Final Report

American Samoa Tsunami Study

WITHSTAND THE EVENT • REBOUND FROM IMPACTS • LEARN FROM THE EVENT

March 2012

US Army Corps of Engineers
Honolulu District

American Samoa Tsunami Study

Final Report

Prepared for

The American Samoan Government

Prepared by

The United States Army Corps of Engineers, Honolulu District

EA/HHF Joint Venture

US Army Corps of Engineers
Honolulu District

EA/HHF Joint Venture

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Abstract

The Samoa Archipelago is very close to the Tonga Trench, one of the most active fault lines on the Pacific's ring of fire, and is particularly vulnerable to local tsunamis which arrive within minutes of the initial natural warning and cause extensive damage and loss of life (like the recent 2009 event). This report summarizes a major planning effort by the U.S. Army Corps of Engineers and the American Samoa Government to increase coastal community resilience to the devastating effects of tsunamis in American Samoa.

The study process involved broad stakeholder involvement, regular interaction with a Governor-appointed Tsunami Advisory Committee, extensive research into a variety of coastal resilience topics, and the development of recommendations and a multi-year implementation plan focused on improving community resilience. The study recognizes and builds on the inherent resilience of Pacific Island cultures developed over thousands of years of oceanic living, and Fa'asamoa, the traditional approach Samoans follow to govern village life.

The study website—http://astsunamiresilience.org/—provides a repository of all working papers, briefing materials, and resources gathered throughout the study.

Laufala (Pandanus tectorius) was brought to Samoa in ancient times. Its prepared dried leaves are woven into mats and baskets; the weaving symbolizes the interconnectedness and resilience of people working together.

American Samoa Villages on Tutuila and the Manua Islands

Special Acknowledgments

The study team would like to acknowledge the leadership and support provided by Governor Togiola Tulafono. His early encouragement and willingness to commit his cabinet to the sharing of their time and knowledge in the development of this report are greatly appreciated.

The study team would also like to express their deepest gratitude to the late Tufele Fa'atoia Li'amatua for his generous support and counsel on the fa'asamoa perspective of community resilience. We were guided by his strength of character, humility and wisdom.

For her outstanding support and generous provision of time, knowledge, and resources in overseeing all aspects of the study, special thanks are given to the Governor's Authorized Representative Evelyn Vaitautolu-Langford.

This study is dedicated to the memory of those who lost their lives in American Samoa in the 2009 South Pacific Tsunami. May this work assist American Samoa in moving towards greater resilience in the face of future events.

Acronyms

AA	Assembly Area
ARRA	American Recovery and Reinvestment Act
AS	American Samoa
ASCC	American Samoa Community College
ASDCJ	American Samoa Department of Criminal Justice
ASDHS	American Samoa Department of Homeland Security
ASDRO	American Samoa Disaster Recovery Office
ASEPA	American Samoa Environmental Protection Agency
ASESRO	American Samoa Economic Stimulus & Recovery Office
ASG	American Samoa Government
ASPA	American Samoa Power Authority
ASTCA	American Samoa Telecommunications Authority
ASVB	American Samoa Visitors Bureau
ASVOAD	American Samoa Voluntary Organizations Active in Disaster
BLAST	Broadband Linking the American Samoa Territory
CCR	Coastal Community Resilience
CI	Critical Infrastructure
CMU	Concrete Masonry Unit
COC	Chamber of Commerce (American Samoa)
CRM	Coastal Resource Management
CZMA	Coastal Zone Management Act
DART	Deep-Ocean Assessment and Reporting of Tsunamis
DHS	Department of Homeland Security
DHSS	Department of Health and Social Services
DMWR	Department of Marine and Wildlife Resources
DPA	Department of Port Authority (American Samoa)
DOC	Department of Commerce (American Samoa)
DOE	Department of Education (American Samoa)
DOH	Department of Health (American Samoa)
DOI	Department of Interior
DOT	Department of Transportation
DPS	Department of Public Safety
DPW	Department of Public Works
EAC	Economic Advisory Council
EAS	Emergency Alert System
EERI	Earthquake Engineering Research Institute
EMS	Emergency Medical Service
EOP	Emergency Operating Plan
ER	Emergency Response
ESF	Emergency Support Function
FBNMS	Fagatele Bay National Marine Sanctuary
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GAR	Governor's Authorized Representative
Gov	Governance
HFH	Habitat for Humanity
HMC	Hazard Mitigation Council
HMP	Hazard Mitigation Plan
ICS	Incident Command System
IT	American Samoa Department of Information Technology
ITIC	International Tsunami Information Centre
LBJ	Lyndon B. Johnson Memorial Hospital
LUSD	Land Use & Structural Design
NAS	National Academy of Science
NCS	National Communications System

Acronyms continued

NDPTC	National Disaster Preparedness Training Center
NFIP	National Flood Insurance Program
NIMS	National Incident Management System
NOAA	National Oceanic & Atmospheric Administration
NPS	National Park Service
NRF	National Response Framework
NTHMP	National Tsunami Hazard Mitigation Plan
NWR	NOAA Weather Radios
NWS	National Weather Service
OIA	Office of Insular Affairs (Department of Interior)
PTWC	Pacific Tsunami Warning Center
RK	Risk Knowledge
SBA	U.S. Small Business Administration
SE	Society & Economy
SPT	South Pacific Tsunami (2009)
SST	Samoa Standard Time
TAC	Technical Advisory Committee
TEMCO	Territorial Emergency Management Coordination Office
TEO	Territorial Energy Office
TEOP	Territorial Emergency Operating Plan
TOFR	Territorial Office of Fiscal Reform
TR	Tsunami Recovery
UH	University of Hawaii
UHC	Unified Health Command
UHF	Ultra High Frequency
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WE	Warning & Evacuation
WSO	Weather Service Office Pago Pago (NWS)

Glossary

Aumaga	village organization of untitled men
Fa‘asamoa	the Samoan way of life or culture
Fono	Territorial Legislature of American Samoa
Matai	village chiefs
Pulenu‘u	village mayors

Acknowledgements

The Project Team would like to express sincere gratitude to the Tsunami Advisory Committee and Technical Advisory Group members, stakeholders, experts in various fields, and other participants who shared their time, energy and spirit of talofa in the development of the American Samoa Tsunami Study. Individuals that contributed to the body of work developed throughout this study are identified below.

Tsunami Advisory Committee – American Samoa

Name	Organization	Name	Organization
Evelyn Vaitautolu-Langford	Governor's Authorized Representative (GAR)	Salu Tuigamala	American Samoa Disaster Recovery Office (ASDRO)
David Robinson	Governor's Economic Advisory Council (EAC) and Chamber of Commerce (COC)	Andra Samoa	American Samoa Power Authority (ASPA)
Sergeant Major Filipo Lokeni Ilaoa	Chairman Governor's Post-Tsunami Task Force	Aleki Sene, Jr.	American Samoa Telecommunications Authority (ASTCA)
Deanna Fuimaono	American Samoa Senate	Pili "Phil" Falema'o	American Samoa Voluntary Organizations Active in Disaster (ASVOAD)
Talalemotu Mauga	American Samoa House of Representatives	Lelei Peau	ASG Department of Commerce (DOC)
Sanele Ilalio-Tuiteleleapaga	Office of Samoan Affairs (OSA)	Taeaotui Tilei	ASG Department of Public Works (DPW)
Lydia Faleafine-Nomura	Department of Interior Office of Insular Affairs (OIA)	Siitia Soliai-Lemusu	Unified Health Command (UHC)
Jacinta Nomura-Brown	AS Department of Homeland Security/ Territorial Emergency Management Coordination Office (ASDHS/TEMCO)		

Technical Advisory Group – Federal Partners

Name	Organization	Name	Organization
Mike Reynolds, Sara Bone	National Park Service (NPS)	Kevin Grant	Fagatele Bay National Marine Sanctuary, National Oceanic & Atmospheric Administration (FBNMS)
Akapo Akapo, Hans Malala	National Weather Service, Pago Pago Weather Service Office (WSO)		

Stakeholders – American Samoa

ASCC:
Komiti Emmsley
Rosevonne Sato

ASDCJ:
Leonard Seumanutafa

ASDHS/TEMCO:
Alefa Afalava
Vinnie Atofau
Jacinta Brown

ASDRO:
Ulima (Lima) Fiatoa
Salu Tuigamala

ASESRO:
Suaavamata (Pat) Galeaʻi

ASPA:
Karen Kitiona
Kesi Kuki
Andra Samoa
Edward Setu
Ryan TuaTua
Aperila Tuufuli
Reno Vivao

ASTCA:
Aleki Sene, Jr.

