundation zone. Additionally, participants from all sites also agreed that for those schools located within the inundation zone of a distant tsunami hazard community should also be required to have at minimum a plan in place. Drills or exercises of that plan could then be recommended but not required.

The only caveat raised during the discussion of mandatory school evacuation exercises was whether this requirement would be mandated for all schools – both public and private. One site in particular has several private schools. It was discussed that private schools are run in the same manner as private businesses; the local government cannot dictate how a private entity is run. The participants at this site shared their concern in achieving TR recognition status when they would be unable to ensure private school participation saying, "…we cannot 'require' them to do that. It is totally out of our hands, so you can't put 'requirements' that we really can't complete."

Participants from several sites also discussed the possibility of requiring other care facilities located within an inundation zone to conduct annual evacuation exercises. The care facilities discussed ranged from preschools, to hospitals and federal or state agency offices. Participants from the majority of sites agreed, that each of these different agencies or businesses

should have a plan in place and conduct some type of drill or exercise (table-top, full-scale drill, etc.) every 3 years.

***Vertical Evacuation*.** As of the completion of data collection, only one study site (Coronado) currently uses a vertical evacuation strategy. Participants from all sites agreed that requiring communities to identify natural high or inland ground for people to use for self-evacuation was a good practice. Participants at all sites also agreed that recommending those communities without natural high or inland ground to build vertical evacuation structures would be acceptable. While the recommendation would be acceptable, participants at all sites agreed that requiring a community to build a structure would be unrealistic and poorly received. Participants from several sites shared concerns regarding the costs associated with both the research process of identifying appropriate sites for vertical evacuation structures and the expenses of building such structures. The majority of study sites also described zoning regulations prohibiting the construction of buildings above a certain height in many of the communities located along the coastline. Regardless of study site location, all participants emphasized the barriers a requirement of building vertical evacuation structures would pose to many communities seeking TR recognition. Participants from several sites shared the belief that many communities would choose not to engage in the TR Community program if such a requirement were added.

Participants from two communities shared the opinion that the proposed guidelines were missing a "step" within the Mitigation section. Participants from both of these communities agreed that emergency managers should prioritize funding and resources to evaluate, clear, "harden" or strengthen evacuation routes before spending money building vertical evacuation structures. During both of these discussions, participants agreed that using municipal resources

to ensure safe and effective evacuation routes would be better received by communities and be more cost effective than building new structures. Participants from several sites also emphasized the importance of education and outreach as a more useful means of preparing community members for a potential tsunami.

Participants from several sites shared their own consideration of vertical evacuation and their major concerns. Three major reasons cited for abandoning the inclusion of a vertical evacuation strategy in some community's included:

1) the queuing of people trying to get into a building during the panic of an actual event that would delay or eliminate a person's ability to reach safe refuge from the tsunami,
2) buildings being overrun by more people than they were created to accommodate, and
3) the false sense of security people are given by being told to use a man-made structure that is not guaranteed to withstand both the tsunami and the tsunami-generating event (i.e. earthquake).

Regardless of when a building or structure was built, participants were concerned that the building would need to be continually assessed and evaluated to ensure it would remain stable and safe for use during a tsunami. While participants from study communities were largely against a vertical evacuation requirement, when pressed by the researchers the majority did acknowledge that a community that was unable to provide safe evacuation refuge for its population should not receive TR recognition. One participant responded to this acknowledgement by stating, "…any requirement would have to come combined with commensurate resources to meet the requirement. You can't say [a community] is required to build a $50 million structure and then say; now you have to pay for it."

Education. All participants were asked to consider two newly proposed actions requiring training, education, or outreach to both residents and high occupancy or high volume businesses located within the tsunami hazard zone of a local-tsunami hazard designated community. The majority of participants agreed that outreach education of any kind is highly valuable in any community at-risk to tsunamis. Education is extremely important in communities that experience high transient or seasonal populations. Participants from all sites agreed that providing education to the entire community (residents, businesses, all branches of government, etc.) is one of the most useful actions a community can take to increase tsunami preparedness. However, participants at study sites also agreed that outreach education can also be quite expensive both in terms of money and time. These costs were emphasized when discussing the requirement to provide annual training to part-time residents in communities where homes are often second homes and emergency mangers have no way of knowing when the owner will be in residence for educational offerings. Participants from several sites shared concern for planning and implementing activities that would be wasted on few residents.

When discussion focused on providing mandatory training, education, or outreach to business owners and staff of high occupancy or high volume businesses located within a tsunami hazard zone, participants voiced additional concerns. Participants from several sites felt that local emergency management would be hard-pressed to get buy-in from the business community because of the costs associated with providing annual training to staff. The majority of participants expressed frustration in working with various hotels and businesses because to date, very few have been willing to post or share tsunami preparedness information to guests, visitors, or patrons. Participants from several study sites also highlighted the need to educate businesses and residents of the entire community, not just those located within an inundation zone.

Conversely, Kauai participants shared that they currently work very closely with the hotel associations and the security guard organizations including every hotel within the community to ensure that each hotel has an emergency plan in place. Supporting this viewpoint, the Seaside community is currently working on creating their own "Business Ready" program modeled after the TR Community program. This community recognizes the important role businesses play in providing education and guidance to tourists and transient populations visiting the community. By engaging the business community in a recognition program, it is hoped that these businesses will become interested in the program and become more engaged in tsunami preparedness.

Participants from all sites agreed that regardless of any other outreach or education, communities should always include education at the local schools. One participant summed up this perception by saying, "Basic fire safety is a generational thing, you have to keep doing it – any safety education – and this [tsunami education] is no different. It doesn't stop." Several sites agreed that one key to building community awareness and preparedness was to continue educating the children. It was also emphasized that educating the children in distant tsunami hazard communities is also important. Participants shared that in a distant tsunami hazard community, it was also important not to overwhelm people with too much information. These same participants put emphasis on combining tsunami education with other educational events using YouTube© clips to teach natural cues, what to look for, and evacuation.

A final integrated matrix depicting the focus group discussion topics with their supporting and opposing themes (described in the narrative above) can be seen below in Table 15.

Table 15:

Integrated Matrix Depicting Discussion Topics with Supporting and Opposing Themes

Discussion Topics	**Supporting Themes**	**Opposing Themes**
Subdivision of communities by vulnerability	• Four standard actions (4) • Prioritize local event (6)	• Need education (4) • Implementation questions (4)
Proportion of the population to be protected	• 100% of at-risk population (6)	• 100% of population unrealistic (6) • No mandatory evacuation laws (2)
Education of residents	• Useful (6) • Necessary (2)	• Seasonality (3)
Education of businesses	• Useful (6) • Necessary (3)	• Perceived lack of cooperation (2)
Evacuation effectiveness	• Communication flows (4) • Signage (2) • Testing plan elements (5) • Four standard actions (2) • Evaluation (4)	• Full-scale test unrealistic (1) • Signage (2) • Seasonality (5)
School evacuation drills or exercises	• Useful (6) • Necessary (5)	• Private school buy-in (1)

Vertical evacuation	• Protection of human life (3)	• Missing a "step" or action
		  • Secure & clear evacuation routes first (2)
		• Costs (6)
		  • Time & money (6)
		• Zoning laws (2)
		• Limitations
		  • Need education (3)
		• False sense of security (2)

Guidelines document	• Checklist (2) • NIMS formatting (6)	• Definitions (3)

The number in parentheses indicates the number of study sites discussing a particular theme

CHAPTER 5

DISCUSSION

Introduction

The purpose of this research was to evaluate the acceptability and usefulness of key components within a revised set of draft national guidelines for the TR Community program. The key components of the revised guidelines included: 1) perceptions of effective evacuation strategies, 2) perceptions of required evacuation strategies; specifically vertical evacuation, and 3) perceptions of defining a proportion of population requiring protection through evacuation planning for inclusion in the TR Community program guidelines. Analysis of prediscussion surveys and focus group discussions concentrated on a total of eight discussion topics. The five main or overarching topics included: subdivision of communities by vulnerability, proportion of the population to be protected, education, evacuation, and the guidelines document format. Within evacuation, three subtopics were discussed: evacuation effectiveness, evacuation drills or exercises and vertical evacuation. Within education, two additional subtopics were also discussed: education of businesses and education of residents. A discussion of the evaluation process, findings, and the TR Community program guidelines recommendations are also discussed below. Several of the recommendations in this discussion are reinforcing or supporting prior recommendations to the NWS. In cases where these findings support prior recommendations, the author indicates that the recommendation should be "maintained" by the NWS.

The Evaluation (Aim 4)

Participatory research strategies, involving various forms and methods of CBPR are increasingly being applied to emergency preparedness research (Gershon, Rubin, Qureshi,

Canton, & Matzner, 2008; Nepal, Banerjee, Perry, & Scott, 2012; Pelling, 2007). This evaluation of the TR Community Program guidelines applied the ELM (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979), in conjunction with CBPR participatory group processes working directly with panels of expert community stakeholders. Using this theory and these CBPR methods allowed for use of two different qualitative data collection methods in conducting this evaluation research study. Prediscussion surveys explored individual participant beliefs formed through observations and personal experiences using the peripheral route of the ELM; focus group discussions explored participant beliefs formed through discussion, debate and colearning among participants using the central route of the ELM (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979).

When comparing the survey response rate to the focus group participation rate, it may be hypothesized that the sampled expert community stakeholders may be invested in tsunami preparedness activities (a higher participation rate for the focus group discussions) but are busy individuals with time commitments to other projects and programs (a lower response rate for the surveys). This hypothesis is supported by the highly engaged and active interaction between participants recorded at each focus group discussion compared with the minimalistic response depth found in the survey. Additionally, there were five emergency mangers who did not confirm their participation in a focus group discussion, but attended a discussion anyway. While the participants were clearly invested in the face-to-face interaction and immediate feedback cultivated during focus group discussions, they appeared to have less time to devote to reading a lengthy proposed guidelines document coupled with completing a short-answer survey

As we expected, data collected from participants in the prediscussion survey support the recognition that people are confused by or misunderstand some terms and definitions used in the

TR Community program guidelines. Specifically, participants were most concerned with the proposed subdivision of the guidelines by community vulnerability to tsunami hazards with significant confusion regarding the definition of hazard classification. Building on this concern, participants were unsure how the proposed guideline changes would be implemented and used within a local community setting. Regardless of community hazard category, all participants questioned how the proposed changes would impact their own individual community. Prediscussion survey data allowed participants to share personal opinions and concerns without formally discussing or analyzing the proposed changes with other participants (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979). These data provided researchers with useful opinion and perception information that helped to tailor each focus group discussion to the individual study site. Researchers were able to spend more time explaining important background information regarding the definitions and terms being used as well as the proposed changes to the guidelines.

The focus group discussions collected data using discussion, debate, and colearning between participants and researchers (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979; Wood, 2000). This collaborative interaction was informed by the prediscussion survey data and helped participants to better conceptualize and understand the proposed guideline changes. Participants were able to problem-solve with each other, and the researchers, to identify possible responses to individual concerns or questions. Across study sites, the focus group discussions highlighted many of the preconceived notions and beliefs identified in the prediscussion surveys. This demonstrated the importance of discussion and group colearning for the sharing of information to refine and expand personal perceptions and opinions (Bitner & Obermiller, 1985; Cacioppo & Petty, 1979; Wood, 2000) regarding the TR Community program guidelines.

Dynamic group processes were observed as participants naturally engaged in discussing identified topics while also allowing researchers to facilitate specific inquiries within the discussion.

Finally, participants from all sites were asked to discuss their knowledge of other communities engaging in specific tsunami hazard preparedness and mitigation activities (specifically, vertical evacuation). The majority of participants admitted to having no knowledge of other communities and their activities, participants from all sites admitted to being very interested in learning more about those other communities. Participants from two sites continued this discussion by asking specific questions regarding how other communities handled specific actions required for TR recognition. Regardless of prior knowledge or connection to other communities engaged in the TR Community program, all participants agreed it would be very interesting and potentially useful to learn more about other community experiences with preparing for a tsunami hazard. This participant interest supports the original research team's prior recommendation made to the NWS advising the "transfer best practices and identification model communities to share experiences" across TR recognized and nonrecognized communities. Using this current set of findings combined with the prior recommendation opens the door for the NWS to create a networking and communications forum that could be used to share best practices, challenges, and successes between communities engaged in tsunami preparedness and the TR Community program; similar to the CERT forum created by FEMA (FEMA, 2013). This forum would also allow communities to brainstorm and problem solve together so that no single community is "reinventing the wheel" as they work through the recognition process with the NWS.

Recommendation:

1) The NWS should establish a networking and communications forum for communities that have either earned or are seeking TR recognition status.

TsunamiReady™ Program (Aim 4)

Research describes three critical components of community emergency preparedness for natural disasters: planning, training, and written plans (Perry & Lindell, 2003). The TR Community program guidelines help provide structure for communities to combine these three components into a community preparation process for a tsunami hazard. The revised format of the proposed guidelines used for this research maintained the NTHMP and original research team's recommended format with program activities identified by mitigation, preparedness, response, or recovery categories; rather than using the current NWS guidelines categories of communications and coordination, tsunami warning reception, local warning dissemination, community preparedness, and administration. The recommended categories follow the FEMA NIMS formatting and standardize the tsunami preparedness process (planning, creating a written plan, and providing training or education) with the national all-hazards approach to emergency preparedness and response (FEMA, 2011). All study sites discussed the importance and utility of using this specific formatting for individuals who also work with and plan for various other community hazards. With unanimous support and approval for the proposed format, expert community stakeholders are invested in emergency preparedness programs and activities that build on NIMS infrastructure.

Recommendations:

1) NWS should maintain the recommended NIMS format used in the current revised TR Community program guidelines.
2) NWS should maintain the recommended checklist of required activities so that communities can track their progress towards recognition. These checklists may also be used to streamline reporting of community information to the NWS.

Subdivision of Communities by Vulnerability (Aim 1, Aim 4)

The greatest amount of time during each focus group discussion was devoted to increasing participant understanding and discussing the proposed subdivision of the TR Community program guidelines by community tsunami hazard vulnerability. The definition of terms used to describe the subdivision of tsunami hazard have not been widely used outside of the academic sphere and have some overlap between researchers and the NTHMP. This overlap of terms, particularly regarding the wave-arrival times used to define the tsunami, can create confusion and disagreement when emergency managers apply the definitions in the field. For the purposes of both this research, and in revising the TR Community program guidelines for the NWS, the definitions published by the NTHMP were used:

> *Definitions:*
> - *Local (near-field) tsunami– wave arrives 30 minutes or less after it is generated (e.g. earthquake or landslide)*
> - *Regional tsunami – wave arrives between 30 minutes – 2 hours after a generation* event
> - *Distant (far-field) tsunami– wave arrives several hours after it is generated*
>
> (NTHMP, 2013)

Regardless of hazard classification (high, intermediate, or low) all communities discussed the proposed subdivision of guidelines and the recommendation of an NWS appointed panel of tsunami experts to assess community vulnerability. Consistent with current research and literature (National Academy of Sciences, 2011; Intergovernmental Oceanographic Commission,

2012), participants from all sites agreed that the greatest hazard to human life is posed by a local tsunami. If a community is identified as being at risk for a local tsunami, the planning and preparation activities should focus on protecting the people at risk. Participants agreed with this priority, and granted that the TR Community program guidelines should be subdivided in a way that provided more rigorous requirements for communities with a local tsunami hazard distinction. Participants also supported not mandating those communities with only a distant tsunami hazard to complete the more rigorous requirements.