COC:
Hobbs Lawson
David Robinson
David Whitby

DMWR:
Carolyn Doherty
Doug Fenner

DOC:
Lasiandra Hall
Hideyo Hatori
Nate Ilaoa
Mataio King
Maʻu Leha
Sean Morrison
Lelei Peau
Christin Reynolds
Junior Sauni
Mohan Seetharam
Charles Seitz
Mike (Kang) Sevao
Mine Timoteo
Marvis Vaiagae
Lauren Wetzel

DOE:
Sally Faumunia
Christina Fualaau
Jacinta Galeai
Lavinia Levaula
Lisa Vasai Mapu
Sofa Seumalo
Jeannette Vasaitilo

DOH:
Siitia Soliai-Lemusu

DHSS:
Lupe Fiso
Masele Iafeta
Muavaefaʻatasi John Suisala

DPA, Airport:
Tavita Fuimano - Harbors
Peter Lefiti - Airport
Chris Soti – Harbors
Ioakopo F. Toilolo – Water Transportation

DPW:
Faleosina Voigt

EAC:
David Robinson

FBNMS:
Kevin Grant

IT:
Andrew Berquist
Easter Bruce

LBJ:
Michael Gerstenberger

NOAA Pacific Islands Regional Office:
Fatima Sauafea-Leʻau

OSA:
Tufele Liʻamatua
Sanele Ilalio-Tuiteleleapaga

TOFR/ ASVOAD:
Phil Falemaʻo

UH Pacific Business Center Program:
Dr Papalii Failautusi Avegalio

UH Sea Grant Extension:
Ephraim Temple

WSO:
Akapo Akapo
Carol Baqui
Hans Malala
Simone Taufua

Subject Matter Experts – Hawai‘i and U.S. Mainland

DHS:
Richard ‘Scott’ Mitchem

FEMA:
Marilyn Shigetani
Colby Stanton
Gen Tamura
Kenneth Tingman (FEMA Federal Coordinating Officer during 2009 SPT)

NDPTC:
James Burke
Grant Chartrand
Karl Kim
Justine Nihipali
Dean Sakamoto

NOAA ITIC:
Laura Kong
Brian Yanagi

NOAA PSC:
Steve Frano
Doug Harper
Jessie Huart
Kristina Kekuewa
Penny Larin
Adam Stein
Bill Thomas

NOAA Fisheries Service:
Chris Hawkins

NOAA PTWC:
Gerard Fryer
Charles ‘Chip’ McCreery
Stuart Weinstein

NPS:
Vicki Ozaki

PDC:
Stanley Goosby
Sharon Mielbrecht
Lara Payne

UH Mānoa:
Dolores Foley, Department of Urban and Regional Planning
Luciano Minerbi, Department of Urban and Regional Planning
Dr Papalii Failautusi Avegalio, Pacific Business Center Program
Cheryl Anderson, Social Science Research Institute

UH Sea Grant, Coastal Storms Program:
Dolan Eversole
Darren Okimoto

USACE:
Derek Chow
Athline Clark
Harold Nakaoka
Tom Smith

USGS:
Michael Shulters

American Samoa Tsunami Study Team

USACE:
Athline Clark
Tom Smith

EA:
Abbie Adams
Renee Kinchla
Phillip Potter
Dan Savercool

HHF:
Tina Bushnell
Tom Fee
Dane Sjoblom

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Executive Summary

The U.S. Army Corps of Engineers (USACE), Honolulu District, at the request of the American Samoa Government (ASG) conducted the American Samoa Tsunami Study (Tsunami Study or study) under USACE's Planning Assistance to States program. The study goal was to help guide ASG efforts to prepare for, protect against, respond to and recover from tsunami hazards by providing recommendations and an implementation strategy. This goal is referred to as building resilience. Three resilience facets are defined as the ability to withstand a tsunami event, the capacity to recover from the event, and the ability to learn from the event.

USACE contracted with EA/HHF Joint Venture to assist in completing this study. The study team was comprised of nine (9) members with expertise in planning, critical infrastructure risk assessment and management planning, natural hazard mitigation, land use, civil works and facility planning, disaster preparedness and response in coastal and aquatic environments, and coastal and environmental engineering.

A website was developed to provide stakeholders and interested parties with access to study updates, work products and resources used: http://astsunamiresilience.org

Data and information used in the study was obtained via interviews and through the review of numerous documents between July and November 2011. Documents reviewed were compiled in a sortable "Resource Compendium" available on the study website. Over 400 man hours were spent on Tutuila in site visits and pursuing consultations with American Samoa-based organizations with over 50 interviews held.

The study was based on input from the ASG and key stakeholders throughout the process in a top-down/bottom-up approach. Study inputs were collaborative and built sequentially off of preceding efforts. A local advisory committee reviewed findings and guided the study through a series of four meetings.

The study team wrote 12 working papers to provide a comprehensive review of current resilience building efforts and challenges, and to develop recommendations and an implementation plan for bolstering existing efforts. The working papers developed in this study, available on the study website, provide references and supporting information for the study findings and recommendations.

Recommendations made in this study were categorized by type into eight focus topics to correlate with disaster management functions. The continuance of resilience building efforts in American Samoa through collaborative implementation of the recommendations made in this report is a key component of continued success.

Recommendations were categorized into focus topics based on general disaster planning functions. The focus topics helped organize the material; although overlap exists within the topic areas, the topics are not assumed to be exhaustive.

Figure E.1 illustrates the relationship of the resilience facets to the eight focus topics.

Figure E.1 – Resilience Facets and Focus Topics (EA/HHF, 2011)

Recommendations were ranked by priority (Top, High, Medium, and Low) and other factors described in the Chapter 4 implementation plan. The top priority recommendations are summarized on the right by recommendation type. Table E.1 provides a summary of all recommendations—listed in order of perceived priority—and are discussed further in Chapter 4.

Top priority recommendations:

...the means to learn from the event...

1. Information Management
- 1.1 – Sustaining Resilience Efforts
- 1.2 – EOP Reporting
- 1.3 – Public Awareness
- 1.4 – Critical Infrastructure

2. Emergency Planning
- 2. 1 – Evacuation Plan Awareness
- 2. 2 – Evacuation of Commercial Enterprises

...the capacity to withstand the event

3. Land Use & Structural Design
- 3.1 – Tsunami Modeling

4. Utilities
- 4.1 – Radio Reception

5. Response Capacity
- 5.1 – Programmatic Agreements
- 5.2 – Clinic Expansion

...the ability to rebound from impacts...

6. Economy
- 6.1 – Comprehensive Plan

7. Health Services
- 7.1 – Counseling/ Outreach

Table E.1 – Types of Recommendations by Resilience Facets and Focus Topics

Types of Recommendations by Facets and Focus Topics

Learn

1. Information Management
- **1.1 - Sustaining Resilience Efforts**
- **1.2 - EOP Reporting**
- **1.3 - Public Awareness**
- **1.4 - Critical Infrastructure**
- 1.5 - Accountability
- 1.6 - Capital Improvements

2. Emergency Planning
- **2.1 - Village Preparedness**
- **2.2 - Evacuation Plan Awareness**
- **2.3 - Evacuation of Commercial Enterprises**
- 2.4 - EOC Operations and SOPs
- 2.5 - Redevelopment
- 2.6 - Medical Services
- 2.7 - Port Contingency
- 2.8&9 - Special Needs
- 2.10 - School Evacuation Drills
- 2.11 - EMS Response Planning

Top priority recommendations shown in blue.

Withstand

3. Land Use & Structural Design
- **3.1 - Tsunami Modeling**
- **3.2 - Relocations**
- **3.3 - Building Techniques**
- 3.4 - Building Regulations
- 3.5 - Replacement Housing
- 3.6 - Shore Protection
- 3.7 - Long Range Land Use
- 3.8 - Hospital Modification
- 3.9 - Tsunami Loss
- 3.10 - Natural Resource Education
- 3.11 - Aquifer Vulnerability
- 3.12 - Flood Mapping
- 3.13/14 - Land Use Management/pollution

4. Utilities
- **4.1 - Radio Reception**
- 4.2 - Telecommunication
- 4.3 - Power
- 4.4 - Airport
- 4.5 - Emergency Alert System
- 4.6 - Wastewater

5. Response Capacity
- **5.1 - Programmatic Agreements**
- **5.2 - Clinic Expansion**
- 5.3 - Supply Unloading/Delivery
- 5.4 - Evacuation Route Maintenance
- 5.5 - Traffic Study
- 5.6 - Response Training
- 5.7 - Evacuation Routes, Mapping, Signage
- 5.8 - Risk and Response Education
- 5.9 - Testing Warning Communications
- 5.10 - Facilities at Major Assembly Areas

Rebound

6. Economy
- **6.1 - Comprehensive Plan**
- 6.2 - Public Infrastructure
- 6.3 - Tourism
- 6.4 - Natural Resource Valuation
- 6.5 - Community Goals
- 6.6 - Ag and Fishing Outreach
- 6.7 - Job Training and Development
- 6.8 - Economic Stimulation
- 6.9 - Recovery Fund

7. Health Services
- **7.1 - Counseling and Outreach/Support Services**

8. Clean-up
- 8.1 - Refuse
- 8.2 - Reef/Marine Debris
- 8.3 - Critical Facilities and Roads
- 8.4 - CZM
- 8.5 - Equipment

Top priority recommendations comprise actions that are recommended to be undertaken within the first year following the conclusion of the study. The highest number of top recommendations were associated with the third facet, **the means to learn from the event**, and included:

- Information Management
  - Executive Order to sustain resilience efforts through expansion of HMC membership and responsibilities
  - Annual reporting to the Fono to provide updates on plan and training status
  - Improving public awareness and information sharing on disaster management related documents
  - Implementation of a critical infrastructure database and management system
- Emergency Planning
  - Support and encourage further village preparedness planning and training
  - Provide informational bulletins for at risk villages and vulnerable populations in publically available sources
  - Formal policy for evacuation plan development and outreach at vulnerable commercial enterprises

Top recommendations for the first resilience facet, **the capacity to withstand the event**, include:

- Land Use & Structural Design
  - Tsunami modeling
  - School and critical facility assessment for relocation or modification (EOC, hospital, schools, shelters)
  - Structural modification guidebook for coastal homes in American Samoa
- Utilities
  - Radio coverage analysis to identify areas where warning communication improvements are needed
- Response Capacity
  - Programmatic agreements to more effectively utilize available on-island resources during disaster response
  - Expand the facilities/services, training and utilization of medical clinics in outlying areas to reduce dependence on the main hospital

Top recommendations for the first resilience facet, **the ability to rebound from impacts**, include:

- Economy
  - Consolidate existing economic plans into a comprehensive economic development strategy, to incorporate broad scale public outreach and participation
- Health Services
  - Support a comprehensive, coordinated and cohesive mental health infrastructure which includes continued efforts to bolster post-disaster counseling services, training and outreach on available health resources

Chapter 1

Study Overview

Rebuilding continues more than a year and a half after the event - Western Tutuila
(EA/HHF, 2011)

1. Study Overview

The American Samoa Tsunami Study was conducted by the U.S. Army Corps of Engineers, (USACE) Honolulu District in cooperation with the American Samoa Government (ASG) under USACE's Planning Assistance to States Program to help strengthen American Samoa's ability to prepare for, respond to, and recover from tsunami hazards. The study included a broad field of research topics to provide comprehensive coverage for assessing current tsunami resiliency and a significant public outreach component to capture the concerns of local officials and the knowledge and experience of subject matter experts.