Additionally, to ensure standard implementation practices in determining community vulnerability, all sites supported the use of an NWS appointed panel of tsunami experts. The panel would determine which Pacific, Caribbean and Atlantic Ocean state and territory coastal regions are vulnerable to local tsunamis and which are not. This committee would also clarify which tsunami trigger mechanisms (e.g. landslides, earthquakes, etc.) would be used for making the determination about community vulnerability to local versus distant tsunamis. The expert panel would identify possible tsunami scenarios for a community, but focus on plausible hazards that communities could readily use for planning and mitigation efforts.

Recommendations:

1) NWS should appoint an unbiased panel of tsunami experts who can assess and identify local tsunami hazard for communities seeking TsunamiReady ^{TM} recognition.
2) NWS should maintain the recommended subdivision of the TR Community program guidelines by community vulnerability to a tsunami hazard.

Proportion of the Population to be Protected (Aim 3, Aim 4)

Throughout all discussions of hazard vulnerability and population to be protected through tsunami planning, participants from all communities also commented on the inclusion of

additional standard actions for any community seeking TR recognition. Recognizing that community evacuation is dependent on local conditions and factors, communities largely supported the inclusion of additional mitigation activities that would improve tsunami mitigation efforts for at-risk populations within communities. Expanding on the current governmental literature describing the local tsunami hazard to human life (National Academy of Sciences, 2011; Intergovernmental Oceanographic Commission, 2012) and focusing on providing protection to those most at-risk populations, these added activities provide communities with focused at-risk population and evacuation information to use for tsunami planning (identifying at-risk populations within the inundation zone and assessing and estimating evacuation times for the at-risk populations within the inundation zone). Regardless of tsunami hazard classification, these additional activities will improve tsunami preparedness for communities with any tsunami hazard vulnerability and increase the chance of protecting human life.

Recommendation:

1) NWS should include the two recommended Mitigation activities in the TR Community program guidelines: identifying at-risk populations within the inundation zone and assessing and estimating evacuation times for the at-risk populations within the inundation zone.

Evacuation Effectiveness (Aim 2a, Aim 4)

Regardless of tsunami hazard classification, all participant communities supported the current emergency preparedness literature by agreeing that an effective evacuation strategy for any community seeking TR recognition would involve many different actions or activities, with continual evaluation and evolution over time (Sinclair, Doyle, Johnston, & Paton, 2012). This collaborative and iterative process is not only preparing a plan of action during an emergency, it

is building relationships and capacity within a community which helps strengthen a community's overall resiliency (Paton, 2005; Sinclair et al., 2012). Participants from several sites expanded on this concept by describing the various components of an effective evacuation strategy or plan and the collaborative nature necessary for emergency services within a community.

Participants discussed potential metrics, or scales, for testing the effectiveness of a community's tsunami evacuation plan. These participants highlighted the utility of the "four standard actions" recommended by the research team. As participants returned to those recommended actions, some of the focus group discussions emphasized how communities may accept the inclusion of these actions as mandatory for all communities seeking TR recognition.

Recommendations:

1) NWS should encourage TR recognized communities to share best practices, challenges, and successes regarding evacuation and plan effectiveness through the recommended networking and communications platform or forum.
2) NWS should research and examine the potential for using the results of the two new Mitigation activities in the TR Community program guidelines mentioned under the *Proportion of the Population to be Protected* section above as potential performance standards for TR recognition and renewal of recognition.

Evacuation Drills and Exercises (Aim 2a, Aim 4). Schools across the US are known to engage in certain state-specific emergency preparedness drills and exercises for both natural and human-caused emergencies. While the societal demands to better protect US schools and children have increased significantly over the last few years, scant research on emergency preparedness is available specific to schools (Kano & Bourque, 2008). Currently, only three states within the US are known by the researcher to have state mandates requiring schools

located within a tsunami inundation zone to practice tsunami evacuation drills annually: Oregon, Washington, and Hawaii (Dengler, 2005; Hawaii, focus group discussion, November 8, 2013). Both of the study communities (Oregon and Hawaii) with current state mandates supported current literature describing the efficacy of school tsunami evacuations by emphasizing the importance of their evacuation education and drilling exercises within schools as a means of preparing their communities for a tsunami event (Dengler, 2005; Ramirez, Kubicek, Peek-Asa, & Wong, 2009). Expert community stakeholders from both of these communities highlighted the utility of educating and drilling students as a gateway to reach the parents and wider-community.

The remaining four study sites (Alaska, California, North Carolina, US Virgin Islands) do not currently have any state or territory mandates requiring schools located within a tsunami inundation zone to engage in tsunami evacuation drills or exercises. Despite this lack of formal, state-level guidance, all study participants recognized the significant role tsunami education and evacuation drills or exercises play in saving lives should a tsunami event occur. Participants in several communities also discussed the American Samoa tsunami event in 2009 as a good example of the efficacy of tsunami education and evacuation drilling in saving human lives (Choudhary et al., 2012; Fritz et al., 2011; Leong-Nowell et al., 2012). It is clear from each study site that expert community stakeholders recognize the benefits and are motivated to include school evacuation drills and exercies in their tsunami preparedness plans.

All study sites expanded their discussion regarding tsunami education and evacuation exercises beyond only those communities with a local tsunami hazard. As participants discussed schools and preparing students for a potential tsunami, most sites acknowledged that any school located within a tsunami inundation zone should be required to have a tsunami preparedness plan in place. This plan could be modified and adapted to the specific tsunami threat of a given

community and school based on other emergency preparedness plans that may already be in place for that school. The benefits of engaging in this risk reduction and plannimg activity would increase overall emergency preparedness for both the schools and the students (O'Brien & Mileti, 2003).

One concern raised by a study site questioned the enforcability of this requirement for private schools operating within the inundation zone of a community with a local tsunami hazard. Due to the nature of a privately run entity, the participants were unsure how the local government would be able to require an annual school evacuation drill. The implementation of this requirement might be greatly facilitated through the recommended TR networking and communications platform or forum hosted or sponsored by the NWS. Communities could use this platform or forum to share best practices and help troubleshoot community-specific issues like the public versus private school concern.

Recommendations:

1) NWS should maintain the recommended Preparedness activity requiring all communities with a local tsunami hazard to conduct annual tsunami evacuation drills with schools located within the inundation zone.

2) NWS should consider including a Preparedness activity requiring all communities with a distant tsunami hazard to have a tsunami evacuation plan in place for schools located within the inundation zone as a topic to explore in future TR Community program research.

Vertical Evacuation (Aim 2b, Aim 4). While vertical evacuation is an acceptable practice in Japan (Fraser et al., 2012) and is being considered in other localities at-risk to tsunami ("Project Safe Haven," 2011), many expert community stakeholders and communities within the

US remain under-educated regarding vertical evacuation. Most participants in this research had little or no knowledge of other US communities using or considering vertical evacuation but were very interested in learning from other community experiences. While only one study site currently uses and educates community members to use a vertical evacuation strategy, some expert community stakeholders admitted to considering and rejecting its use in local tsunami planning efforts.

Participants at two sites specifically discussed the addition of a new Mitigation activity, which was recommended to be placed before the required action of planning for vertical evacuation. These participants agreed that communities should first dedicate resources to evaluating evacuation routes for reliability and strengthening or "hardening" those routes as indicated by the evaluation. These sites both recommended that once evacuation routes have been evaluated, upgraded, and strengthened; only then should communities begin looking at vertical evacuation strategies and building structures. Discussion from all sites, including the site currently operating with a vertical evacuation strategy, agreed that the TR Community program guidelines should include the construction of vertical evacuation structures as an additional option or recommended activity. As discussed by the various focus groups, this activity would be placed in the "Optional mitigation efforts" section of the guidelines instead of its current location in the proposed guidelines as the final required Mitigation activity. Building on this discussion, no participants agreed, or was comfortable with the idea of making this action required or mandated by the guidelines (as it currently is by the proposed guidelines). One particular participant quote sums up the general opinion from all study sites, "I can see a recommendation, but I can't see a requirement to build anything."

When pressed to discuss the ability of a tsunami evacuation plan to protect the lives of the people living within a community, participants recognized that certain proposed actions, like vertical evacuation planning and building, would be very beneficial to all communities. All participants recognized that the goal of any hazard planning and mitigation effort is to save as many of the people at risk as possible. However, participants were very hesitant to support requiring the construction of vertical evacuation structures due to the significant monetary and time costs they perceived as being associated with completing the construction process. When compelled to give a yes or no answer, the majority of participants acknowledged that communities should not be recognized as TR if they were unable to meet these requirements and provide a safe evacuation site for their residents, seasonal workers, and visitors.

With multiple participants concerned with the research, engineering, and building costs associated with vertical evacuation structures, consideration should be given to expanding the FEMA P-646 guidance document (Applied Technology Council, 2012) to include a discussion on costs and funding. The Safe Haven Project documents could potentially be used as a community-level case study for this discussion ("Project Safe Haven," 2011). With this additional information, the FEMA P-646 could then be shared with all interested communities as a more comprehensive educational tool for alternative evacuation methods for tsunami. The FEMA P-646 document itself could be used as an ELM peripheral route tool for expert community stakeholders and other emergency managers. Providing detailed information that individuals and communities could use to help form personal perceptions of vertical evacuation, the FEMA P-646 document could be geared to educate and inform emergency services.

Discussions and peer collaboration or problem-solving (activating the ELM central route of attitude and perception formation) regarding both the FEMA P-646 guidance document and

community experiences or perceptions of vertical evacuation strategies could also be facilitated through the recommended TR networking and communications forum to be created by the NWS. Communities could use this forum to strengthen the national tsunami emergency preparedness community and potentially generate innovative solutions to the concerns expressed by all study participants. When discussion was encouraged regarding the Pacific County Safe Haven Project ("Project Safe Haven," 2011), participants were interested in learning more about the project and the current status on funding. The recommended communications forum could provide an avenue for sharing the Project Safe Haven experience and encourage other communities to build on the potential successes of the programs.

Recommendation:

1) NWS should include the recommended Mitigation activity to evaluate evacuation routes for reliability and strengthen or upgrade as needed per the evaluation.
2) NWS should maintain the recommended Mitigation activity requiring all communities with a local tsunami hazard to have a plan for vertical evacuation where it has been established that at-risk populations would be unable to reach natural high or inland ground before the tsunami wave arrival. It should be clearly explained that this activity will require multiple actions and stages, so communities would be expected to track their progress throughout the course of implementation to both earn and maintain TR recognition.
3) NWS should encourage TR participant communities to share best practices, challenges, and successes regarding vertical evacuation planning and construction processes through the recommended networking and communications platform or forum.

Education (Aim 2a, Aim 4)

When asked to discuss the proposed Preparedness actions requiring communities with a local tsunami hazard to conduct annual education, training, or outreach activities for both residents and business staff located within a tsunami hazard zone, all participants agreed that tsunami education was a vital element in preparing for the eventuality of a tsunami. Supporting evidence from current literature, participants from two sites specifically mentioned the American Samoa tsunami, and the importance of the tsunami emergency preparedness education in the protection of human lives (Choudhary et al., 2012; Fritz et al., 2011; Leong-Nowell et al., 2012). While not all participants supported making these actions mandatory, participants from all communities agreed that these types of outreach and training activities were important.

Ongoing research in Coastal Washington by Johnston et al. (2007) has focused on tsunami education specifically for tourism businesses and associations. After conducting a baseline assessment of tsunami preparedness education among local high occupancy businesses in a Washington community, Johnston et al. (2007) recommend collaborative training needs analyses and training cooporatives between local businesses. Taking another twist on the concept of Johnston's research, one of the study sites is currently in the process of creating their own "Business Ready" program, modeled after the TsunamiReady™ program and aimed specifically at local businesses in a local tsunami vulnerable community. This initiative demonstrates both creativity and dedication to changing the perception of tsunami perparedness in the business community. This new "Business Ready" program changes the process of outreach and makes the businesses vital participants in providing training, education, and outreach. The businesses themselves become change agents within the community and earn investment in their own recognition program. While monetary costs were a significant concern

shared by all participant communities, current literature demonstrates the efficacy of such training and education programs (Choudhary et al., 2012; Fritz et al., 2011; Leong-Nowell et al., 2012; Johnston et al. 2007). By soliciting the investment of the businesses operating in a community vulnerable to tsunami hazards, expert community stakeholders widen their sphere of influence and begin to share responsibility within the greater community. This type of inovative program, successes and challenges, should be shared with other communities that are also seeking new ways of engaging businesses in tsunami preparedness.

As the guidelines are currently written, communities may start with smaller activities for the annual training, education, or outreach requirements and grow their tsunami education program over time through continued risk reduction planning (O'Brien & Mileti, 2003). These smaller activities would work well to activate ELM peripheral route perceptions and attitudes by providing detailed definitions and concepts associated with community tsunami emergency preparedness messages. With long-term preparedness planning and community or business engagement, expert community stakeholders can work with available funding to ensure outreach coverage of all businesses and residents within the tsunami hazard zone over a set period of time and track that training for the NWS. These longer-term preparedness efforts could be used to activate ELM central route perceptions and attitudes by including a tsunami preparedness booth at community faires and events or holding community meetings. These face-to-face encounters would allow expert community stakeholders to facilitate discussions that would help community members really develop their understanding of the hazard and their perception of necessary preparedness activities.

Recommendations:

1) NWS should maintain the recommended Preparedness activity requiring all communities with a local tsunami hazard to conduct annual training, outreach, or education for businesses located within a tsunami hazard zone.
2) NWS should maintain the recommended Preparedness activity requiring all communities with a local tsunami hazard to conduct annual training, outreach, or education for residents living within a tsunami hazard zone.

Limitations

Limitations to this research include those related to the use of qualitative data; primarily, the sample size is small with a limited number of participants and study sites. Despite the small sample size, this is the largest collection of tsunami-related preparedness focus group studies every conducted within the US. Additionally, a purposive or criterion-based sampling technique was used instead of random sampling to ensure a variety of emergency management perspectives within each community. Study communities were not randomly selected, but rather chosen specifically to represent a range of tsunami hazard levels from low to medium to high as a means of improving research understanding of communities across all hazard levels.

Another potential limitation to this research was the respondent burden associated with completing the prediscussion survey. Participants were asked to review the proposed revised TR Community program guidelines, which is a multipage document and a checklist. After reviewing this document, participants were then asked seven questions regarding their opinions of the revised guidelines. For already busy expert community stakeholders , the time required to both review the document and respond to the questions may have been asking too much, which

is most likely demonstrated through the low overall response rate (43%) for the prediscussion survey.