Engaging and maintaining local stakeholder participation was integral to the process and undertaken with due consideration to cultural norms and customary practices. A Tsunami Advisory Committee (TAC) was established by Governor Togiola Tulafono to channel input from ASG and to help facilitate a participatory top down/bottom up process. TAC meetings and stakeholder interviews informed research efforts and helped shape recommendations. Recommendations for improving risk awareness, policy, and emergency protocol were developed through research and stakeholder collaboration.

For more information, please visit study website at: http://astsunamiresilience.org

The American Samoa Tsunami Study was designed to provide a high level, comprehensive overview of key considerations relevant to building coastal community resilience and provide a resource base for agencies and organizations undertaking natural hazard management throughout the Territory.

1.1 Need for Action

American Samoa is located only 120 miles away from one of the fastest moving subduction zones in the world, the Tonga Trench. On September 29, 2009, the South Pacific Tsunami (2009, SPT) was generated by a series of strong earthquakes originating from the Tonga Trench. Figure 1.1 illustrates the tsunami propagation caused by the 2009 SPT. The tsunami resulted in wide-spread devastation and several fatalities. Figures 1.2-4 show some of the damage that was caused by the 2009 SPT.

The Tonga trench, and more distant subduction zones throughout the Pacific Basin, will continue to produce earthquakes and potentially damaging tsunamis in American Samoa. There is an urgent need to bolster risk knowledge and preparedness practices to maximize community resilience to future tsunami events.

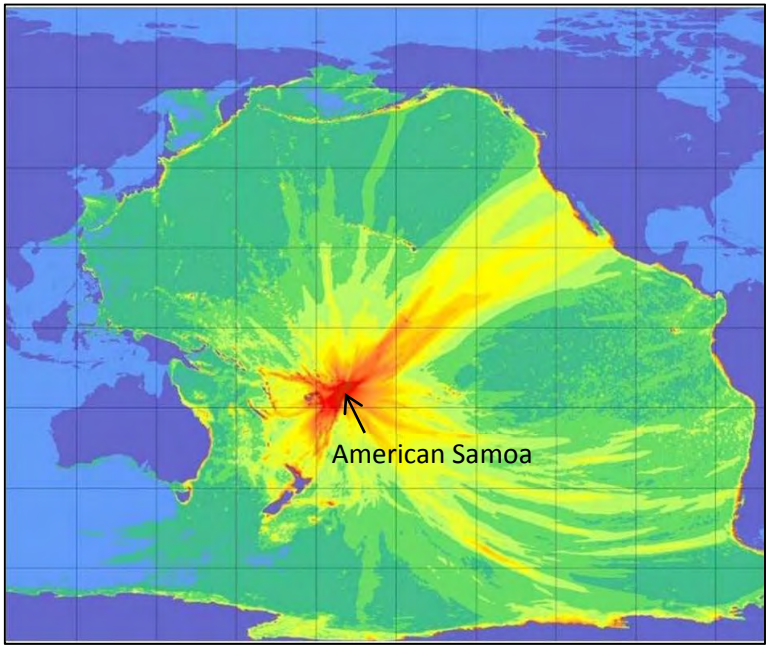

Figure 1.1 – Visualization of tsunami propagation 2009 SPT (NOAA, 2009)

Figure 1.2 - Pago Pago during 2009 SPT. (Associated Press, 2009)

Figure 1.3 - Asili Village post 2009 SPT. (Associated Press, 2009)

Figure 1.4 – Leone Village Post 2009 SPT. (EA/HHF, 2011)

The meaning of resilience in the tsunami study

Resilience was first adapted for use as an ecological term to describe organisms that are able to persist through challenging conditions. This term is readily applicable to a community's ability to withstand, rebound from, and learn from all forms of natural hazard events and commonly referred to as Coastal Community Resilience (CCR). Figure 1.5 shows the interconnectedness of these three resilience facets and indicates a continuous improvement cycle that builds community resilience. For the purposes of this study, resilience specifically addressed the ability of American Samoa to withstand, rebound from, and learn from tsunami events.

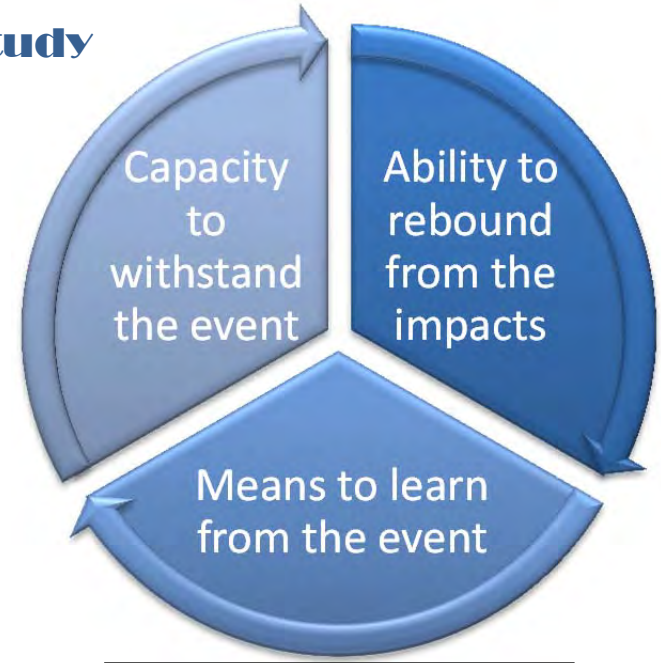

Figure 1.5 - Resilience Facets (EA/HHF, 2011)

The measure of a community's resilience correlates with the extent of impacts experienced (such as life, property, and economic losses) and the amount of time needed for the community to regain the quality of life and pursue daily activities similar to the conditions that existed before the event took place. Figure 1.6 illustrates that resilient communities are able to withstand shocks, rebound faster, and learn more from the experience than less resilient communities.

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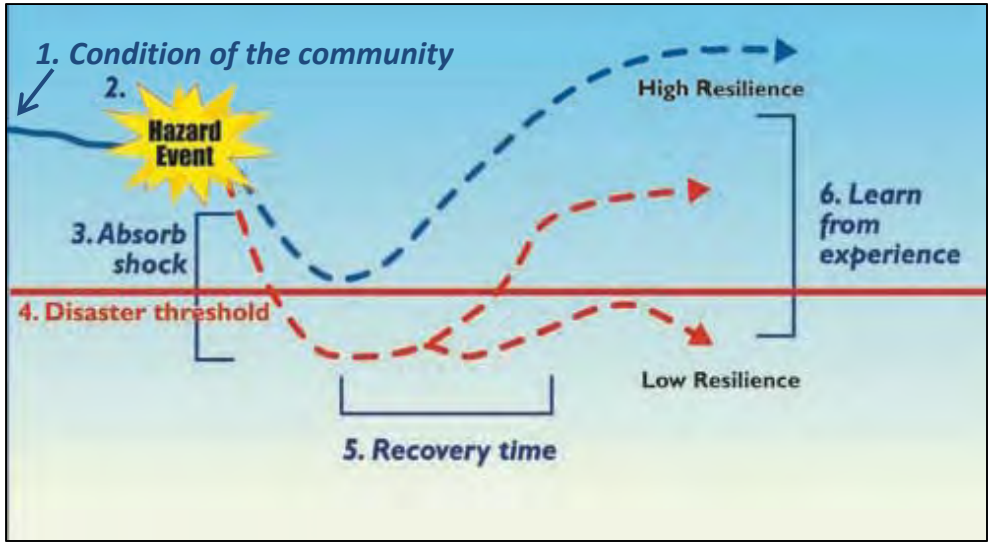

Figure 1.6 - Resilience and the Disaster Threshold (IOTWS, 2004)

1.2 Goals and Objectives

The Tsunami Study was designed to provide a high level, comprehensive overview of key considerations relevant to building coastal community resilience. It represents a comprehensive starting point and also identifies a number of promising, ongoing initiatives that are critical to building resilience. This report represents the culmination of this effort resulting in a series of priority recommendations. Study goals and objectives are summarized below.

goal:

Identify areas that could be improved to strengthen American Samoa's ability to prepare for, protect against, respond to, and recover from tsunami hazards.

objectives:

1. Provide a single repository of American Samoa resilience related documents, outside studies, and data related to the 2009 SPT.
2. Working with an American Samoa-based advisory committee, develop recommendations to build community resilience to cope with future tsunami events. Recommendations are comprehensive and include potential studies, policies/procedures, and projects.
3. Provide a forum to learn from others and build local resilience.

1.3 Recommendations

Recommendations developed in the working papers were reviewed with TAC members and, in some cases, discussed with subject matter experts. Detailed information for each recommendation is provided in Chapter 4 of this report. The process used to categorize the recommendations is summarized below and also described in Chapter 4. More information on the basis for recommendations can be investigated in the correlating working papers. The working papers captured a comprehensive view of tsunami resilience in American Samoa, and, while the papers provided direction for study team research, the paper titles did not provide distinct categories to correlate recommendations with disaster management functions or resilience facets. To categorize the recommendations more accurately and reduce overlap—with respect to the interconnectedness of disaster management efforts—the study team developed focus topic groups, based on recommendation type, that correlate with resilience facets.

resilience facets:

The focus topics were aligned with the three factors of resilience, **shown in Figure 1**, that define the goals of this study:

1. capacity to **withstand** tsunami
2. ability to **rebound** from impacts
3. means to **learn** from event

focus topics:

Recommendations were grouped into eight focus topic categories:

1. Information Management
2. Emergency Planning
3. Land Use & Structural Design
4. Utilities
5. Response Capacity
6. Economy
7. Health Services
8. Clean-up

Focus topic sorting divided recommendations from working papers. Unique numbers, based on topic focus and priority, allow each recommendation to be tracked to related working papers through the master recommendations table, provided as an attachment at the back of the report. Chronology, Case Studies, and Geomorphology papers did not provide unique recommendations. The categorization of recommendations from other papers into focus topics is shown in Table 1.1.