Finally, the removal of two original study sites due to monetary restrictions for data collection added another limitation to this research evaluation. Ideally, all eight of the original study sites would have been included in the second wave of focus group discussions and data collection. In removing two sites, longitudinal community feedback and data regarding the TR Community program guidelines were reduced.

Contribution to Public Health

This research contributes to the growing field of public health emergency preparedness, specifically to national tsunami community preparedness programming. This evaluation research dissertation provides both the public health and the emergency management communities with insight and contextual information regarding community emergency preparedness and the TR Community program for communities with tsunami hazards ranging from low to medium to high. Even more specifically, this research has provided both community-level data and written recommendations for the NWS based on community expert stakeholder input and the current emergency management and preparedness literature for updating and improving the TR Community program guidelines.

Future Research Efforts

Future research and program evaluation studies should be considered following this study. The most immediate avenue being a larger-scale sampling of communities from across the US and US territories to assess perceptions and opinions found to be significant in this study. Both communities already recognized as TR and those currently seeking recognition or unrecognized should be included in the sample for this larger, nation-wide study. Extending the

sample to include more sites would bolster and increase generalizability, while also providing the NWS with stronger evidence for or against the programmatic guideline recommendations provided by this research. Future studies should also note the utility of providing information to expert community stakeholders through both the central and peripheral routes of the Elaboration Likelihood Model (ELM). Written materials including detailed definitions and explanations of concepts would be well placed to activate an individual's peripheral route, while community meetings (both in-person or virtual) would allow in-depth discussion facilitating the central route of attitude formation.

REFERENCES

Akiba, S. (2011). Our response in the aftermath of the Great Tohoku-Kanto Earthquake and Tsunami. *Journal of Epidemiology, 21*, 237-239. doi: 10.2188/jea/JE20110064

American Red Cross. (2013). Disaster relief. Retrieved September 7, 2013, from http://www.redcross.org/what-we-do/disaster-relief

Applied Technology Council. (2012). *Guidelines for design of structures for vertical evacuation from tsunamis*. (FEMA P-646). Redwood City, CA: Applied Technology Council Retrieved from http://www.atcouncil.org/files/FEMA%20P-646%20Final.pdf.

Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative data: An introduction to coding and analysis*. New York: New York University Press.

Becker, J. S., Paton, D., Johnston, D. M., & Ronan, K. R. (2012). A model of household preparedness for earthquakes: how individuals make meaning of earthquake information and how this influences preparedness. *Natural Hazards, 64*(1), 107-137.

Bernard, E. N. (2001). *The US National Tsunami Hazard Mitigation Program summary.* Paper presented at the Proceedings of the International Tsunami Symposium 2001 (ITS 2001).

Bernard, E. N. (2005). The US National Tsunami Hazard Mitigation Program: A successful state—federal partnership. D*eveloping Tsunami-Resilient Communities* (pp. 5-24): Springer Netherlands.

Bitner , M. J., & Obermiller, C. (1985). *The Elaboration Likelihood Model: Limitations and extensions in marketing.* (Vol. 12). Provo, UT: Association for Consumer Research.

Cacioppo, J. T., & Petty, R. E. (1979). Effects of message repetition and position on cognitive response, recall and persuasion. *Journal of Personality and Social Psychology, 27*, 97-109.

Carver, G. A., Jayko, A. S., Valentine, D. W., & Li, W. H. (1994). Coastal uplift associated with the 1992 Cape Mendocino earthquake, northern California. *Geology, 22*(3), 195-198.

Choudhary, E., Chen, T.-H., Martin, C., Vagi, S., Roth, J., Keim, M., . . . Bayleyegn, T. (2012). Public health needs assessments of Tutuila Island, American Samoa, After the 2009 tsunami. *Disaster medicine and public health preparedness, 6*, 209-216.

Coyne, C. J., Leeson, P. T., & Sobel, R. S. (2009). The impact of FEMA reorganization: Implications for policy. *Mercatus Policy Series, Policy Comment* (24).

Dengler, L. (2005). The role of education in the national tsunami hazard mitigation program. *Developing Tsunami-Resilient Communities* (pp. 141-153): Springer Netherlands.

Division of the Civilian Volunteer Medical Reserve Corps. (2013). About the Medical Reserve Corps. Retrieved September 6, 2013, from https://www.medicalreservecorps.gov/pageViewFldr/About

Doocy, S., Daniels, A., Dick, A., & Kirsch, T. D. (2013). The human impact of tsunamis: a historical review of events 1900-2009 and systematic literature review. *PLoS Curr, 5*. doi: 10.1371/currents.dis.40f3c5cf61110a0fef2f9a25908cd795

Dunbar, P. K., & Weaver, C. S. (2008). *US States and territories national tsunami hazard assessment: Historical record and sources for waves*. Washington DC:US Department of Commerce, National Oceanic and Atmospheric Administration.

Eikenberry, A. M., Arroyave, V., & Cooper, T. (2007). Administrative failure and the international NGO response to Hurricane Katrina. *Public Administration Review, 67*(s1), 160-170.

EMDAT. (2008). Tsunami data and statistics. In U. c. d. Louvain (Ed.). Brussels, Belgium: EM-DAT: The OFDA/CRED International Disaster Database.

Federal Emergency Management Agency. (2011). National Incident Management System. Retrieved February 3, 2013, from http://www.fema.gov/national-incident-management-system

Federal Emergency Management Agency. (2012). About community emergency response team. Retrieved September 6, 2013, from http://www.fema.gov/community-emergency-response-teams/about-community-emergency-response-team

Federal Emergency Management Agency. (2013). National Preparedness Community: CERT Forum. Retrieved February 7, 2014, from http://community.fema.gov/connect.ti/readynpm/view?objectId=166042

Forgette, R., Dettrey, B., Van Boening, M., & Swanson, D. A. (2009). Before, now, and after: Assessing Hurricane Katrina relief. *Population Research and Policy Review, 28*(1), 31-44.

Franklin, D. (2013). StormReady! Retrieved September 9, 2013, from http://www.stormready.noaa.gov/

Fraser, S., Leonard, G. S., Matsuo, I., & Maurakami, H. (2012). Tsunami evacuation: Lessons from the Great East Japan earthquake and tsunami of March 11th 2011 (pp. 89): GNS Science Report 2012/17.

Friday, E. (1994). The modernization and associated restructuring of the National Weather Service: An overview. *Bulletin of the American Meterological Society, 75*(1), 43-52.

Friese, S. (2012). *Qualitative data analysis with ATLAS.ti.* Thousand Oaks, CA: Sage.

Fritz, C. E., & Marks, E. S. (1954). The NORC studies of human behavior in disaster. *Journal of Social Issues, 10*(3), 26-41.

Fritz, C. E., & Mathewson, J. H. (1957). *Convergence behavior in disasters: A problem in social control: A special report prepared for the Committee on Disaster Studies.* Washington DC:National Academy of Sciences National Research Council.

Fritz, H. M., Borrero, J. C., Synolakis, C. E., Okal, E. A., Weiss, R., Titov, V. V., . . . Chan, I. (2011). Insights on the 2009 South Pacific tsunami in Samoa and Tonga from field surveys and numerical simulations. *Earth-Science Reviews, 107*(1), 66-75.

Gershon, R. R., Rubin, M. S., Qureshi, K. A., Canton, A. N., & Matzner, F. J. (2008). Participatory action research methodology in disaster research: results from the World Trade Center evacuation study. *Disaster Medicine and Public Health Preparedness,* 2(3), 142-149.

Gregg, C. E., Johnson, V., & Johnston, D. M. (2012a). *Draft Report on Emergency Manager and Stakeholder Comments to the Draft Guidelines for Recognition as TsunamiReady™: A Component of the TsunamiReady™Program Improvement Plan*. Unpublished Report January 2012.

Gregg, C. E., Johnson, V., & Johnston, D. M. (2012b). *Suggested draft: "Guidelines and Checklist for Recognitions of a Community as TsunamiReady™".* Unpublished Report August 2012.

Gregg, C. E., Wood, N., Johnson, V., & Johnston, D. M. (2012). *Guidelines and Checklist for TsunamiReady™ Recognition*. Unpublished Report October 2012.

Gregg, C. E., Wood, N., Johnson, V., & Johnston, D. M. (2013*). Guidelines and Checklist for TsunamiReady™ Recognition*. Unpublished Report January 2013.

Gresham, R. (1994). Going... going... gone? Federal Emergency Management Agency. *Emergency Medical Services, 23*(1), 42.

Grilli, S. T., Ioualalen, M., Asavanant, J., Shi, F., Kirby, J. T., & Watts, P. (2007). Source constraints and model simulation of the December 26, 2004, Indian Ocean Tsunami. *Journal of Waterway, Port, Coastal, and Ocean Engineering, 133*(6), 414-428.

Guha-Sapir, D., & van Panhuis, W. G. (2009). Health impact of the 2004 Andaman Nicobar earthquake and tsunami in Indonesia. *Prehosp Disaster Med, 24*(6), 493-499.

Guha-Sapir, D., van Panhuis, W. G., & Lagoutte, J. (2007). Short communication: Patterns of chronic and acute diseases after natural disasters - a study from the International Committee of the Red Cross field hospital in Banda Aceh after the 2004 Indian Ocean tsunami. *Trop Med Int Health, 12*(11), 1338-1341. doi: 10.1111/j.1365-3156.2007.01932.x

Hayashi, K., & Tomita, N. (2012). Lessons learned from the Great East Japan Earthquake: Impact on child and adolescent health. *Asia Pac J Public Health, 24*(4), 681-688. doi: 10.1177/1010539512453255

Helquist, M. (2007). Portland to the rescue: The Rose City's response to the 1906 San Francisco earthquake and fire. *Oregon Historical Quarterly, 108*(3), 384-409.

Henderson, A. (2006). The human geography of catastrophe: Family bonds, community ties, and disaster relief after the 1906 San Francisco earthquake and fire. *Southern California Quarterly, 88*(1), 37-70.

Hesse-Biber, S. N., & Leavy, P. (2006). *The practice of qualitative research*. Thousand Oaks, CA: Sage.

Hollis, A. L. (2005). *A tale of two federal emergency management agencies.* Paper presented at the The Forum.

Horan, J., Ritchie, L. A., Meinhold, S., Gill, D. A., Houghton, B. F., Gregg, C. E., . . . Johnston, D. (2010). Evaluating disaster education: The National Oceanic and Atmospheric Administration's TsunamiReady™ community program and risk awareness education efforts in New Hanover County, North Carolina. *New Directions for Evaluation, 2010*(126), 79-93.

Huang, S.-K., Lindell, M. K., Prater, C. S., Wu, H.-C., & Siebeneck, L. K. (2012). Household evacuation decision making in response to Hurricane Ike. *Natural Hazards Review, 13*(4), 283-296.

Hudson, J. J. (1976). The California National Guard: In the San Francisco earthquake and fire of 1906. *California Historical Quarterly, 55*(2), 137-149.

Hunter, J. C., Crawley, A. W., Petrie, M., Yang, J. E., & Aragon, T. J. (2012). Local public health system response to the tsunami threat in coastal California following the Tohoku Earthquake. *PLoS Curr, 4*. doi: 10.1371/4f7f57285b804

Intergovernmental Oceanographic Commission. (2012). Tsunami, the great waves. In I. O. Commission (Ed.), *Brochure 2012-4* (Second Revised ed.). Paris, France: UNESCO.

Ivers, L. C., & Ryan, E. T. (2006). Infectious diseases of severe weather-related and flood-related natural disasters. *Current Opinion in Infectious Diseases, 19*(5), 408-414.

Jin, D., & Lin, J. (2011). Managing tsunamis through early warning systems: A multidisciplinary approach. *Ocean & Coastal Management, 54*(2), 189-199. http://dx.doi.org/10.1016/j.ocecoaman.2010.10.025

Johnson, G. S., & Rainey, S. A. (2007). Hurricane Katrina: Public health and environmental justice issues front and centered. *Race, Gender & Class*, 17-37.

Johnston, D., Becker, J., Gregg, C., Houghton, B., Paton, D., Leonard, G., & Garside, R. (2007). Developing warning and disaster response capacity in the tourism sector in coastal Washington, USA. *Disaster Prevention and Management, 16*(2), 210-216.

Johnston, D., Paton, D., Crawford, G. L., Ronan, K., Houghton, B., & Bürgelt, P. (2005). Measuring tsunami preparedness in coastal Washington, United States. In E. N. Bernard (Ed.), *Developing tsunami-resilient communities* (pp. 173-184): Springer Netherlands.

Jonientz-Trisler, C., Simmons, R. S., Yanagi, B. S., Crawford, G. L., Darienzo, M., Eisner, R. K., . . . Priest, G. R. (2005). Planning for tsunami-resilient communities. *Natural Hazards, 35*(1), 121-139. doi: 10.1007/s11069-004-2408-y

Kano, M., & Bourque, L.B. (2008). Correlates of School Disaster Preparedness: Main Effects of Funding and Coordinator Role. *Natural Hazards Review*, 9(1), 49–59.

Keim, M. E. (2006). Cyclones, tsunamis and human health. *Oceanography, 19*(2), 40-49.

Keim, M. E. (2011). The public health impact of tsunami disasters. *Am J Disaster Med, 6*(6), 341-349.

Kouadio, I. K., Aljunid, S., Kamigaki, T., Hammad, K., & Oshitani, H. (2012). Infectious diseases following natural disasters: Prevention and control measures. *Expert Rev Anti Infect Ther, 10*(1), 95-104. doi: 10.1586/eri.11.155

Kutner, N. G. (2007). *Health needs and health care: Perspectives from Katrina*. Paper presented at the Annual Meeting of the American Sociological Association, New York City, NY.

LaPlante, J., & Kaeser, T. P. (2007). *A history of pedestrian signal walking speed assumptions.* Paper presented at the 3rd Urban Street Symposium: Uptown, Downtown, or Small Town: Designing Urban Streets That Work.

Lay, T., Ammon, C. J., Kanamori, H., Rivera, L., Koper, K. D., & Hutko, A. R. (2010). The 2009 Samoa-Tonga great earthquake triggered doublet. *Nature, 466*(7309), 964-968.

LeCompte, M. D., & Preissle, J. (1993). *Ethnography and qualitative design in educational research* (2 ed.). San Diego, CA: Academic Press.

Leong-Nowell, T. A., Leavai, F., Ching, L. A., Fiu, L., Wyber, R., Nisbet, M., . . . Ioane-Cleverley, T. (2012). Aspiration pneumonia and challenges following the Samoa Tsunami in 2009. *Clinical Correspondence*.

Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539-556.

Lindell, M. K., & Perry, R. W. (1992). *Behavioral foundations of community emergency planning.* Belize:Hemisphere.

Lindell, M. K., & Perry, R. W. (2004). *Communicating environmental risk in multiethnic communities.* New York:Sage (7).

Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: Theoretical modifications and additional evidence. *Risk Analysis, 32*(4), 616-632.

Livingston, R. (2006). When an American city is destroyed: the U.S. Military as first responders to the San Francisco earthquake a century ago. *Prologus, 38*(1), 36-44.

Llewellyn, M. (2006). Floods and tsunamis. *Surgical Clinics of North America, 86*(3), 557-578.

McIvor, D., Paton, D., & Johnston, D. (2009). Modelling community preparation for natural hazards: understanding hazard cognitions. *Journal of Pacific Rim Psychology, 3*(02), 39-46.

Mileti, D. S., & O'Brien, P. (1992). Warnings during disaster: Normalizing communicated risk. *Social Problems, 39*(1).

Mileti, D. S., & O'Brien, P. (1993). Public response to aftershock warnings. *US Geological Survey Professional Paper, 1553*, 31-42.

Mileti, D. S., & Peek, L. (2000). The social psychology of public response to warnings of a nuclear power plant accident. *Journal of Hazardous Materials, 75*(2), 181-194.

Minkler, M., & Wallerstein, N. (Eds.). (2010). *Community-based participatory research for health: From process to outcomes*. Second edition. San Francisco: Jossey-Bass.

Mishra, S., Suar, D., & Paton, D. (2009). Is externality a mediator of experience–behaviour and information–action hypothesis in disaster preparedness? *Journal of Pacific Rim Psychology, 3*(01), 11-19.

Moore, H. E., Bates, F. L., Layman, M. V., & Parenton, V. J. (1963). *Before the wind: A study of the response to hurrican Carla*. Washington DC: National Academy of Sciences - National Research Council.

Morrissey, W. A. (2005). *Tsunamis: Monitoring, detection, and early warning systems*. Washington DC: Library of Congress.

Morse, S. S. (2006). *Disaster preparedness*. San Francisco: Jossey-Bass.

National Academy of Sciences. (2011). *Tsunami warning and preparedness: An assessment of the U.S. Tsunami Program and the nation's preparedness efforts*. Washington, DC: The National Academies Press.

National Oceanic and Atmospheric Administration. (2013). About NOAAs National Weather Service. Retrieved September 2, 2013, from http://www.weather.gov/about

National Oceanic and Atmospheric Administration. (2013). About the National Tsunami Hazard Mitigation Program (NTHMP). Retrieved July 26, 2013, from http://nthmp.tsunami.gov/about_program.html

National Tsunami Hazard Mitigation Program. (May 10-11, 2000). *Summary report of the tsunami hazard mitigation steering group meeting.* Paper presented at the Tsunami Hazard Mitigation Steering Group Meeting, Seattle, WA.

National Tsunami Hazard Mitigation Program. (2013). *NTHMP Historic Archive Site for the National Tsunami Hazard Mitigation Program: Tsunami Terminology*. Seattle, WA: NOAA Pacific Marine Enviornmental Laboratory. http://nthmp-history.pmel.noaa.gov/terms.html

National Weather Service. (March 1, 2006). NOAA's National Weather Service celebrates 135th anniversary. *NOAA's National Weather Service.* Retrieved August 20, 2013, from http://www.nws.noaa.gov/pa/history/135anniversary.php

National Weather Service. (April 19, 2013). Evolution of the National Weather Service. *NOAA's National Weather Service.* Retrieved August 20, 2013 from http://www.nws.noaa.gov/pa/history/timeline.php

National Weather Service. (April 2, 2014). TsunamiReady™. *NOAA's National Weather Service.* Retrieved April 2, 2014, from http://www.tsunamiready.noaa.gov/ts-communities.htm

Nepal, V., Banerjee, D., Perry, M., & Scott, D. (2012). Disaster preparedness of linguistically isolated populations practical issues for planners. *Health promotion practice*, 13(2), 265-271.

O'Brien, P. W., & Mileti, D. S. (2003). 75 The sociological dimensions of earthquake mitigation, preparedness, response, and recovery. *International Geophysics*, *81*, 1241-1252.

Okal, E. A., Fritz, H. M., Synolakis, C. E., Borrero, J. C., Weiss, R., Lynett, P. J., . . . Liu, P. L.-F. (2010). Field survey of the Samoa tsunami of 29 September 2009. *Seismological Research Letters*, *81*(4), 577-591.

Patel, V. M., Patel, H. S., & Singh, A. P. (2011). Comparative study of earthquake and tsunami loading on vertical evacuation structure at Dwarka. *International Journal of Earth Sciences and Engineering*, 4(4), 659-668.

Paton, D. (2003). Disaster preparedness: A social-cognitive perspective. *Disaster prevention and Management*, *12*(3), 210-216.

Paton, D., Frandsen, M., & Johnston, D. (2010). Confronting an unfamiliar hazard: Tsunami preparedness in Tasmania. *The Australian Journal of Emergency Management, 25*(4), 31-37.

Paton, D., Houghton, B. F., Gregg, C. E., Gill, D. A., Ritchie, L. A., McIvor, D., . . . Johnston, D. M. (2008). Managing tsunami risk in coastal communities: Identifying predictors of preparedness. *The Australian Journal of Emergency Management, 23*(1).

Paton, D., Houghton, B. F., Gregg, C. E., McIvor, D., Johnston, D. M., Bürgelt, P., . . . Horan, J. (2009). Managing tsunami risk: Social context influences on preparedness. *Journal of Pacific Rim Psychology, 3*(01), 27-37. doi: doi:10.1375/prp.3.1.27

Paton, D. (2005). *Community resilience: Integrating hazard management and community engagement*. University of Tasmania:Launceston.

Patton, M. (1990). *Qualitative evaluation and research methods* (2 ed.). Newbury Park, CA: Sage.

Pelling, M. (2007). Learning from others: the scope and challenges for participatory disaster risk assessment. *Disasters*, 31(4), 373-385.

Perry, R. W., & Lindell, M. K. (2003). Preparedness for emergency response: Guidelines for the emergency planning process. *Disasters, 27*(4), 336-350.

Project Safe Haven. (2011). In J. Clark (Ed.), *Tsunami vertical evacuation on the Washington coast*. Pacific County: University of Washington.

Quarantelli, E. L. (1990). *The warning process and evacuation behavior: The research evidence*. University of Delaware Disaster Reserach Center:Newark.

Ramirez, M., Kubicek, K., Peek-Asa, C., & Wong, M. (2009). Accountability and assessment of emergency drill performance at schools. *Family & community health, 32*(2), 105-114.

Rothfusz, L. P. (2013). StormReady: From idea to national program. Retrieved September 9, 2013, from http://www.stormready.noaa.gov/history.htm

Schneider, S. (2008). Who's to Blame?(Mis) perceptions of the intergovernmental response to disasters. *Publius: The Journal of Federalism, 38*(4), 715-738.

Siebeneck, L. K., Lindell, M. K., Prater, C. S., Wu, H.-C., & Huang, S.-K. (2013). Evacuees' reentry concerns and experiences in the aftermath of Hurricane Ike. *Natural Hazards, 65*(3), 2267-2286.

Sinclair, H., Doyle, E. E., Johnston, D. M., & Paton, D. (2012). Assessing emergency management training and excercises. *Disaster Prevention and Management, 21*(4), 507-521. doi: 10.1108/09653561211256198

Smith, M. E. (1977). The strategic bombing debate: The second World War and Vietnam. *Journal of Contemporary History, 12*(1), 175-191.

Sorensen, J. H. (1992). Assessment of the need for dual indoor/outdoor warning systems and enhanced tone alert technologies in the chemical stockpile emergency preparedness program. Oak Ridge National Lab:TN (United States).

Sorensen, J. H. (2000). Hazard warning systems: Review of 20 years of progress. *Natural Hazards Review, 1*(2), 119-125.

Suppasri, A., Koshimura, S., Imai, K., Mas, E., Gokon, H., Muhari, A., & Imamura, F. (2012). Damage characteristic and field survey of the 2011 great east Japan tsunami in Miyagi prefecture. *Coastal Engineering Journal, 54*(01).

Tsunami Warning and Education Act, Pub.L. 109-424 C.F.R. (2005).

Ulin, P. R., Robinson, E. T., & Tolley, E. E. (2004). *Qualitative methods in public health: a field guide for applied research*. San Francisco, CA:Wiley.

United Nations International Strategy for Disaster Reduction. (2005). Platform for the promotion of early warning. In UNISDR (Ed.). Bonn, Germany: UN Day 2005.

US Nuclear Regulatory Commission. (1986). *Nuclear Regulartory Commission issuances*. (NUREG-0750). Washington, DC: Division of Technical Information and Document Control.

US Nuclear Regulatory Commission. (1996). *Criteria for preparation and evaluation of radiological emergency response plans and preparedness in support of nuclear power plants*. Washington, DC: Division of Technical Information and Document Control.

Wada, K., Fukuda, K., Yoshikawa, T., Hirose, T., Ikeno, T., Umata, T., . . . Aizawa, Y. (2012). Bacterial hazards of sludge brought ashore by the tsunami after the great East Japan earthquake of 2011. *J Occup Health, 54*(4), 255-262.

Wisner, B. (2004). *At risk: Natural hazards, people's vulnerability and disasters.* Washington DC:Psychology Press.

Witt, J. L., & Morgan, J. (2002). *Stronger in the broken places: Nine lessons for turning crisis into triumph*. Washington DC:Macmillan.

Wood, W. (2000). Attitude change: Persuasion and Social Influence. *Annual Reiew of Psychology,* 51:539-570.

Wu, T. Y. (1981). Long waves in ocean and coastal waters. *Journal of Engineering Mechanics, 107*(EM3), 501-522.

APPENDICES

Appendix A: Current NWS TsunamiReady™ Guidelines

TsunamiReady™ Guidelines

Guidelines for being designated TsunamiReady are given in the following table. Each guideline is fully discussed following the table. The guidelines are based on four population-based categories.

Guidelines	**Population**			
	< 2,500	2,500 - 14,999	15,000 - 40,000	> 40,000
Guideline 1: Communications and Coordination				
Established 24-hour Warning Point (WP)	**X***	**X***	**X**	**X**
Established Emergency Operations Center (EOC)	**X***	**X***	**X**	**X**
Guideline 2: Tsunami Warning Reception				
Number of ways for EOC/WP to receive NWS tsunami messages. (If in range, one *must* be NWR receiver with tone alert; NWR-SAME is preferred)	**3**	**4**	**4**	**4**
Guideline 3: Local Warning Dissemination				
Number of ways EOC/WP can disseminate warnings to public	**1**	**2**	**3**	**4**
NWR - SAME receivers in public facilities	**X**	**X**	**X**	**X**
For county/borough warning points, county/borough communication network that ensures information flow among communities	**X**	**X**	**X**	**X**
Guideline 4: Community Preparedness				
Number of annual tsunami awareness programs	**1**	**2**	**3**	**4**
Designate/establish tsunami shelter/area in safe zone	**X**	**X**	**X**	**X**
Designate tsunami evacuation areas and evacuation routes, and install evacuation route signs	**X**	**X**	**X**	**X**
Provide written, locally specific, tsunami hazard response material to public	**X**	**X**	**X**	**X**
Schools: Encourage tsunami hazard curriculum, practice evacuations (if in hazard zone), and provide safety material to staff and students.	**X**	**X**	**X**	**X**
Guideline 5: Administrative				
Formal tsunami hazard operations plan	**X**	**X**	**X**	**X**
Biennial meeting between emergency manager and NWS	**X**	**X**	**X**	**X**

Visit by NWS official to community at least every other year	**X**	**X**	**X**	**X**

* For cities or towns with less than 15,000 people, a 24-hour warning point and EOC are required; however, another jurisdiction within the county may provide that resource.

Guideline 1: Communications and Coordination Center

A key to effective hazards management is effective communication. This is especially true in tsunami emergencies, since wave arrival times may be measured in just minutes. Such a "short fused" event requires an immediate but careful response. To ensure such a proper response, communities must have set up the following:

1. 24-Hour Warning Point. To receive recognition under the TsunamiReady program, an agency needs to have a 24-hour Warning Point (WP) able to receive NWS Tsunami information and provide local reports and advice. Typically, this might be a law enforcement or fire department dispatching point. For cities or towns without a local dispatching point, a county/borough agency could act for them in that capacity. The warning point needs to have:
    - 24 hour operations
    - Warning reception capability
    - Warning communication/dissemination capability
    - Ability and authority to activate local warning system(s)
2. Emergency Operations Center. Agencies serving jurisdictions of more than 2,500 people will need an emergency operations center (EOC). It must be staffed during tsunami events to execute the warning point's tsunami warning functions. Summarized below are tsunami-related roles of an EOC:
        - Activate based on predetermined guidelines related to NWS tsunami information and/or tsunami events
        - Staffed by emergency management director or designee
        - Possess warning reception/dissemination capabilities equal to or better than the warning point
        - Ability to communicate with adjacent EOCs/Warning Points C Ability to communicate with local NWS office.

Guideline 2: Tsunami Warning Reception

Warning points and EOCs each need multiple ways to receive NWS Tsunami Warnings. TsunamiReady guidelines to receive NWS warnings in an EOC/WP require a combination of the following, based on population:

- NOAA Weather Radio (NWR) receiver with tone alert. Specific Area Message Encoding (SAME) is preferred. Required for recognition only if within range of transmitter
- NOAA Weather Wire drop: Satellite downlink from NWS.
- Emergency Management Weather Information Network (EMWIN) receiver: Satellite feed and/or VHF radio transmission of NWS products

- Statewide Telecommunications System: Automatic relay of NWS products on statewide emergency management or law enforcement system
- Statewide Warning Fan-out System: State authorized system of passing message throughout warning area
- NOAA Weather Wire via Internet NOAAPort Lite: Provides alarmed warning messages through a dedicated Internet connection
- Direct link to NWS office: For example, amateur or VHF radio
- E-mail from Tsunami Warning Center: Direct e-mail from Warning Center to emergency manager
- Pager Message from Tsunami Warning Center: Page issued from Warning Center directly to EOC/WP
- Radio/TV via Emergency Alert System: Local radio/TV or cable TV
- US Coast Guard Broadcasts: WP/EOC monitoring of USCG marine channels
- National Warning System (NAWAS) drop: FEMA-controlled civil defense hot-line

Guideline 3: Warning Dissemination

1. Upon receipt of NWS tsunami warnings or other reliable information suggesting a Tsunami is imminent, local emergency officials should communicate the threat to as much of the population as possible. Receiving TsunamiReady recognition requires having one or more of the following means of ensuring timely warning dissemination to citizens (based on population):
    - A community program subsidizing the purchase of NWR.
    - Outdoor warning sirens
    - Television audio/video overrides
    - Phone messaging (dial-down) systems
    - Other locally-controlled methods, e.g., local broadcast system or emergency vehicle sirens.
2. Once NWS Tsunami Warnings are received, or local information suggests an imminent tsunami threat, the local emergency officials should communicate with as much of the population as possible. To be recognized as TsunamiReady, a community must have NOAA Weather Radio in the following facilities:

    Required Locations:

    - 24 hour Warning Point
    - Emergency Operations Center
    - City Hall
    - School superintendent office or equivalent

    Recommended Locations:

    - Courthouses
    - Public libraries
    - Hospitals
    - All schools

- Fairgrounds
- Parks and recreation areas
- Public utilities
- Sports arenas
- Transportation departments
- Nursing Homes/Assisted Living
- Harbors

Receivers with SAME capability are preferred (this is required for recognition only if locations are within range of NWR transmitter). In addition, recognition will be contingent on having one or more of the following means (based on population) of ensuring timely warning dissemination to citizens:

- Cable television audio/video overrides.
- Local Flood warning systems with no single point of failure.
- Other locally-controlled methods like a local broadcast system or sirens on emergency vehicles.
- Outdoor warning sirens.