Table 1.1 – Categorization of Recommendations from Working Papers into Focus Topics

Working Papers	Focus Topics							
	Information Management	Emergency Planning	Land Use & Structural Design	Utilities	Response Capacity	Economy	Health Services	Clean-up
Critical Infrastructure	X	X	X	X	X			X
Risk Knowledge	X	X			X			
Emergency Response					X			X
Land Use & Structural Design			X					
Warning & Evacuation		X	X	X	X			
Governance	X	X	X			X		
Tsunami Recovery	X	X	X		X	X		X
Coastal Resource Management			X	X		X		X
Society & Economy	X				X	X	X	

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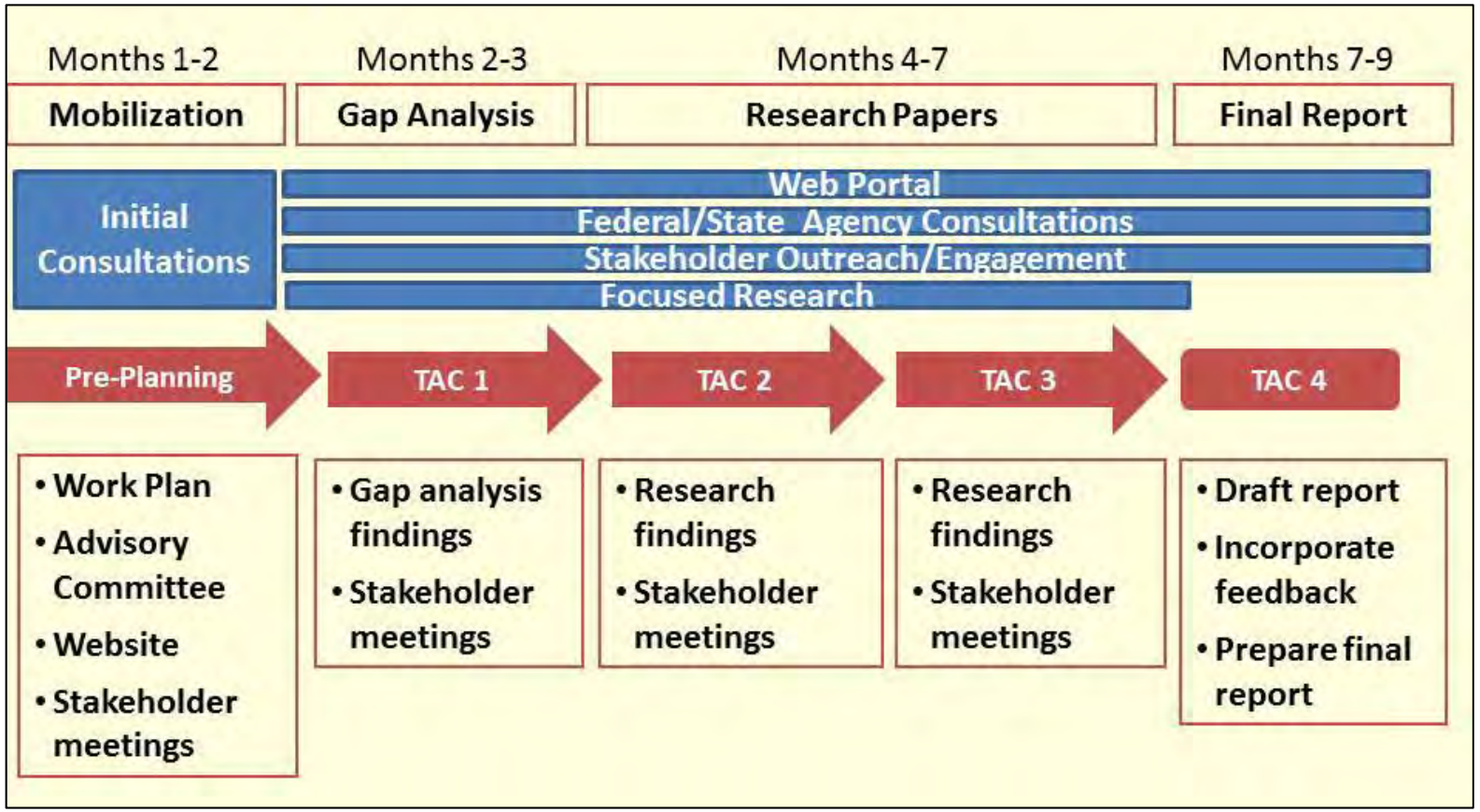
Chapter 2
Approach

Tsunami Advisory Committee Meeting #3 – Reviewing challenges and recommendations identified in Group 2 working papers (EA/HHF, 2011)

2. Approach

This chapter provides an overview of the methods used during this study. It describes the major tasks in the study process, research and compilation of resources, stakeholder participation, public outreach, and the review and decision-making processes. Figure 2.1 shows the overall study process that took place between March 2011 and January 2012.

Figure 2.1 –American Samoa Tsunami Study Process (EA/HHF 2011)



2.1 Process Introduction

Based on a top-down/bottom-up approach, the study process was rooted in broad stakeholder consultation and outreach. The overarching goal of strengthening tsunami resilience in American Samoa focused the study team's attention on capacity building and opportunities to improve and guide efforts on information sharing, enhancing knowledge, and developing skills to prepare for, protect against, and recover from tsunami impacts.

The study was undertaken in three phases including gathering of relevant literature, extensive research and stakeholder consultation to capture existing efforts and propose applicable improvements, and the development of recommendations and implementation framework.

Figure 2.2 - Dual approach to research for building resilience (EA/HHF, 2011)

Figure 2.3 – Project Schedule Summary (EA/HHF, 2011)

Study Phases

Phase I – compile existing information and ongoing studies; gauge the status of current resiliency and challenges experienced during the 2009 SPT; develop public website to provide access to general study information and materials developed.

Phase II – develop working papers to capture study team and TAC findings and recommendations; working papers included critical infrastructure, land use and structural design, hazard mitigation protocols and policies, economic resiliency, and relevant disaster case studies.

Phase III – compile findings and recommendations identified and reviewed with the TAC into a final report and implementation strategy with priorities, potential participating agencies, estimated cost ranges, and timeframes for follow-on efforts.

2.2 Study Process Tasks

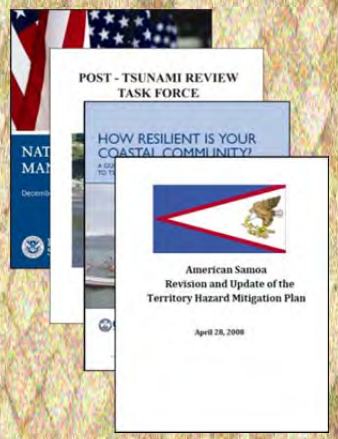


Figure 2.4 – Resource Compendium contains 378 local, Federal, and academic resources (EA/HHF, 2011)

Figure 2.5 - Study website includes resources used and materials prepared throughout the study (EA/HHF, 2011)

Task 1: Resource Compendium

The study began with background research and stakeholder consultation in early 2011. Because many Federal agencies pursue projects in American Samoa, the study team included wide representation in the study stakeholder group. Pacific Risk Management ‘Ohana (PRiMO), an umbrella group focused on information sharing and collaboration, was identified early on as an effective link to gather collective knowledge and the initiatives or needs of outside organizations. One major need identified through discussions with PRiMO was for a collection of resources related to resilience building and studies done by outside organizations in American Samoa. This task is described further in Section 2.3.

Task 2: Project Website Implementation

A study website was built and used as the repository for ASTS related resources. The website was activated during the pre-planning stages and was gradually populated as the study progressed. All materials produced, references/links to resources used, links to related and informative websites, and general information on the study were made available on the website. In addition to its role as a platform for the resource compendium, the website was also used to provide public information on the status and findings of this study. Public awareness and the availability of information are important to a top-down/bottom-up process. In addition to the information shared during limited visits to American Samoa and face-to-face meetings with concerned parties the website helped inform the public and provided a venue for submitting input and feedback to the study team. Website components and functions are described further in Section 2.3.

Study website:
http://astsunamiresilience.org

Task 3: Creation of the Tsunami Advisory Committee (TAC)

A participatory process was needed to build a platform for mutual learning and exchange. Key information needed to inform the study team on existing efforts and levels of preparedness was not always available in documented resources. The TAC was developed in Phase I of the study to help inform the study team, provide local representatives the opportunity to review and comment on study team findings, and allow for open discussions between all parties. TAC members were selected by the Governor based on their role in tsunami response and recovery. To reach and share information with all sectors, the TAC served as the hub for a larger group of stakeholders engaged in the planning process and is discussed further in Section 2.4.

Task 4: Stakeholder Meetings

Meetings were held with stakeholders during each of the study team's visits to American Samoa that provided insight and valuable resources. The utility of stakeholder meetings is discussed further in Section 2.4.

Task 5: Consultation with Subject Matter Experts

In addition to local experts, the study team sought out subject matter experts (SME) outside of American Samoa. More discussion on SME meetings is offered in Section 2.4.