3. Counties/Boroughs Only: A county/borough-wide communications network ensuring the flow of information among all cities and towns within its borders. This would include provision of a warning point for the smaller towns, and fanning out of the message as required by state policy. Critical public access buildings should be defined by each community's tsunami warning plan.

Guideline 4: Awareness

Public education is vital in preparing citizens to respond properly to Tsunami threats. An educated public is more likely to take steps to receive tsunami warnings, recognize potentially threatening Tsunami events, and respond appropriately to those events. Communities seeking recognition in the TsunamiReady program must:

1. Conduct or sponsor Tsunami awareness programs. Possible locations may include schools, hospitals, fairs, workshops, and community meetings (number of presentations per year is based on population).
2. Define Tsunami evacuation areas and evacuation routes, and install evacuation route signs.
3. Designate a Tsunami shelter/area outside the hazard zone.
4. Provide written Tsunami hazard information to the populace, including:
    - Hazard zone maps
    - Evacuation routes
    - Basic tsunami information

    These instructions can be distributed through mailings, i.e, utility bills, within phone books, and poste at common meeting points such as libraries and public buildings throughout the community.

5. Local schools must meet the following criteria:
    - Encourage the inclusion of Tsunami information in primary and secondary school curriculums. NWS will help identify curriculum support material.
    - Provide an opportunity biennially for a Tsunami awareness presentation by the local NWS office and/or the local Emergency Manager.
    - Schools within the defined hazard zone must have Tsunami evacuation drills at least biennially.
    - Written safety material should be provided to all staff and students.
    - Have an earthquake plan.

Guideline 5: Administrative

No program can be successful without formal planning and a pro-active administration. To be recognized in the TsunamiReady Program:

1. A Tsunami warning plan must be in place and approved by the local governing body. This plan must address the following:
    - Warning point procedures
    - EOC activation criteria and procedures
    - Warning point and EOC personnel specification
    - Hazard zone map with evacuation routes
    - Procedures for canceling an emergency for those less-than-destructive Tsunamis
    - Criteria and procedures for activation of sirens, cable television override, and/or local systems activation in accordance with state Emergency Alert System (EAS) plans, and warning fan-out procedures, if necessary
    - Annual exercises.
2. Yearly visit/discussion with local NWS Office or Tsunami Warning Center personnel. Due to distance and other logistical constraint in the Alaska and Pacific Regions, this guideline can be met by a visit to the NWS office, phone discussion, or e-mail.

NWS officials will commit to visit recognized communities, at least every other year, to tour EOCs/Warning points and meet with key officials.

Appendix B: Current Revised Draft of the TR Guidelines

Guidelines for Community Recognition as TsunamiReady™

BACKGROUND

The TsunamiReady™ Program

The TsunamiReady™ Program of the National Weather Service (NWS) recognizes coastal jurisdictions and other population centers (e.g., tribes, counties, universities) that take and maintain steps to reduce risk from tsunamis. Communities recognized as TsunamiReady™ become more resilient through a suite of mitigation, preparedness, response, and recovery activities that address their vulnerability to either far-field or near-field tsunamis.

Addressing the appropriate tsunami threats in your community— far and near-field tsunamis

Preparing for tsunamis in the United States (US) is complicated by the fact that two distinctly different types of tsunami threats exist for its coastal communities. Far-field tsunamis (also called distant tsunamis) are generated by distant earthquakes (such as the 2011 Tohoku earthquake in Japan). In the U.S., communities typically have several hours to respond before far-field tsunamis strike low-lying areas. Near-field tsunamis, on the other hand, are generated by local sources (such as an earthquake within the Cascadia subduction zone). They involve large-magnitude earthquakes followed by potentially catastrophic tsunami waves striking coastal communities in a matter of minutes. Usually, but not always, damage is greater from near-field tsunamis than far-field tsunamis.

The TsunamiReady™ Program recognizes that reducing risks requires different strategies and provides guidelines that distinguish between far-field and near-field threats. For communities with only far-field tsunami threats, guidelines emphasize ensuring seamless communication among NWS Tsunami Warning Centers and stakeholders using modern communications capabilities. For communities that also have near-field tsunami threats, these same communications capabilities between NWS and practitioners are critical, but at-risk individuals also must:

- recognize the natural warnings or environmental cues of a possible or imminent tsunami (e.g., ground shaking from an earthquake, unusual rapid rise or fall of a shoreline);
- know where high ground is accessible in the limited time available; and
- take personal responsibility to evacuate in the few minutes they have to survive.

Addressing your community's vulnerability to tsunamis

Preparing your community for future far-field or near-field tsunamis means implementing risk-reduction actions that are tailored to local conditions and needs. Therefore, a critical element in preparing your community is understanding the threat and how it is specifically vulnerable to tsunamis, such as the types of people and systems that are exposed to tsunami hazards, factors that make them more sensitive to threats (e.g., age, language barriers, certain business sectors), and the capacity of individuals to respond effectively to potential or imminent threats.

Incentives for becoming TsunamiReady™

No coastal community is tsunami proof, but being recognized as TsunamiReady™ will help decision-makers feel confident that they are engaged in risk-reduction activities that have been acknowledged by tsunami experts and by their peers from multiple states and territories to be necessary. The expectation is that TsunamiReady™ communities will have fewer human fatalities and injuries, as well as property damage, than communities who do not take similar preparedness actions.

GUIDELINES

Initial determination of tsunami threat

TsunamiReady™ guidelines distinguish between near-field and far-field tsunami threats. They require all coastal communities seeking TsunamiReady™ recognition to meet the requirements (elements) for communities exposed to far-field threats. Communities with a near-field tsunami threat must meet additional elements. Headings for mandatory elements are shown in red below and underlined, for both far-field and near-field threats. Optional elements are shown with a green, underlined heading, using bullets and open circles.

NOTE: Determination of whether a community must meet additional requirements for near-field tsunami threats shall be made by the state representatives for the National Tsunami Hazard Mitigation (NTHMP) in collaboration with the NWS WCM with responsibility for that area.

I. MITIGATION (MIT)

Mandatory elements for all coastal communities:

Mit-1. Tsunami-hazard zones have been mapped. The primary source for mapping potential tsunami-impact zones is inundation modeling. If this is unavailable, other acceptable sources include guidance from tsunami experts from the NOAA Tsunami Warning Centers, the U.S. or State Geological Surveys, universities, or consultants. Modeling and mapping efforts shall meet NOAA/NTHMP guidelines.

Mit-2. Tsunami hazard and vulnerability are addressed in your FEMA-approved Local Multi-Hazard Mitigation Plan. As detailed in section 44CFR Part 201.6 (c)(2) of the Stafford Disaster Mitigation Act, this shall include a tsunami-hazard profile (location, extent, previous occurrences, likelihood of future events) and a description of community vulnerability (exposure and impact summary of populations, individuals with access and functional needs, business, and critical facilities). Vulnerability information will help guide the development of preparedness and outreach efforts that are tailored to local conditions and needs.

Mit-3. Designated tsunami hazard areas, evacuation routes, non-hazard areas, and assembly areas (sufficient to support the population) based on tsunami inundation modeling and mapping.

Mit-4. Signage to identify tsunami hazard areas, evacuation routes and assembly areas

Additional, mandatory elements for communities with near-field tsunami threats:

Mit-5. Availability of natural high or inland ground has been identified for at-risk populations. If suitable high or inland ground is available, then it should be determined if at-risk populations can reasonably reach these areas before tsunami waves are predicted to arrive. Evacuation assessments and/or modeling should take into account the types of at-risk individuals present (e.g., elderly, the very young, tourists, seasonal workers) and the reliability of evacuation routes (e.g., bridges, roads). Or, if natural high or inland ground is not accessible during predicted wave arrival, see Mit-6

Mit-6. A plan for vertical-evacuation strategies (e.g., berms, structures) has been established if it is unlikely that at-risk populations would be able to reach natural high ground and inland locations before wave arrival. This plan identifies proposed locations of vertical evacuation structures, the at-risk populations they would serve, funding sources, land use considerations, and a timeline for implementation. At subsequent reviews of TsunamiReady™ recognition, communities will need to demonstrate progress in implementing this plan.

Optional mitigation efforts to increase community resilience

- Tsunami-related elements in nationally-recognized planning efforts, such as:
    - FEMA's National Flood Insurance Program, including the Community Rating System
    - No Adverse Impact (NAI) coastal floodplain management as outlined by the Association of State Floodplain Managers (ASFPM).
    - Multi-Objective Management/Special Area Management Plans (SAMPs) in accordance with the Coastal Zone Management Act (CZMA)
- Tsunami-related elements in local planning efforts, such as:
    - Adoption of appropriate seismic standards and building codes
    - Local zoning ordinances to minimize or steer development away from tsunami-hazard zones
    - Critical-facility ordinance to minimize having critical facilities in tsunami-hazard zones
    - Tsunami hazard disclosure for permit applicants
    - Tsunami-resistant design and construction regulations
    - Open space in tsunami-hazard zone, such as parks, greenways, and natural areas
    - Incentives (e.g., density bonuses, fee waivers, set asides) to encourage mitigation
    - Plans that establish and/or preserve coastal buffers to slow shoreline erosion
- Tsunami-related mitigation projects, such as
    - Infrastructure to support evacuations, including seismic strengthening of bridges and roads, as well as vertical-evacuation berms, structures or other shelter(s) using the criteria from FEMA P646 (Guidelines for Design of Structures for Vertical Evacuation from Tsunamis)
    - Port- and harbor-related efforts, such as tying down refueling-tanks, automatic shut-off valves, caps on pier moorings, minimal long-term storage of material that would become potential debris (e.g., empty shipping containers, logs and lumber)
    - Automatic shut off valves on major supply gas lines
    - Relocation of buildings, hazardous materials, and critical infrastructure out of hazard zone
    - Protection of structures using NFIP coastal flood-resistant design and construction requirements and the FEMA Coastal Construction Manual if relocation is not feasible
    - Store important documents where they will not be damaged or lost, such as in remote archives.

II. PREPAREDNESS (PREP)

Mandatory elements for all coastal communities:

Prep-1. Tsunami exercise at least every three years, such as a tabletop, functional or full-scale exercise

Prep-2. Initial Responder training that includes tsunami hazard, warning and evacuation protocols

Prep-3. Evacuation maps of tsunami hazard areas, evacuation routes, non-hazard areas and assembly areas

Prep-4. Written materials that include tsunami information, hazard maps, evacuation routes, safety tips, and response protocols (e.g., natural cues of near-field tsunamis, warning system for far-field tsunamis). Information should be tailored to reflect local conditions and demographics such as appropriate languages or recognizing workforce differences between businesses where necessary. Information shall be disseminated using three or more of the following**:**

- Visitor centers and local tourist businesses (e.g., restaurants, bars, hotels)
- Local hotel and motel staff
- Historical markers and interpretative signs
- Radio and television spots
- Libraries
- Public utility/service industry bill safety notices.
- Billboard, highway, or beach entry signs.
- Local faith-based and civic organization bulletins/mailings.
- Bulk mailings of tsunami safety information to local residents and businesses

Prep-5. Events (at least one per year) to educate citizens on local tsunami hazards, evacuation routes, safety and response, such as

- Community tsunami safety workshop and education campaign
- Door-to-door safety awareness campaign with residents and businesses in your community's tsunami inundation/hazard zone.
- Local business workshop to help them to develop response and business continuity plans
- Local Emergency Planning Committee (LEPC) meetings.
- Local Area Emergency Communications Committee
- State Tsunami Technical Review/Advisory Committee
- Presentations or workshops for faith-based organizations, community or civic groups
- Booths at community events and county fairs.
- Local public safety campaigns, such as "Tsunami Awareness" week/month.
- Requirement to have weather radios in new buildings.

Prep-6. Information provided annually to schools in tsunami-hazard zones. Emergency management must inform all schools and child care centers annually of their risk of tsunami hazards and provide information on warning and evacuation procedures; EM must provide information on recommended evacuation sites to schools, including vertical evacuation sites if necessary. Schools in the inundation

zone must have an Emergency Operations Plan that includes tsunami response. An offer for an in-person presentation from the local emergency management office should be included in the information that is sent to schools.

Prep-7. Participation in NOAA/NWS Tsunami Warning Center communication tests

Additional, mandatory elements for communities with near-field tsunami threats:

Prep-8. Tsunami evacuation exercise for schools in the inundation zone at least once per year (possibly combined with fire drills or local field trips). To support school evacuation exercises, emergency managers shall also provide written safety material to school staff.

Prep-9. Annual training, outreach or education that targets owners and staff for high-occupancy businesses in the tsunami-hazard zones (e.g., hotels, restaurants, fisheries, industrial sites)

Prep-10. Annual training, outreach or education that targets residents living or working in tsunami-hazard zones on evacuation routes, safety and personal actions need to response.

Optional preparedness efforts to increase community resilience

- School-based training, such as:
  - Tsunami education program, including science and safety in primary and secondary schools
  - Tsunami awareness presentations by subject matter experts
- Evacuation plans for facilities with access and functional need individuals (e.g., assisted living facilities, child-day-care centers)
- Community-based training, such as:
  - COMET
  - "TsunamiReady Champions" to spearheads tsunami hazard education and awareness
  - "Map your Neighborhood," Citizens Corp, or Community Emergency Response Team
  - FEMA's "Are You Ready?" workshop or others from Emergency Management Institute
  - State Emergency Training Services
  - American Red Cross sheltering training
- Business-based preparedness training, such as:
  - Education materials distributed to guests (e.g. evacuation plans).
  - Appropriate tsunami evacuation signage placed at site
  - Employees trained in the site's procedures for a tsunami emergency.
  - Tsunami response policies and procedures, including MOUs/MOAs, plan annexes,
- Participation in national emergency-management programs, such as:
  - Emergency Management Accreditation Program (EMAP)
  - Certified Emergency Manager® or Associate Emergency Manager® through the International Association of Emergency Managers
- Preparedness projects
  - Designated harbor and marine vessel-evacuation areas in offshore deep-water areas
  - Interpretative tsunami hazard zone signs along beach/shore access points

- Participation in annual end-to-end communications test, including EAS activation, use of real event code (TSW) or EAS test message (e.g., RMT), evacuation drills/exercises, siren systems, and telephone mass notification system
- Surveys to assess the success of your community tsunami awareness program.

III. Response (RESP)

Mandatory elements for all coastal communities:

Resp–1. Tsunami hazards are addressed in the Emergency Operations Plan, including

- Identify tsunami as a hazard and provide a risk assessment
- Detail Communication/Dispatch Center procedures relating to tsunamis
- Specify EOC activation criteria and demobilization procedures
- Specify tsunami criteria and procedures for the activation of the public warning system in its area of responsibility
  - Criteria and procedures for siren activation, cable television override, and/or local activation in accordance with state EAS plans, warning fan-out procedures, and communication to functional and access needs populations.
- Provide contact information for all jurisdictional agencies and response partners including the NWS
- Evacuation plans for both far-field and near-field events, roles of community entities/agencies, hazard zones map with evacuation routes, and protocols for access and functional needs populations.
-
- Procedures for updating information and "all-clear" messages after initiating a tsunami incident response
- Procedures for providing security for evacuated zone.

Resp–2. Emergency Operations Center (EOC) (for jurisdictions of 15,000 or more people) that is staffed during tsunami incidents and capable of:

- Executing tsunami warning functions based on predetermined guidelines related to NWS tsunami information and/or tsunami incidents
- 24 hour operations or plan to activate the EOC for tsunami incidents in accordance with the EOP
- Warning reception and dissemination capability
- Staffed with trained and credentialed emergency management personnel
- Has ability and authority to activate the public warning system in its area of responsibility
- Maintains ability to communicate within and across jurisdictions (e.g., with other EOCs including those maintained by private organizations, Incident Command Posts, etc.) through resilient and redundant methods. Should have communication capabilities equal to or better than the Communication/Dispatch Center
- Maintains established communication links with NWS (e.g., NWSChat, phone, etc.) to relay real-time weather and flood reports to support the warning decision making process.

Or, for communities smaller than 15,000, there are ties to an EOC.

Resp–3. Redundant and reliable means for 24-Hour Warning Point and/or EOC <u>to receive</u> official tsunami watch, warning and advisory messages from NOAA Tsunami Warning Centers, local NWS Offices, or other officially-recognized warning centers**.** <u>At least three</u> of the following must be met:

- Public Alert™ certified NOAA Weather Radio receiver: Required for recognition only if within reliable reception range of a NWR transmitter
- National Warning System (NAWAS) drop: FEMA-controlled, 24-hour, continuous-private-line telephone system used to convey warnings to federal, state and local governments, as well as the military and civilian population.
- NWSChat: An instant messaging program available via the Internet used by NWS operational personnel to share critical warning decision expertise and other significant weather information InteractiveNWS (iNWS): An experimental real-time, user-defined, warning messaging service for mobile devices intended for emergency management/response personnel
- Emergency Management Weather Information Network (EMWIN) receiver: Device that receives satellite feed and/or VHF radio transmission of NWS products
- Statewide Telecommunications System: Automatic relay of NWS products, usually on law enforcement systems
- CMAS/WEA Alerts: Commercial Mobile Alert System (CMAS)/Wireless Emergency Alerts (WEA) service that allows public safety authorities to use FEMA's IPAWS Open Platform for Emergency Networks (IPAWS-OPEN) to send geographically targeted, text-like wireless emergency alerts to the public
- Amateur Radio transceiver: Potential communications directly to NWS office.
- Alerts provided through an AWCI provider: Typically received via email and/or a texting service to a smartphone, tablet, or computer
- Television: Access to local network or cable TV
- Local Radio: Emergency Alert System, LP1/LP2
- Internet monitoring capability, including social media such as Facebook and Twitter
- NOAA Weather Wire drop: Satellite downlink data feed from NWS.
- Direct e-mail from Tsunami Warning Center
- Direct fax from Tsunami Warning Center
- Text message or direct pager message from Tsunami Warning Center
- US Coast Guard Broadcasts: WP monitoring of USCG marine channels
- Satellite Phone
- Other Communications channel (please explain): For example, active participation in a state-run warning network, two-way, local emergency responder radio network, etc.

Resp–4. Redundant and reliable means for 24-Hour Warning Point and/or EOC <u>to disseminate</u> official tsunami watch, warning and advisory messages to the public. <u>At least three</u> of the following capabilities must be met:

- Emergency Alert System (EAS) message initiation and broadcast
- Cable television audio/video overrides
- Local flood warning systems ideally with no single point of failure
- Plan for siren/megaphone notification on emergency vehicles

- Outdoor warning sirens
- Other local alert broadcast system
- Local pager/texting system
- CMAS/WEA Alerts available capability throughout the jurisdiction
- Amateur Radio Operator network (Ham Radio)
- Telephone mass notification system
- Telephone tree to critical facilities
- Coordinated jurisdiction-wide radio network
- Counties, Parishes, Boroughs, etc. - A countywide communications network that ensures the flow of information between all cities and towns within its borders. This would include acting as the surrogate WP and/or EOC for jurisdictions without those capabilities.
- Social Media usage (Twitter, Facebook, etc.)
- Other, please explain

Resp–5. Public Alert Certified* NOAA Weather Radio (NWR) receivers in critical facilities and public venues in and around the tsunami inundation zone (where reception is available) including:

- **Required Locations:**
  - Communication/Dispatch Center serving as the 24-hour WP
  - EOC
  - City Hall
  - Public School Superintendent office

- **Recommended, but not required, Locations:**
  - Courthouses
  - Public libraries
  - Hospitals
  - All schools, usually located in Principal's or designee office
  - Fairgrounds, parks and recreation areas*
  - Public utilities*
  - Large-event venues, e.g., arenas, stadiums, etc.*
  - Transportation departments*
  - Nursing homes/Assisted living facilities*
  - Harbor Masters' Offices

*__Note__: Usually, the NWR receivers would be located in the primary management office/facility that has the authority to alter operations and the ability to order protective actions based on the NWS hazardous weather or flood warning received.

Additional, mandatory elements for communities with near-field tsunami threats:

There are no additional mandatory response elements for communities with near-field tsunami threats. Immediate response to a near-field tsunami will be performed primarily by at-risk individuals. Any individuals in tsunami-prone areas, including emergency personnel, will need to take personal responsibility for evacuating after recognizing the natural warnings or environmental cues of a possible or imminent tsunami (e.g., ground shaking from an earthquake, unusual rapid rise or fall of a shoreline). Official communications and warnings may be difficult to perform given the potential for infrastructure

and telecommunication damage from the preceding earthquake and the limited time between the generation and arrival of near-field tsunamis.

Optional response efforts to increase community resilience

- Additional elements in Emergency Response Plan
    - Response plan for businesses to notify and evacuate visitors and employees
    - Exercises with businesses (e.g. seminar, table-top, meeting, etc.)
    - Transportation plans for contra flow and traffic maintenance for distant tsunami incidents.
    - Notification plan for marinas and harbormasters to expedite relocating vessels
    - MOUs with private land owners to allow evacuees access through gates and across land
    - Procedures for keeping evacuees and other impacted individuals informed throughout the incident
    - Procedures for opening assembly areas and evacuation shelters
    - Emergency Management Assistance Compact (EMAC) for tsunami response/recovery
- Ensuring Critical Facilities such as hospitals, police stations, fire stations, utilities, etc. in and near the tsunami inundation zone have the tsunami hazard addressed in their Emergency Operations Plans.
    - Emergency service facilities and equipment (fire stations; police stations; custodial facilities, such as jails and juvenile detention centers, hospitals, and other health care facilities; rescue squads; public works facilities, etc.).
    - Communications networks (telephones, emergency service radio systems, repeater sites and base stations, television and radio stations, etc.).
    - Water supply system/facilities, to include waste water treatment.
    - Utilities (power plants, substations, power lines, etc.)
    - Transportation networks (roads, bridges, airports, rail terminals, maritime ports).
- Additional elements in Emergency Operation Center (EOC) communications – County-, parish-, or borough-wide communications network including warning points
- Additional suggested places for NOAA weather radios: communications centers for life guards, courthouses, public libraries, fairgrounds, sports arenas, parks and recreation areas, public utilities, transportation departments, City Hall, other critical public facility

IV. RECOVERY (REC)

Mandatory elements for all coastal communities:

Rec–1. A plan that considers how communities will continue to operate and recover after a tsunami disaster.

Rec–2. A plan that considers how communities will manage debris after a tsunami disaster.

Optional recovery efforts to increase community resilience

- Identification of Long-Term Recovery Coordinator (local expert) in accordance with ESF-14

- Plan for conducting a post-tsunami incident Interagency After Action Review. Goals would include identifying lessons learned and best practices, and evolving the Emergency Operations Plan as necessary.
- Plan that addresses a community's housing strategy, both temporarily and long-term, for individuals/families that were directly impacted by a tsunami disaster.

Community Name:	**Reviewer Name & Date:**

Checklist for Determining Completion of Mandatory Elements for TR recognition

Code	Action Short Name	Applicability	Achieved	Reviewer Notes
Mit-1	Tsunami-hazard zones have been mapped	All		
Mit-2	Tsunami hazard and vulnerability are addressed in FEMA-approved Local Multi-Hazard Mitigation Plan	All		
Mit-3	Designated tsunami hazard areas, evacuation routes, safe zones, and assembly areas	All		
Mit-4	Signage to identify tsunami hazard areas, evacuation routes, safe zones, and assembly areas	All		
Mit-5	Availability of natural high ground and inland locations has been identified for at-risk populations. Or, (see Mit-4)	Near-field threats only		
Mit-6	A plan for vertical-evacuation strategies has been established (e.g., berms, structures)	Near-field threats only		
Prep-1	Tsunami exercise at least every three years, such as a tabletop, functional or full-scale	All		
Prep-2	Initial Responder training that includes tsunami hazard, warning and evacuation protocols	All		
Prep-3	Evacuation maps of tsunami hazard areas, evacuation routes, safe zones, and assembly areas	All		
Prep-4	Written materials that include tsunami information, hazard maps, evacuation routes, safety tips, and response protocols	All		
Prep-5	Events (at least 1 per year) to educate all citizens on local tsunami hazards, evacuation routes, safety and response	All		

Code	Action Short Name	Applicability	Achieved	Notes
Prep-6	Annual presentations to schools in tsunami-hazard zones	All		
Prep-7	Participation in NOAA/NWS Tsunami Warning Center communication tests	All		
Prep-8	Tsunami evacuation exercise for schools in the inundation zone	Near-field threats only		
Prep-9	Annual training, outreach or education that targets owners and staff for high-occupancy businesses	Near-field threats only		
Prep-10	Annual training, outreach or education that targets residents living or working in tsunami-hazard zones	Near-field threats only		
Resp-1	Tsunami hazard addressed in Emergency Operations Plan	All		
Resp-2	Emergency Operations Center (EOC)	All		
Resp-3	Redundant and reliable means for Communication/Dispatch Center and/or EOC to receive official messages	All		
Resp-4	Redundant and reliable means for Communication/Dispatch Center and/or EOC to disseminate official messages	All		
Resp-5	Public Alert Certified* NOAA Weather Radio receivers in critical facilities and public venues	All		
Rec-1	Plan for continuity of operations plan and/or continuity of government	All		
Rec-2	Plan for management of debris	All		

Mit = mitigation, Prep = preparedness, Resp = response, Rec = Recovery

Appendix C: Prediscussion Survey

TR prediscussion survey

In preparation for the upcoming state and territorial focus group meetings on the TsunamiReady (TR) program, we would like to ask you about a few important aspects of the revised TR guidelines under consideration. Your input will help us frame our upcoming discussions.

Background:

During the 2011 focus group discussions we learned that the current method of subdividing the TR guidelines by population size was undesirable. Basing the guidelines on population allowed communities with larger populations to do more, which would result in 'have' and 'have not' communities. Focus Group participants preferred that guidelines be based on some aspect of community vulnerability to tsunamis. Recognizing this, recent government reports have highlighted that locally-generated tsunamis represent the primary threat to human life, while distant tsunamis primarily represent a threat to development and loss of business. With these focus group and report findings in mind, we have proposed a new method for subdividing the requirements for TR recognition based on vulnerability to local versus distant tsunamis. In short, all communities would be required to comply with the guidelines for distant tsunami hazards, while the communities vulnerable to local tsunami hazards would have to comply with additional guidelines related to:

1) availability of evacuation and safe sheltering locations;
2) schools in inundation zones annually practicing evacuation drills;
3) annual education of staff of high occupancy visitor facilities; and
4) annual education of local residents.

Additional Background Information:

Community vulnerability to <u>local</u> tsunami versus <u>distant</u> tsunami hazards:
Under this option, all coastal communities are assumed to be vulnerable to regional and distant tsunamis while fewer coastal communities are assumed to also be vulnerable to local tsunamis. The sources for local tsunamis could be nearby earthquakes or landslides, or both. An expert panel administered by the NWS Tsunami Program would determine which coastal regions are vulnerable to local tsunamis and which are not, for all of the Pacific, Caribbean and Atlantic Ocean states and territories. This committee would also determine which trigger mechanisms of tsunamis would be used for making a determination about community vulnerability to local versus distant tsunamis. For example, the panel may decide to only include tsunamis generated by earthquakes or earthquake-induced landslides.

Definitions:

- *<u>Local (near-field) tsunami</u>– wave arrives 30 minutes or less after it is generated (e.g. earthquake or landslide)*
- *<u>Regional tsunami</u> – wave arrives between 30 minutes – 2 hours after a generation* event
- *<u>Distant (far-field) tsunami</u>– wave arrives several hours after it is generated*

We would appreciate your feedback regarding these ideas.

Questions for Your Consideration:

Question 1. Should communities vulnerable to a local tsunami have to take more actions to protect human life than those communities vulnerable only to distant tsunamis to receive TR recognition? What are your *concerns* about doing so or not?

Question 2. Would this subdivision of community vulnerability to local versus distant tsunami hazards be *appropriate* in your community? Why or why not?

Question 4a-e. Currently, the proposed guidelines require 5 additional actions for communities with local tsunami hazards or tsunami hazards for which at-risk people cannot reach a safe area before the first wave arrives. We want to ask you about each of these 5 actions.

First (**Question 4a**), what are your thoughts about requiring communities to identify any available natural high or inland ground to which at-risk populations will have to self-evacuate?

Question 4b. If at-risk populations in a community are unable to reach natural high or inland locations before arrival of the first tsunami wave, what are your thoughts about requiring the community to identify berms or other structures to which people can vertically evacuate? If structures are not present, should communities have to construct vertical evacuation structures? What are your *concerns* about doing so or not?

Question 4c What are your thoughts about requiring that there be a tsunami evacuation exercise for schools located within the inundation zone at least once per year?

Question 4d. What are your thoughts about requiring that there be annual training, outreach or education that targets owners and staff of high-occupancy businesses in the hazard zones for local tsunami threats (e.g., hotels, restaurants, fisheries, industrial sites)?

Question 4e. What are your thoughts about requiring annual training, outreach or education for residents living or working in tsunami-hazard zones? This would include education on evacuation routes, safety, and personal actions needed to respond to tsunami (e.g., self-initiated evacuation).

Focus Group Discussion Guide

→ You each received a copy of the proposed TsunamiReady™ (TR™) guidelines, how many of you were able to review those guidelines? Did any of you discuss these revisions with anyone? If so, who?