Figure 2.6 - Meeting with Pulenuu, July 2011 (EA/HHF, 2011)

Figure 2.7 – Final TAC meeting, January 2012 (EA/HHF, 2012)

Figure 2.8 - Example tsunami warning and response practices discussed in working papers (Graphic: NPS)

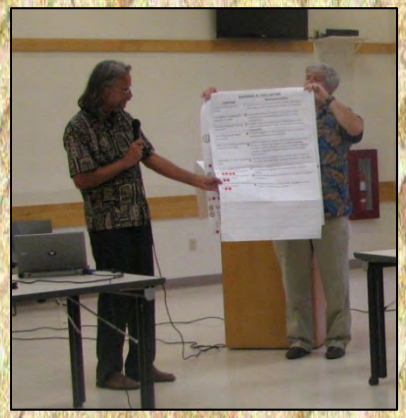


Figure 2.9 - TAC recommendation review and voting on key challenges (EA/HHF, 2011)

Task 6: Working Papers

Twelve working papers were developed over the course of the study to capture study findings and recommendations for building resilience. The working papers developed in this study, available on the study website, provide references and supporting information for the study findings and recommendations. Eight of the working papers were based on the Resilience Facets outlined in the U.S. Indian Ocean Tsunami Warning System Program document, "How Resilient Is Your Coastal Community?," and four topics were added to serve as a resource base for related information (e.g. Case Studies) or to further develop a topics area (e.g. Critical Infrastructure). Figure 2.8 shows the earthquake and tsunami response practices recommended by NPS.

Task 7: Presentations

Presentations were given at four TAC meetings to provide information and status reports on the study, and to review findings, challenges, and recommendations developed in the working papers. Presentations were also provided to the Council of Mayors (Pulenu'u), the Governor's Cabinet, and to the Chamber of Commerce.

Task 8: Review of Recommendations and Challenges

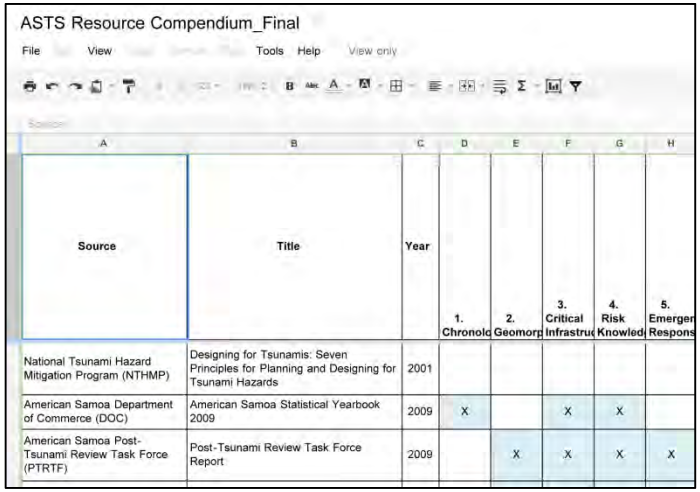
Challenges and recommendations identified in working papers were reviewed by TAC members. Discussion during general sessions and in break-out working groups was welcomed from all attendees. Once discussions of challenges and recommendations were complete, TAC members were asked to vote on which challenges were most important to them. Nominations were tallied and recorded for further consideration in developing priority rankings for recommendations developed in the study.

2.3 Resources and Work Products

2.3.1 Resource Compendium

Phase I of the ASTS included a high-level review of resources available for each working paper topic area. A database of resources was created to assist future research and as a contribution to PRiMO's resource database efforts. The resource compendium includes documents considered "CCR Building Resources" and "American Samoa studies by outside agencies" to assist individuals seeking related information. The compendium, available on the Resources page of the Tsunami Study website, includes:

- 378 distinct documents
- 79 documents that contribute to CCR building
- 53 American Samoa-specific studies by outside agencies


ASTS Resource Compendium_Final

File View Tools Help View only

Source	Title	Year	1. Chronolo	2. Geomorp	3. Critical Infrastru	4. Risk Knowled	5. Emerger Respons
National Tsunami Hazard Mitigation Program (NTHMP)	Designing for Tsunamis: Seven Principles for Planning and Designing for Tsunami Hazards	2001					
American Samoa Department of Commerce (DOC)	American Samoa Statistical Yearbook 2009	2009	X		X	X	
American Samoa Post-Tsunami Review Task Force (PTRTF)	Post-Tsunami Review Task Force Report	2009		X	X	X	X

Figure 2.10 - Resource Compendium on study website (EA/HHF, 2011)

2.3.2 Website

The study website was developed early on to house the resource compendium, provide information on the study, and to share work products developed during the study. Website pages include:

- Home – study information and navigation guide
- Updates – links to presentation materials
- Reports – description of and links to working papers
- Resources – resource compendium
- Links – valuable related information
- Feedback – provide input to the study team
- Contact Us – for site assistance or more information

Figure 2.11 - Study website – http://ASTsunamiResilience.org (EA/HHF, 2011)

2.3.3 Working Papers

Twelve working papers were created to document the process and the findings of investigations undertaken to identify resilience building possibilities. The 12 papers were completed in two groups; grouping was influenced by availability and extent of information required to develop the topic.

Each working paper identifies sources of information that contributed to the basis of thought used by the study team in identifying recommendations.

Table 2.1 - List of Working Paper Topics and TAC Presentation Dates

Group 1 Papers	TAC #2	Group 2 Papers	TAC #3
1. Chronology	Sept. '11	7. Warning & Evacuation	Nov. '11
2. Geomorphology	Sept. '11	8. Governance	Nov. '11
3. Critical Infrastructure	Sept. '11	9. Disaster Recovery	Nov. '11
4. Risk Knowledge	Sept. '11	10. Coastal Resource Management	Nov. '11
5. Emergency Response	Sept. '11	11. Case Studies	Nov. '11
6. Land Use & Structural Design	Sept. '11	12. Society & Economy	Nov. '11

The working paper topics provided a convenient research structure for the team, and enabled a relatively detailed review of the literature and information available for each of the 12 topic areas. The papers educated the study team and TAC members on relevant data for each topic, and provided an important vehicle to vet and discuss key issues with all stakeholders. By definition, they are considered works-in-progress that provided a foundation for developing overall recommendations.

The working papers developed in this study, available on the study website, provide references and supporting information for the study findings and recommendations. The working papers and summary presentation materials are available for viewing or download on the study website.

Study website:
http://astsunamiresilience.org

2.4 Stakeholder Participation

2.4.1 TAC Meetings

Figure 2.12 - TAC #1 opening remarks (EA/HHF, 2011)

The Tsunami Advisory Committee is a group comprised of several different American Samoa Government agencies, including Cabinet members, whose purpose was to inform the study team's research findings and to guide their recommendations based on first-hand experience in tsunami resilience. Information and ideas gleaned from TAC input and discussions are interwoven throughout the ASTS. The significance of the TAC cannot be overstated.

Figure 2.13 - Governor Tulafono spoke of the value of building tsunami resilience at TAC 1 (EA/HHF, 2011)

TAC Members:

- ASDRO
- ASPA
- ASTCA
- ASVOAD
- COC
- DOC
- OIA
- DPW
- EAC
- GAR
- House/ Senate
- OSA
- Post-Tsunami Task Force Chair
- ASDHS/TEMCO
- UHC

Figure 2.14 - Governor Togiola Tulafono stressed the importance of sustaining Tsunami Study efforts at TAC 4 (EA/HHF, 2012)

Selected Federal agencies with a presence in American Samoa were invited to TAC meetings as part of a Technical Advisory Group (TAG). TAG members assisted the project team in facilitating discussions during the TAC meeting breakout sessions and provided invaluable input into the study.

TAG Members:

- NPS
- NWS-WSO
- FBNMS

Four TAC meetings were conducted between 2011 and 2012. Attendance at TAC meetings ranged from nearly 30 to over 60 people, and discussions at each meeting were highly informative. Presentations provided status reports and were followed by break-out sessions to discuss specific concerns raised in working papers. Input from various positions was captured and incorporated in the study team information base and in the recommendations.

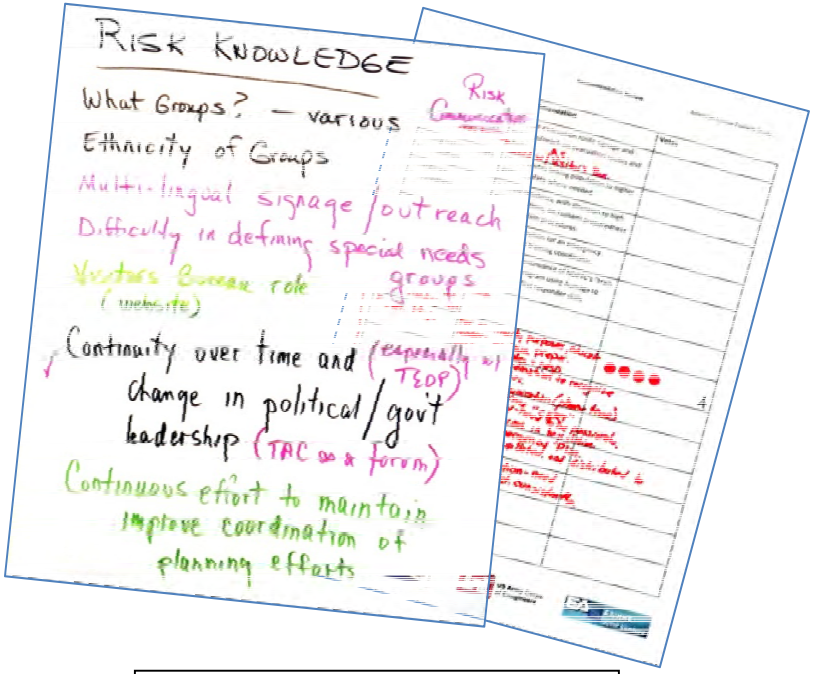


Figure 2.15 – Example of Notes and Recommendations from TAC #2 (EA/HHF, 2011)

TAC #1 - July 7, 2011: The objective of the first TAC meeting was to introduce the study team, review the study goals and objectives, discuss the significance of the TAC and its purpose, officially launch the study website, and review preliminary findings. Open discussions, experiences, and lasting concerns about the 2009 SPT provided valuable insight to the study team.

TAC #2 - September 28, 2011: The second TAC meeting focused on the findings from the first group of working papers (See Table 2.1). The TAC separated into breakout sessions, discussed the recommendations, and voted on the challenges identified in the working papers. Challenges were added to the lists prepared by the study team, and high priority concerns were identified.

TAC #3 - November 16, 2011: Like the second TAC meeting, the third meeting was devoted to discussing working paper findings and recommendations and voting on challenges identified in the second group of working papers (See Table 2.1).

TAC #4 - January 25, 2012: Tsunami Study results were presented and TAC members had the opportunity to provide input on the recommendations and implementation plan. Based on this input, recommendations and report content were revised and four recommendations were added to Chapter 4.

Figure 2.16 – Discussions during breakout sessions contributed to challenges and findings

2.4.2 Stakeholder Meetings

TAC selection and meetings with agency representatives in American Samoa were undertaken with close coordination from the Governor's Authorized Representative. Support for stakeholder input was also provided by the OIA field representative's office. Stakeholder groups for the ASTS included representatives from local departments and non-governmental agencies as well as Federal agencies that have an ongoing presence in American Samoa. Consultation with stakeholders began early in the study and was continued through every phase; in many cases, several meetings with the same stakeholders. Over 50 meetings were held with local organizations in the five trips taken during the study.

Early research informed the study team of the agencies involved in disaster management that took on response and recovery roles for the 2009 SPT. Meetings often helped identify other leads, and PRiMO members were particularly helpful in bridging connections with relevant agencies and individuals as well as providing input into the study.

Stakeholders informed the study team about on-going resilience building efforts, land use constraints unique to American Samoa, cultural norms, customary practices, and how these considerations relate to the challenges and recommendations identified throughout the study.

Organizations Consulted:

American Samoa-based Organizations

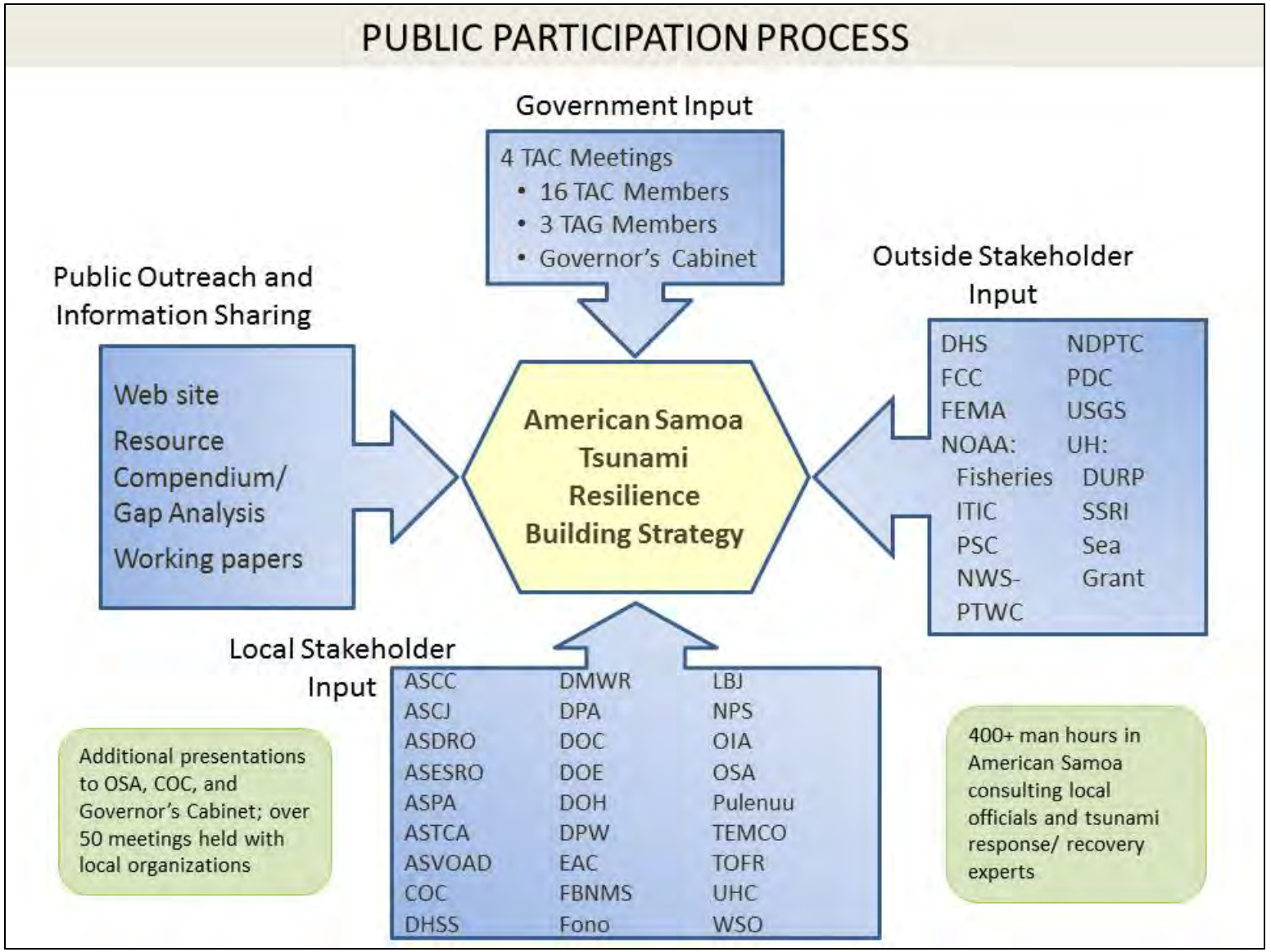
ASCC	DHSS	EAC	OSA
ASCJ	DMWR	FBNMS	Post-Tsunami Task Force
ASDRO	DPA	Governor	Pulenu'u
ASESRO	DOC	House/ Senate	ASDHS/TEMCO
ASPA	DOE	LBJ	TOFR
ASTCA	DOH	NPS	UHC
ASVOAD	DPA	OIA	WSO
COC	DPW		

Outside Organizations

DHS	NOAA, ITIC	USGS
FCC	NOAA, PSC	UH DURP
FEMA	NOAA, PTWC	UH Pacific Business Center
NDPTC	PDC	UH SSRI
NOAA, Fisheries	USACE	UH Sea Grant

The overall approach taken to engage, learn from, and share information with stakeholders, both in and outside of American Samoa, is illustrated in Figure 2.17.

Figure 2.17 - Public Participation Process (USACE, EA/HHF, 2012)



Chapter 3

Summary Findings

View of typical American Samoa coastal plain backed by steep slopes - Western Tutuila. (EA/HHF, 2011)

3. Summary Findings

The 12 working papers developed for this study, in combination with outreach/engagement of local officials and subject matter experts, informed the study team on existing tsunami resilience, challenges experienced during and after the 2009 SPT, and efforts that could be pursued to strengthen ASG's ability to prepare for, protect against, respond to, and recover from tsunami hazards. Extensive research and consultation with ASG officials, cultural leaders, business representatives, non-governmental organizations, and subject matter experts in American Samoa, Hawai'i, and the US mainland provided the basis for the information presented in the working papers, expressed as findings and challenges. Challenges identified in the working papers stem from lessons learned on the limits of preparedness and response capacity and impediments to recovery after the 2009 SPT. The study team believes that working to improve these areas will help build tsunami resilience. The 12 papers were completed in two groups and addressed areas indicated in Table 3.1.

Table 3.1 – Working Paper Research Areas

Group 1	Group 2
• Geomorphology • Chronology of Events of the 2009 SPT • Critical Infrastructure • Risk Knowledge • Emergency Response • Land Use & Structural Design	• Warning & Evacuation • Governance • Tsunami Recovery • Coastal Resource Management • Case Studies • Society & Economy

Ten of the 12 working papers identified challenges for further resilience building actions; *Chronology of Events* of the 2009 SPT and *Geomorphology* were pursued to develop the knowledge base of the study team and TAC members, and provide reference information for investigations. The working papers developed in this study, available on the study website, provide references and supporting information for the study findings and recommendations. The major findings and challenges of the working paper topics are summarized in this chapter and are presented by title in the order shown above.

Working papers available at:
http://astsunamiresilience.org

3.1 Geomorphology

The surface of the Earth is made up of a number of rigid 'plates' that are in constant motion. The movement of these plates is the origin of earthquakes and some volcanic events. American Samoa is located north east of the Tonga Trench—a boundary between the Pacific plate and the Tonga Block of the Australian continental plate. The Pacific plate pushes westward against and dives beneath the Tongan Block, a "microplate" on the northeast edge of the Australian plate (NSF, 2010). Figure 3.1 illustrates a subducting plate and how outer rise and thrust quakes occur.

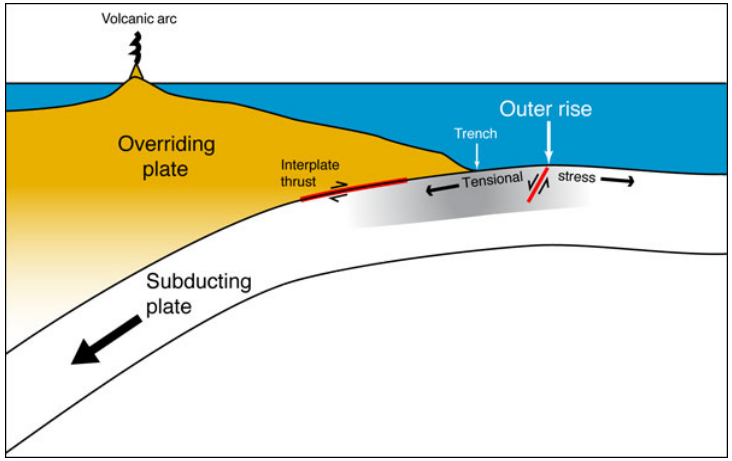


Figure 3.1 - Visualization of a subducting plate and outer rise and thrust quakes. (Geist, 2009)

Earthquakes frequently occur in the Tonga subduction zone. High magnitude (M_W) earthquakes, measuring 8 M_w or more, are not common. The earthquake that caused the 2009 SPT was generated primarily by an 8.1 M_W normal faulting (outer rise) earthquake, meaning that there was a rupture on the sea floor. Two 7.8 M_W thrust quakes followed but are not believed to have contributed significantly to the tsunami. Figure 3.2 shows the epicenters and magnitudes of the three earthquakes.