→ Does anyone have any initial questions or comments before we get started?

Background
We have identified 8 topics that we believe are the most important and in need of discussion regarding the TR™ program guidelines.

The current TR™ guidelines base community requirements on *population size*. The 2011 Focus Group results indicated that this was undesirable and that *community vulnerability* to tsunamis is a much better basis of subdivision. Based on these findings and recent government reports, our team has proposed an alternative for subdividing community requirements looking generally at a community's vulnerability to local and distant tsunami events.

Definitions:

- *Local (near-field) tsunami– wave arrives 30 minutes or less after it is generated (e.g. earthquake or landslide)*
- *Regional tsunami – wave arrives between 30 minutes – 2 hours after a generation* event
- *Distant (far-field) tsunami– wave arrives several hours after it is generated*

Community vulnerability to local tsunami versus distant tsunami hazards:

Sources for local tsunamis could be nearby earthquakes or landslides, or both. An expert panel administered by the NWS Tsunami Program would determine which coastal regions are vulnerable to local tsunamis and which are not, for all of the Pacific, Caribbean and Atlantic Ocean states and territories. This committee would also determine which trigger mechanisms of tsunamis would be used for making a determination about community vulnerability to local versus distant tsunamis. The expert panel would identify possible tsunamis for a community, but focus on *plausible* hazards.

1. **Would this subdivision of community vulnerability to local versus distant tsunami, assessed and identified by the expert panel, be appropriate in your community?**

   →Why or why not?

One limitation with basing community vulnerability on local and distant tsunamis is that some communities require more than 1-hour to evacuate their at-risk population. Consequently, we think that all communities should identify the:

1) likely extent of inundation,
2) time it would take for the first wave to arrive,
3) number of people who would be in the inundation zone (and subgroups of people), and

4) time needed for them to get to a safe area (e.g., natural high ground).

→ If at-risk people are unable to evacuate in the time available, they would need to evacuate to a berm or other vertical structure. What do you think about this limitation? [Note: Question 4 will also return to the issue of vertical evacuation]

2. Looking at the revised guidelines, there are additional mandatory requirements for those communities that have a local tsunami threat. (Section I. Mit-5 & Mit-6 and Section 2. Prep 8, 9, and 10 are for near-field communities only.). **What are your thoughts about having additional activity requirements for communities with local tsunami threats?**

→How acceptable is this for your community?

3. Please describe any current *tsunami* evacuation plans or strategies you are using in your community.

→Ask about storm surge if no tsunami plan

→Would you describe the plan/strategy as effective?

→Why or why not?

4. What do you think an effective evacuation strategy should look like for a community to be considered TR™?

→Consider the following as they affect ability to evacuate inland, to high ground, or vertically within the time available for various tsunami events (e.g., 30 minutes or up to 10 hours):

→ Must everyone be able to evacuate in the time available? If not, who? What are your considerations regarding evacuating everyone?

→ How would seasonal changes affect this number? Consider:

- residents (smallest population)
- seasonal workers (intermediate population)
- visitors (largest population)

→ Issues involving rapid *self-initiated* evacuation versus organized/orderly evacuation?

→ Does population size or vulnerable subgroups change what is considered an effective evacuation strategy?

→ Do you know of a methodology to determine the proportion of population which needs to be evacuated? What seems ideal? What seems more realistic?

→ Are there analogies you think might be useful for determining this (e.g., other hazards like fire, flash flooding, industrial facilities, etc.)?

5. The revsied guidelines would require communities with local tsunami hazards to develop a vertical tsunami evacuation strategy (or a plan to do so when no natural high or inland ground or vertical evacuation structures exist (Section I. Mit-5 & Mit-6). **Are you familiar with any cities which have vertical evacuation structures (e.g., buildings, berms, etc.)?**

   →What are your thoughts about requiring a vertical evacuation strategy?

   →What do you think are some barriers to communities adopting a vertical evacuation strategy?

      →Tell us more about those barriers?

   →What are some motivators or incentives that would help communities adopt a vertical evacuation strategy**?**

6. The revised guidelines propose conducting mandatory, annual evacuation drills for schools in the inundation zone as a requirement for communities with local tsunami threats. **How useful are these activities for a TR™ community?**

   →How acceptable is this for your community?

   →How acceptable is this for communities with local tsunami threats?

   →How acceptable is this for communities with no local tsunami threats?

   →How achievable are these activities?

7. Different communities have a different amount of risk tolerance for a tsunami. Some community residents may be more or less willing to accept higher risk than others (e.g., tourists who do not know about the tsunami hazard).

   Should the requirements for TR™ recognition account for these differences? If yes, how?

   →For example, should high occupancy businesses (e.g., hotels and restaurants) be required to have annual staff training, especially in high hazard regions?

8. The revised guidelines utilize the NIMS classification system for stages of resiliency describing program actions and activities for mitigation, preparedness, response, and recovery. **How useful are these activity divisions for a TR™ community?**

   →How acceptable are these activity divisions?

   →How achievable are these activity divisions?

Appendix E: Focus Group Meeting Agenda

Focus Group Discussion
Review of Draft TsunamiReady™ Guidelines

AGENDA

1. Introduction

a) Project Goal: To evaluate the acceptability and usefulness of the revised TsunamiReady™ guidelines for community recognition.
b) Meeting Objectives:
   - To gain insight on the utility and acceptability of the proposed guidelines for becoming TsunamiReady™.
   - To discuss and gain insight on key questions regarding content of the TsunamiReady™ guidelines for community recognition.

2. Self-introductions of participants - name, title, description of tsunami-related duties

3. Review of Revised Guidelines for TR & Discussion of key questions regarding content of the TR Program

- Review revised guidelines for the TsunamiReady™ program.
- Discuss the usefulness and achievability of the revised TsunamiReady™ guidelines for stakeholders and communities, effective evacuation strategies as a possible requirement for recognition, vertical evacuation strategies as a possible requirement for recognition, various methods for subdividing the TsunamiReady™ guidelines based on community vulnerability to tsunamis, and mandatory evacuation drills.

4. End of Meeting – comments on project next steps

Appendix F: ETSU IRB Approval

East Tennessee State University
Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

IRB APPROVAL – Initial Expedited Review

September 16, 2013

Colleen Scott

Re: Evaluation of National Weather Service (NWS) TsunamiReady Program Guidelines
IRB#: c0813.35s
ORSPA #: 10188

The following items were reviewed and approved by an expedited process:

- xform New Protocol Submission; Informed Consent Document* (version 4/10/13, stamped approved 9/16/13); Email Script; Phone Script; Discussion Guide; Agenda; Resume

The item(s) with an asterisk(*) above noted changes requested by the expedited reviewers.

On **September 16, 2013**, a final approval was granted for a period not to exceed 12 months and will expire on **September 15, 2014**. The expedited approval of the study *and* requested changes will be reported to the convened board on the next agenda.

The following **enclosed stamped, approved Informed Consent Documents** have been stamped with the approval and expiration date and these documents must be copied and provided to each participant prior to participant enrollment:

- Informed Consent Document (version 4/10/13, stamped approved 9/16/13)

Federal regulations require that the original copy of the participant's consent be maintained in the principal investigator's files and that a copy is given to the subject at the time of consent.

Projects involving Mountain States Health Alliance must also be approved by MSHA following IRB approval prior to initiating the study.

Unanticipated Problems Involving Risks to Subjects or Others must be reported to the IRB (and VA R&D if applicable) within 10 working days.

Accredited Since December 2005

Proposed changes in approved research cannot be initiated without IRB review and approval. The only exception to this rule is that a change can be made prior to IRB approval when necessary to eliminate apparent immediate hazards to the research subjects [21 CFR 56.108 (a)(4)]. In such a case, the IRB must be promptly informed of the change following its implementation (within 10 working days) on Form 109 (www.etsu.edu/irb). The IRB will review the change to determine that it is consistent with ensuring the subject's continued welfare.

Sincerely,
Chris Ayres, Chair
ETSU Campus IRB

Appendix G: Invitation Letter

East Tennessee State University

Department of Geosciences
Box 70357•Johnson City, TN 37614
Telephone (423) 439-7526•Facsimile (423) 439-7520

[DATE]

RE: Focus Group Meeting on TsunamiReady™ guidelines

To Whom It May Concern:

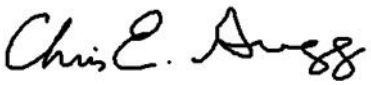
Your presence is requested at a small Focus Group meeting to be held at the [INSERT LOCATION]. **The meeting will take place on [INSERT TIME AND DATE].**

Background: Initial community focus groups were held in 2011 to review and provide comments on proposed revisions to NOAA's TsunamiReady™ program guidelines. Using the information we collected from those focus group discussions, we have drafted a revised set of TsunamiReady™ guidelines. We substantially shortened the guidelines and modified the content and format. We would like to discuss these revised guidelines with community members to gain a community perspective on how useful and achievable these revisions will be for communities. Some of the major topics to discuss include, for example, the subdivision of required guidelines into two groups based on aspects of community vulnerability to local tsunamis versus distant tsunamis (or, those from nearby earthquake sources versus more distant sources), inland and vertical evacuation, and evacuation drills for schools.

This is a collaborative project between researchers at East Tennessee State University, University of Colorado and University of North Carolina at Wilmington, US Geological Survey, the University of Hawaii and Massey University/GNS Science, New Zealand. This meeting will be one of several other focus group meetings being held in five states and two territories (CA, OR, AK, HI, NC, American Samoa and US Virgin Islands) between October 2013 and January 2014.

To confirm your participation or to ask questions, please contact Colleen Scott at: scottc1@goldmail.etsu.edu or 720-442-3250. The meeting is being organized by the PI on the project, Chris Gregg. He may be contacted at: gregg@etsu.edu or 423-439-7526 (office); 423-930-3806 (cell).

Sincerely,



Chris E Gregg, Associate Professor of Geology

Appendix H: Informed Consent Document

PRINCIPAL INVESTIGATOR: Colleen Scott, MPH, CHES

TITLE OF PROJECT: Evaluation of National Weather Service (NWS) TsunamiReady program guidelines

EAST TENNESSEE STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
Informed Consent – Focus Group

This Informed Consent will explain about being a participant in a research study. It is important that you read this material carefully and then decide if you wish to be a volunteer.

PURPOSE:
The purpose of this research is to evaluate the acceptability, usefulness and achievability of the revised national guidelines for the TsunamiReady™ Community program, and perceptions of required evacuation strategies and/or vertical evacuation for inclusion in the TsunamiReady™ guidelines.

DURATION
The focus group discussions are anticipated to last between 2-3 hours.

PROCEDURES
For this research study you will be asked to complete a pre-survey survey and participate in a focus group discussion. During this discussion you will be asked to evaluate the acceptability, usefulness and achievability of the revised TsunamiReady™ Community program guidelines for community recognition. Additional content and key questions will also be discussed.

POSSIBLE RISKS/DISCOMFORTS
The risks associated with this focus group are minimal. There is a slight risk that you could be made uncomfortable during the group discussion as participants are sharing personal views and opinions.

POSSIBLE BENEFITS
Participants may benefit indirectly through the revisions and changes adopted for the final TsunamiReady™ guidelines.

COMPENSATION IN THE FORM OF PAYMENTS TO RESEARCH PARTICIPANTS
There will be no monetary payments for participation.

VOLUNTARY PARTICIPATION
Participation in this research study is voluntary.
You may refuse to participate and you can discontinue participation at any time with no penalty or loss of benefits to which you are otherwise entitled. You may quit by calling or emailing Colleen Scott, (423) 439-7526 or scottc1@goldmail.etsu.edu.

CONTACT FOR QUESTIONS
If you have any questions, problems or research-related questions at any time, you may call Colleen Scott at (423) 439-7526, or Dr. Chris Gregg at (423) 439-7526. You may call the Chairman of the Institutional Review Board at (423)439-6054 for any questions

APPROVED
By the ETSU IRB
OCT 14 2013
By QA
Chair/IRB Coordinator

DOCUMENT VERSION EXPIRES
SEP 15 2014
ETSU IRB

you may have about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone independent of the research team or you can't reach the study staff, you may call an IRB Coordinator at (423)439-6002 or (423)439-6055.

CONFIDENTIALITY

Every attempt will be made to see that your study results are kept confidential. A copy of the records from this study will be stored in Ross Hall, Room 303, East Tennessee State University for at least 5 years after the end of this research. The results of this study may be published and/or presented at meetings without naming you as a participant. Although your rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, ETSU IRB, and NWS have access to the study records. Your records will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above.

FOLLOW-UP CONTACT

Due to the nature of this research and the ultimate aim of creating the most useful and achievable TsunamiReady™ guidelines for both communities and the NWS, we would like to ask your permission to follow-up with you if we have any additional questions after the focus group discussions. To follow up with you, we will use the contact information we used to recruit you into this study. This information will be kept securely locked in the PIs office until the completion of the study. At that time, all of your contact information will be destroyed. No one outside of the study team will contact you.

AUDIO RECORDING

These focus group discussions will be audio recorded. By signing this consent form, you are also agreeing to this recording.

By signing below, you confirm that you have read or had this document read to you. You will be given a signed copy of this informed consent document. You have been given the chance to ask questions and to discuss your participation with the investigator. You freely and voluntarily choose to be in this research project.

SIGNATURE OF PARTICIPANT DATE

PRINTED NAME OF PARTICIPANT DATE

SIGNATURE OF INVESTIGATOR DATE

APPROVED
By the ETSU IRB
OCT 14 2013
By _____
Chair/IRB Coordinator

DOCUMENT VERSION EXPIRES
SEP 15 2014
ETSU IRB

Appendix I: Site Specific Prediscussion Survey Response Matrices

Appendix I1: Kodiak, Alaska prediscussion survey response matrix				
	Participant 1	**Participant 2**	**Participant 3**	**Participant 4**

Should communities with a local-tsunami threat take more actions to protect human life?	• Yes	• It depends on the extent of additional actions
		  • Small communities might be prevented from achieving TR status by unnecessary mandatory actions
			• Yes
			  • "Just have to plan out the program and implement"
				• Yes
				  • All vulnerable communities should be recognized, with those vulnerable to local tsunamis having to comply with more stringent guidelines

Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• Yes	• Yes
		  • All AK communities are vulnerable to both local and distant tsunami
			• Yes
			  • Kodiak qualifies for both local and distant tsunami hazards
				• Yes
				  • Kodiak is vulnerable to local-tsunamis and should have to comply with more stringent guidelines

Thoughts about requiring communities to identify natural high or inland ground for at-risk persons self-evacuation	• Necessary
	  • Part of local planning for tsunami
		• Yes
		  • Natural high ground should be identified for potential evacuation
			• Yes
			  • Good idea!
				• Yes
				  • Needs to be included in the Emergency Operations Plan

Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• More cost-effect if local residents assist at-risk populations • Simpler to have people help others	• ID of berms/structures should be optional not required • Small communities (subsistence lifestyle) will not have access to resources to build berms/structures for vertical evacuation	• Good idea • Hard to find funding to implement	• "The necessary steps must be taken to protect the population" • Unfortunately – costly to implement • Could be paid for by grants if communities have a hazard mitigation plan

Thoughts about requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Yes
	  • Very in-favor of this requirement
		• Yes – highly encouraged in AK
		  • "I agree with this requirement"
			• Yes
			  • Great idea!
			  • Does not apply to schools on the Kodiak road system
				• Yes
				  • Once a year is the minimum that should be required

Thoughts about requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	• Yes
	  • In-favor of this requirement
		• Great goal, somewhat unsuccessful in many communities
		• Communities need a "tsunami champion" to make this goal more realistic
		• Biennial outreach is more realistic
			• Great idea!
			• Very do-able!
				• Good idea
				• How would you require this?
				  ▪ Who would administer or monitor the training?
				  ▪ How would it be tracked?
				  ▪ Who would pay for it?

Thoughts about requiring	• Yes • In-favor	• Great goal, unrealistic • Communities need a	• Another great idea • Very do-able	• Good idea • How would you require

annual training, education, outreach for residents living in the inundation zone		"tsunami champion" to make this goal more realistic • Biennial outreach is more realistic		this? ▪ Who would administer or monitor the training? ▪ How would it be tracked? • Who would pay for it?

Appendix I2: Coronado, California prediscussion survey response matrix			
	Participant 1	**Participant 2**	**Participant 3**
Should communities with a local-tsunami threat take more actions to protect human life?	• No • The standards should be the same for all tsunami prone areas • Emergency plans for notification, evacuation, and sheltering are required by all tsunami communities	NO RESPONSE	• Depends on the geography of the community • Needs to be a balance of the two options not one or the other
Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• Yes • My community is vulnerable to local, regional and distant tsunami	NO RESPONSE	• Yes • Coronado is very limited on evacuation routes and access to high ground • Coronado's ability to react will depend on the time to respond and the height of the predicted wave
Thoughts about requiring communities to identify natural high or inland ground for at-risk persons	• Yes • All tsunami vulnerable areas should identify evacuation routes to higher elevations and inland safe	• Yes • City government has the responsibility to provide a written plan identifying areas of risk and areas for safe	• Yes • This should be required

self-evacuation	areas	evacuation • Plans should also include public outreach	
Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• Yes • All tsunami vulnerable areas should identify vertical evacuation sites/facilities • Requirement to construct vertical evacuation structures relies on many variables that may not be affordable in small communities	• Yes • I support that city government should identify vertical evacuation structures for the public	• Good idea • Not always feasible
Thoughts about requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Yes • All jurisdictions (first and emergency responders, schools, public works) located in tsunami vulnerable areas should exercise emergency plans at least once a year similar to Great CA Shakeout	• Tsunami evacuation exercises for schools in inundation zones should be held at least twice per year	• Good idea

Thoughts about requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	• Yes • I agree on all outreach requirements	• Public outreach and education workshops should be available to the entire community – including residents and businesses both in and outside of the inundation zone annually	NO RESPONSE
Thoughts about requiring annual training, education, outreach for residents living in the inundation zone	• Training all residents would be quite difficult to administer and track • Offering briefings, workshops, and education material as we do for all most probable hazards and threats seem more achievable	• Public outreach and education workshops should be available to the entire community – including residents and businesses both in and outside of the inundation zone annually	NO RESPONSE

Appendix I3: Seaside, Oregon prediscussion survey response matrix				
	Participant 1	**Participant 2**	**Participant 3**	**Participant 4**

Should communities with a local-tsunami threat take more actions to protect human life?	• No
	  • The threat may be different, but both can cause significant impacts
	  • Preparedness, education/outreach and exercises and drills are essential for either hazard
		• No
		  • Too difficult to know when/where a local versus a distant tsunami might happen
		  • If one lives in a coastal community they should prepare for a worst case event
		  ▪ This will save more lives and those who evacuate will be in a safe location regardless of actual event
			• Yes
			  • Communities vulnerable to local tsunamis should take more actions than those communities who are not
			  • I have never heard the definitions of local/distant tsunamis before – based on time of wave arrival
			  ○ Thinks definitions will create confusion
				• Yes
				  • Known threats like local tsunamis should require communities to take more actions to protect human life to receive TR recognition
				  • Not doing so places human life in potentially more jeopardy

Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• This division for TR recognition would be inappropriate
	  • The division is useful for mapping only
		• Not appropriate
		  • It is not the cause, but the effects of the tsunami which make a community vulnerable
		  • It is too difficult to determine the wave behaviors depending on local conditions
		  • It makes more sense to determine one evacuation site
			• Oregon gets both local and distant tsunamis
			• NWS spends a disproportionate amount of time providing warning and resources for distant events, when local events are more lethal
				• Yes
				  • Local vulnerability is substantially higher with limited time to respond/escape from the tsunami event

		located in a safe area, outside the maximum threat or inundation area. • Too difficult to train local citizens to take different actions depending on local, regional or distant events – train to the worst case scenario only		

Thoughts about requiring communities to identify natural high or inland ground for at-risk persons self-evacuation	• Good idea	• This is very important
		• State of Oregon requires all coastal communities to have tsunami inundation maps and safe evacuation sites
		• Dept. of Geology and Mineral Industries is tasked with developing state hazard maps
			• Great idea, but who is requiring and who is enforcing?
			  • What are the ramifications for not doing this?
				• Yes
				  • Communities should have to identify available natural high or inland ground

Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• Good idea to identify berms or structures, but not to build/create them if they are not there • Many coastal communities do not have resources to build or maintain	• Structures are great – if you can clear all the environmental regulations, ESA, nesting areas for endangered birds, erosion patterns, defending law suits from 3rd party	• I prefer behavioral responses over engineering responses • Who requires these types of actions and who pays for them? • Building or identifying structures for vertical evacuation stops people	• Yes, berms or other structures should be identified • No, communities should not be required to construct vertical evacuation structures • People who choose to live in danger zones should

	these structures	environmental groups, etc. • My community looked at developing vertical evacuation structures, but could not secure funding for all of the aforementioned reasons	from thinking about how best to save their lives, they rely on a building which most likely will not be safe	not expect other people to pay for their ignorant decisions
Thoughts about requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Excellent idea	• State of Oregon already requires all schools located in tsunami inundation zones to conduct annual evacuation drills	• Our schools already require these drills • I prefer the idea of moving schools out of inundation zones completely • Moving schools out of the inundation zone will get people/parents doing the wrong thing (driving) moving in the right direction (up and out of the danger zone)	• Yes, there should be a tsunami evacuation exercise each year
Thoughts about requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	• I like the idea, but do not want it as a "required" element for TR recognition • Communities should strive to reach these businesses but it can't be made mandatory • Implementing and tracking this type of requirement would result in many	• This is a current requirement for our TR recognition by NOAA	• Good idea • I am currently frustrated by my attempts to conduct these types of trainings, making it a requirement of the TR program would be great ▪ Who would require this, monitor it, and what would the	▪ Yes, there should be annual outreach and education

	communities not pursuing TR recognition		ramifications be? (I don't think the TR program has the teeth to require this)	
Thoughts about requiring annual training, education, outreach for residents living in the inundation zone	• I like the idea of annual training and outreach • I prefer to keep the requirement more generic to the entire community	• Cannot be mandated or required • The county does conduct annual exercises, and most cities do too	• This is a great idea, is it realistic?	• Yes, there should be annual outreach and education

Appendix I4: Kauai, Hawaii prediscussion survey response matrix		
	Participant 1	**Participant 2**

Should communities with a local-tsunami threat take more actions to protect human life?	• No
	  • Should be the same – a tsunami is a disaster regardless of the source
		• Yes
		  • The two threats are very different and require different levels of response
		  • There should definitely be a second, distinct plan for local versus distant

Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• Hawaii has both threats	• Yes • Hawaii is vulnerable to both kinds of tsunamis
Thoughts about requiring communities to identify natural high or inland ground for at-risk persons self-evacuation	• Private ownership of land make access by public difficult	• This should be required
Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• Constructing unnatural berms for an "unlikely" tsunami events seems wrong • Man-made structures would be cost prohibited	• There should be some kind of plan in place
Thoughts about	• Great!	• Should be required

requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Hawaii has been doing this for all schools	
Thoughts about requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	• This should be a requirement	• Should be required
Thoughts about requiring annual training, education, outreach for residents living in the inundation zone	• This should be a requirement	• Should be required

Appendix I5: New Hanover County, North Carolina prediscussion survey response matrix					
	Participant 1	**Participant 2**	**Participant 3**	**Participant 4**	**Participant 5**

Should communities with a local-tsunami threat take more actions to protect human life?	• Yes	• Yes
		  • Each community should be recognized as TR if they are prepared for the expected impact to their area
			• Requiring more extensive preparedness efforts seems on the surface to make sense for communities that are at greatest risk for a local tsunami
			  • Common sense tells me any community at risk should be well prepared
				• Yes
				  • A system for immediate notification through cellular and TV should be used
					• Yes
					  • I think that the local tsunami would not produce a lot of damage outside the beach zone

Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• No	• No
		  • We would add unneeded complexity to the process
			• How a community perceives risk determines how well it prepares
			  • I'm not sure our community would understand the concept of being "a little prepared" as opposed to "fully prepared"
				• No	• I'm not sure
					  • I don't know how the subdivision would be handled

Thoughts about requiring communities to identify natural high	• Good idea	• Should be helpful, but costly
		  • This is a need for areas that have high impact such as West Coast
			• Identifying "tsunami shelters" or "tsunami free zones" might prove difficult in coastal areas where elevation changes	• Yes
				  • Planning is appropriate for any emergency
					• Yes
					  • This should be a requirement if you are in a tsunami zone
					  • Could be simple

or inland ground for at-risk persons self-evacuation		cities versus East Coast cities	are slight and gradual		signage leading to a high rise building
Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• Yes • Good idea	• No thoughts	• I'm not sure there are any areas along our coast where substantial multi-storey buildings don't already exist that could serve as vertical evacuation shelters – provided they meet some resiliency standard	• Vertical evacuation is a good idea • It should not be a community responsibility to build designated vertical structures	• Yes vertical evacuation is a good idea • The cost to build a structure for vertical evacuation for an event that might never occur would be cost prohibitive and politically unpopular - a waste of funds
Thoughts about requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Good idea	• Yes • They do fire drills, tornado drills, lock down drills, so in case of a tsunami there will be a plan to save lives	• Yes • I think this is a reasonable requirement • We do fire and lockdown (active shooter) exercises, so why not tsunami evacuation exercises??	• Yes • It's a good idea to be prepared	• Yes • This saved lives in American Samoa!
Thoughts about	• Good idea	• Yearly training is preferable	• Yes • I think this is a	• Yes • It's a good idea to	• Yes • Great idea, it

requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone		• If this is not feasible than each business should have training once every three years	reasonable requirement	be prepared	should be mandatory
Thoughts about requiring annual training, education, outreach for residents living in the inundation zone	• Good idea	• Yearly training is preferable • If this is not feasible than each business should have training once every three years	• Yes • I think this is a reasonable requirement	• Yes • It's a good idea to be prepared	• Yes • Good idea • Education on a tsunami would at least give the people some background information and they can decide on what they want to do

Appendix I6: US Virgin Islands prediscussion survey response matrix	
	Participant 1

Should communities with a local-tsunami threat take more actions to protect human life?	• Definitely
	  • Region local earthquake/tsunamis are our main concern
	  • Here time to take action is no more than few minutes without official alert, so people must be aware and be self-prepared

Would subdividing community vulnerability to local versus distant tsunami hazards be appropriate?	• Yes • Distant tsunamis are low probability events in our area
Thoughts about requiring communities to identify natural high or inland ground for at-risk persons self-evacuation	• This is good • Little time to react
Thoughts about communities being required to identify or build berms or other structures for vertical evacuation	• Good recommendation • Very expensive
Thoughts about requiring annual tsunami evacuation exercises for schools located within the inundation zone	• Definitely good idea • There should also be an evaluation of the drilling/exercise
Thoughts about requiring annual training, education, outreach for owners/staff of high-occupancy businesses in the zone	• Good idea • Need a complete and comprehensive plan
Thoughts about requiring annual training, education, outreach for residents living in the inundation zone	• Good idea • Need resources – can be expensive

VITA

COLLEEN SCOTT

Education:	D.P.H. Community and Behavioral Health, East Tennessee State University, Johnson City, Tennessee 2014 M.P.H. Behavioral Science & Health Education, Emory University Rollins School of Public Health, Atlanta, Georgia 2010 A.O.S. Occupational Science, Boulder College of Massage Therapy, Boulder, Colorado 2004 B.A. Communications, Gonzaga University, Spokane, Washington 2002 Public Schools, Berthoud, Colorado
Certifications:	Certified Project Manager 2011 Certified Health Education Specialist 2010 Certificate in Global Complex Humanitarian Emergencies 2010 Certificate in Prenatal, Labor, and Postpartum Massage 2004
Experience:	Tsunami Project Manager, East Tennessee State University, Department of Geoscience 2013 - 2014 Research Assistant, East Tennessee State University, College of Public Health, 2012-2013 Ensign, Youth Engagement Program Officer, Division of the Civilian Volunteer Medical Reserve Corps, June-August 2012 Youth Engagement Program Officer, ICF Macro, Division of the Civilian Volunteer Medical Reserve Corps, May 2012 Research Assistant, East Tennessee State University, College of Public Health, 2011-2012 Tsunami Project Research Analyst, East Tennessee State University, Department of Geoscience 2011 - 2012 HIV Prevention Evaluation & Research Study Advisor, Rosenfield Global Health Fellow, CDC Tanzania, 2010-2011 Research Assistant, Rollins School of Public Health, Behavioral Science & Health Education, 2009-2010 HIV Intern, International Rescue Committee, Kenya, June-August 2009 Research Assistant, CDC, International Emergency and Refugee Health Branch, 2008-2010 Teaching Assistant (Undergraduate course), Emory University, 2008-2009 Health Extension Officer, Peace Corps Zambia, 2005-2007 Owner/Practitioner, Living Arts Therapeutic Massage, 2002-2005 Sexual Assault Education Volunteer, AmeriCorps Learn and Serve Program, 2001-2002

Publications:

Scott, C., Hillhouse, J., & Turrisi, R. (2014). Evaluating a theoretical model of indoor tanning using structural equation modeling. Public Health Reports, 129(1), 107.

Honors and Awards:

American Geophysical Union, *Student Researcher Travel Grant Recipient*, December 2013

East Tennessee State University, *Who's Who in American Universities and Colleges,* April 2013

United States Public Health Service, *Public Health Service Citation,* July 2012

Emory University, *Who's Who in American Universities and Colleges*, May 2010

Emory University, Rollins School of Public Health, *The Eugene J. Gangarosa Award for Outstanding Service and Promise in the International Arena,* May 2010

Emory University, Rollins School of Public Health, *Global Frameworks Grant Recipient*, May 2009

Gonzaga University, *Who's Who in American Universities and Colleges*, May 2002