Historic tsunami records for American Samoa show that 12 tsunamis with maximum run-up heights of one-foot or more occurred in American Samoa over the last 100 years. Seven tsunamis with run-up heights greater than 3 feet were recorded between 1917 and 1960—three of these reached run-up heights of 8 feet. The two most destructive tsunamis were experienced in 1917 and 2009, 92 years apart.

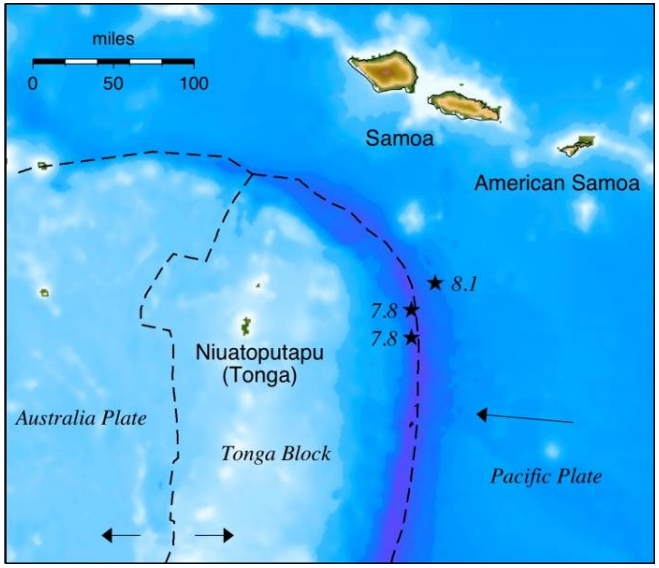


Figure 3.2 - Locations of the three earthquakes that caused the 2009 SPT, and proximity to nearby islands. (Koper, 2009)

3.2 Chronology of 2009 SPT Events (September 29, 2009) (excerpted from NOAA Service Assessment)

Recap of the first 30 minutes highlighting early public agency response actions (in Samoa Standard Time):

- 06:48 am: Strong earthquake felt in American Samoa. Shaking lasted 1-3 minutes. DHS and NWS personnel begin mobilizing to EOC and WSO. DHS requested staff located nearby on Western side of the island to report to the EOC.
- 06:50 am: WSO Pago Pago calls PTWC for mo re information. EOC begins gathering information online and monitoring handheld radios for communication. KKHJ (LP1) issues EAS Alert: Earthquake Warning before earthquake is over (between 6:50-6:51 a.m.) (no official tsunami warning… focused on earthquake safety information).
- 06:52 am: KKHJ calls DHS/EOC for more information. DART 51425 is auto-triggered.
- 06:54 am: Alarm sounds at PTWC and watchstanders paged based on two DART triggers and an automatic earthquake solution.
- 06:57 am: Preliminary seismic data received by WSO Pago Pago… indicating a preliminary… magnitude of 7.9.
- 06:59 am: WSO calls PTWC again for information.
- 07:00 am: Meteorologist in Charge (MIC) arrives at WSO Pago Pago. DHS Deputy Director and additional personnel arrive at EOC... Large waves and more landslides reported to police.
- 07:01 am: MIC calls DHS and tells Deputy Director to verbally activate EAS, with the message that a Tsunami Warning is in effect for American Samoa and that Tsunami Warning evacuation plans should be activated. DHS/EOC contacted KKHJ via handheld EAS radio and issued an oral warning to activate EAS based on WSO confirmation. KKHJ records approximately a 40-second message in English and Samoan relaying a warning to get to high ground.
- 07:02 am: MIC goes live on “Showers of Blessings” radio station, informing the public that American Samoa is now under a tsunami warning and that people need to move inland/to high ground immediately.
- 07:03 am: Director DHS calls police to tell them they were assessing information and would keep police posted. WSO receives call from public (SE American Samoa) reporting seeing the ocean recede. WSO advises caller to get to high ground immediately.
- 07:04 am: WSO receives call from public (E. American Samoa) reporting seeing the ocean recede. WSO advises caller to get to high ground immediately. EOC maintains communication over EAS handheld radio with [KKHJ] and [KULA] (LP2). DHS staff searching for information online: PTWC, USGS, and FEMA Region WatchCenter.
- 07:05 am: KKHJ Radio reports waves coming in to Pago Harbor via EAS handheld radios and over FM Broadcast. EOC and WSO receive WEPA40 Tsunami Bulletin Number 001.
- 07:08 am: Water level at NOS Pago Pago sea level station begins to drop.
- 07:10 am: WSO Pago Pago issues a Tsunami Warning with EAS alert using the Required Weekly Test event code. Message repeats 8 times over 9 minutes. Arrival of tsunami recorded on NOS Pago Pago sea level station.
- 07:11 am: Police… receive reports of people seeing the ocean floor... People are advised to leave their vehicles and move up hill.
- 07:15 am: Police receive… Tsunami Alert. All police units are radioed to warn the public… use loudspeakers to warn people to evacuate.
- 07:16 am: Maximum wave height of 4.6 meters (peak to peak) recorded at Pago Pago sea level station.
- 07:17 am: WSO Pago Pago issues the first official Tsunami Warning with EAS alert using the TSW event code. KKHJ’s Tsunami Warning EAS alert is sent (NOAA, May 2010).

3.3 Critical Infrastructure

Seven categories of critical infrastructure related to the 2009 SPT were evaluated. Major challenges are shown in Table 3.2. Categories evaluated include:

- Communications
- Power Systems
- Gas/Oil
- Transportation
- Water Supply
- Emergency and Rescue Services
- Economy

Figure 3.3 - Direct phone line between the Pago Pago Weather Service Office and PTWC for tsunami warnings. (EA/HHF, 2011)

Communications: Reports indicate that immediate evacuation occurred due to previous education, local leaders who signaled danger, community outreach and knowledge of previous tsunami. The manmade sub-components of communications critical infrastructure often failed during the 2009 SPT. Land based infrastructure, such as overhead telephone and power lines, was impacted, rendering television and telephone land lines inoperable. Figure 3.3 shows the direct line used for communication between PTWC and the Pago Pago WSO. On-island mobile capacity was overwhelmed and phones were jammed. The primary EAS radio station transmitted warnings, but went down shortly after the power plant. New ultra-high frequency two-way radios (UHF) allowed key officials and agencies to communicate during the tsunami.

Electrical Power Systems and Gas and Oil Storage/Transportation: One of two major power plants was disabled by the tsunami, reducing Tutuila's power generation by nearly half. Emergency generators restored power to key locations by mid-October 2009. By December 9, 2009, power was restored throughout Tutuila. Plans call for rebuilding the damaged power plant adjacent to its current location with design modifications. Because nearly all of American Samoa's electrical power is produced by petroleum-fired power plants, power production is closely tied to fuel storage. Fuel tank storage along the coastline may be vulnerable to tsunami hazards. ASPA is exploring alternative energy possibilities to create more resilient power systems. Fuel supply and shortages are an ongoing challenge for the Manu'a Islands.

Transportation: During the 2009 SPT, the port was not significantly damaged and was operational within 72 hours of the event. The Pago Pago International Airport was not extensively damaged during the 2009 earthquake and tsunami, though the runway lights and Tactical Air Navigation system (Figure 3.4) were disabled. Coastal roads, built to withstand coastal erosion, were washed away in some areas.

Water Supply: The tsunami caused $910,000 damage to the water supply/wastewater system in American Samoa. Multiple booster stations, lift stations, treatment plants, distribution lines and service equipment needed repairs. As of 2010, all villages on Tutuila were connected to the ASPA drinking water system, though this does not mean that all homes have indoor plumbing. Groundwater, the primary source of drinking water, continues to be exposed to contaminants such as urban runoff and piggery and cesspool effluent.

Emergency Services: ASDOE responsibilities, sheltering, feeding and transporting residents to emergency facilities, were complicated by the location of schools in 2009 SPT inundation zones. Territorial and Federal response teams successfully assisted many tsunami victims (Figure 3.5). Since 2009, efforts have been made to improve emergency response including EMS substation construction in Leone providing responder coverage to under-served areas. First responder training has been initiated at the village level with a select pool of *aumaga* who will then train others. Following the tsunami, the Territory received supplies of food, water and basic medical supplies. Distribution of supplies was headed by Territory officials, FEMA, and ASDOE, with American Red Cross support. Upland evacuation plans for the LBJ Hospital, located in a tsunami hazard zone, are in place. Eastern and western villages have local clinics but services are limited.

Figure 3.4 - The VHF Omni-directional Radio and Tactical Air Navigation system at the Pago Pago airport was disabled by the 2009 SPT impeding aerial navigation to Tutuila. (Photo: EA/HHF)

Figure 3.5 - The Red Cross assisting in distributing critical supplies, like the tent shown above, following the 2009 SPT. (Photo: Red Cross)

Economy: The ability for the economy to rebound is equally dependent on the ability of the employment infrastructure to withstand a disaster and on the availability of resources and funding to rebuild after the disaster to get business back in operation quickly. The closure of a major employer in American Samoa, a tuna cannery, and layoffs in another cannery in the same time period compounded the impacts of the tsunami on the local economy. Post-tsunami outside assistance and American Recovery and Reinvestment Act (ARRA) funded contract positions boosted employment temporarily (disaster assistance projects and funding created an economic boom in the local economy). The SBA was able to provide low-interest loans and channel Federal funds to affected businesses. Some difficulties in reestablishing businesses were experienced because of lack of flood insurance or loan denial due to business location within the flood zone.

Table 3.2 - Critical Infrastructure Challenges
Damaged or overwhelmed communication
Vulnerable power storage & supply location
Critical supply points are a single airport and harbor.
Small businesses are devastated and difficult to rebuild – prolonging reinstitution of Critical Infrastructure
Quality and availability of water supply can be further degraded during an emergency.
Trained emergency responders can be overwhelmed during an emergency.
Only one main road connects villages.
The TEOP doesn't cover all critical infrastructure.
There is only one primary care hospital.

Critical Infrastructure Management: Several organizations are responsible for operating and maintaining various critical infrastructure components including: ASPA, ASTCA, DOH, DPW, and DOE. A centralized critical infrastructure management strategy is not currently in use and could assist with programming/managing critical infrastructure improvements, as well as coordinating federal assistance after a disaster. Inventorying critical infrastructure, with centralized management, can facilitate post-disaster assistance to critical infrastructure redevelopment. Figure 3.6 shows locations of some of the vulnerable critical infrastructure and facilities within Pago Pago Bay.

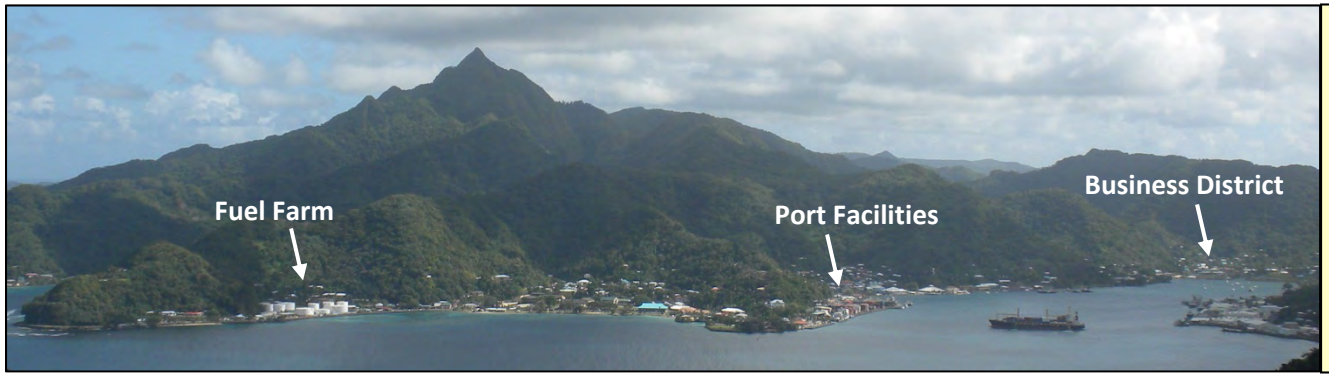


Figure 3.6 - American Samoa's primary fuel storage, harbor, and some major business districts are located in tsunami hazard areas. Harbors and fuel storage were not heavily damaged in the 2009 SPT, but businesses in Pago Pago experienced severe losses. (Photo: EA/HHF)

3.4 Risk Knowledge

In the Pacific, American Samoa is located within the vicinity of a highly active seismic zone making the islands prone to earthquakes and tsunami. Because tsunami risk in American Samoa is high, efforts to build knowledge of these risks should be high as well. Seismic risks are understood, but timing and locations of earthquakes cannot be predicted.

Ongoing efforts to raise tsunami risk awareness include education, outreach, and trainings hosted by organizations including ASDHS/TEMCO, ASDOE, NOAA/ITIC, FEMA, NDPTC, and NOAA/UH Mānoa. Training on tsunami preparedness, emergency response and risk education offered pre-2009-SPT to ASG agency staff, *Pulenu'u* members, schools, the general public and community volunteer groups effectively raised community preparedness and helped keep 2009 SPT losses low (Figure 3.7). ASG is working to attain NOAA's national TsunamiReady program recognition which acknowledges exemplary risk awareness, capacity for warning dissemination, and evacuation preparedness. Lessons learned from the 2009 SPT included improving tsunami evacuation routes and signage, keeping students at schools or together at evacuation assembly areas, and providing effective education and training on emergency plans and warnings. Major challenges are shown in Table 3.3.

Figure 3.7 - School evacuation drill in American Samoa. (Samoa News, N.D.)

Table 3.3 - Risk Knowledge Challenges
Some groups not aware of evacuation practices including special needs individuals, visitors, and immigrants.
Non-native English and Samoan speakers may not understand instructions during a hazardous event.
Existing natural barriers to evacuation
Understanding of roles & responsibilities during emergency response
Incorrect or inconsistent information distributed can cause confusion or lack of confidence in emergency procedures and responders.

3.5 Emergency Response

Impacts from the 2009 SPT emphasized the need to hone emergency response plans and training. ASDHS is the agency responsible for coordinating emergency response and emergency operation plan (EOP) development, coordination, and training for local agencies with emergency response responsibilities in American Samoa. ASG's response and recovery operation reflects the Federal Emergency Support Function (ESF) system; procedural plans are still in progress. Table 3.5 shows how response efforts are coordinated between local and Federal agencies. The 2009 SPT response illustrated the need for formal documentation of response assistance agreements between local agencies and business. ASDHS's Security Strategy covers needs regarding resource mapping and drilling response protocol. Table 3.4 shows major challenges.

American Samoa is in compliance with Federal Stafford Act requirements. The Hazard Mitigation Council continues to identify and update mitigation efforts and implementation strategies in the Territorial Hazard Mitigation Plan (HMP). The HMP may be underutilized and could include procedural needs and other resilience building actions beyond structural adaptation projects.

Table 3.4 - Emergency Response Challenges
Debris clean-up: ports and critical roads
Debris clean-up: coral reefs
Unloading and distribution of supplies
Location for temporary housing/emergency shelters
Reimbursement (from Federal funds) for use of private lands by evacuees
Local emergency response teams
Early failure of local businesses

Table 3.5 - ESFs and Coordinating Agencies (FEMA, 2008 and ASDHS/TEMCO, 2010)

ESF #	Emergency Support Function	American Samoa ESF Coordinator	Federal ESF Coordinator
ESF 1	Transportation	AS Department of Education (DOE)	Department of Transportation
ESF 2	Communications	AS Telecommunications Authority (ASTCA)	Department of Homeland Security (DHS)/NCS
ESF 3	Public Work & Engineering	DPW	Department of Defense & Army Corps of Engineers
ESF 4	Firefighting	Department of Public Safety-Fire	US Department of Agriculture & US Forest Service
ESF 5	Emergency Management	ASDHS/TEMCO	DHS/FEMA
ESF 6	Mass Care, Housing & Human Services	DOE	DHS/FEMA
ESF 7	Logistics (Resource Support)	ASDHS/TEMCO	General Services Administration and DHS/FEMA
ESF 8	Public Health & Medical Services	DOH, DHSS, and LBJ Medical Center	Department of Health and Human Services
ESF 9	Search & Rescue	Department of Public Safety-Police	DHS/FEMA, DHS/USCG and DOI
ESF 10	Oil & Hazardous Materials Response	AS Environmental Protection Agency	Environmental Protection Agency and DHS/USCG
ESF 11	Agriculture & Natural Resources	Department of Agriculture	US Department of Agriculture and DOI
ESF 12	Energy	American Samoa Power Authority	Department of Energy
ESF 13	Public Safety and Security	Department of Public Safety-Police	Department of Justice
ESF 14	Long Term Community Recovery	ASDHS/TEMCO	DHS/FEMA and Small Business Association
ESF 15	External Affairs	ASDHS/TEMCO	DHS and DHS/FEMA

3.6 Land Use & Structural Design

> Most CMU [concrete masonry unit] buildings withstood the 2009 South Pacific Tsunami. Wood-framed and poorly reinforced masonry buildings in areas of deep inundation were heavily damaged and in many cases were torn completely from their foundations. (EERI 2010)

Steep terrain and other development constraints in American Samoa have resulted in concentrated coastal development. Property damage from the 2009 SPT reflects this settlement pattern. Commercial buildings, schools, churches, and emergency shelters are located within tsunami hazard areas. Six schools suffered extensive damage and approximately 50% of designated emergency shelters are located in tsunami hazard zones. Major challenges related to Land Use & Structural Design are shown in Table 3.7.

Relocation falls short of addressing development constraints and community needs in American Samoa for several reasons:

- Steep terrain and land use policy limits land availability
- Traditional land tenure limits family relocation
- Ancestral ties to land; family members buried in yards
- Relocation costs borne by homeowners
- Low frequency and perceived risk of tsunami inundation

Although relocation may be warranted in some cases, structural design modification is proposed as an alternative. Common structural possibilities for reducing the impacts of storm surge and tsunami to homes and other structures include elevating structures, dry flood proofing, wet flood proofing, and hardening. Outreach is being developed to raise awareness on the importance and value of structural adaptation.

American Samoa began participation in the National Flood Insurance Program (NFIP) in 1991. Many of the current land use regulations in American Samoa are consistent with NFIP requirements and the existing permitting process is adequate for addressing tsunami risk reduction efforts. Most American Samoa NFIP policy holders discontinue with the program once the prepaid period ends. Local insurance companies do not carry NFIP policies making it difficult for general populations residing in floodplains to get them. However, the current FEMA-based Flood Insurance Rate Maps (FIRMs) for American Samoa may not sufficiently cover tsunami inundation areas (Figures 3.8 and 3.9). Tsunami inundation modeling is needed to inform flood-plain management, relocation efforts, and structural design requirements.

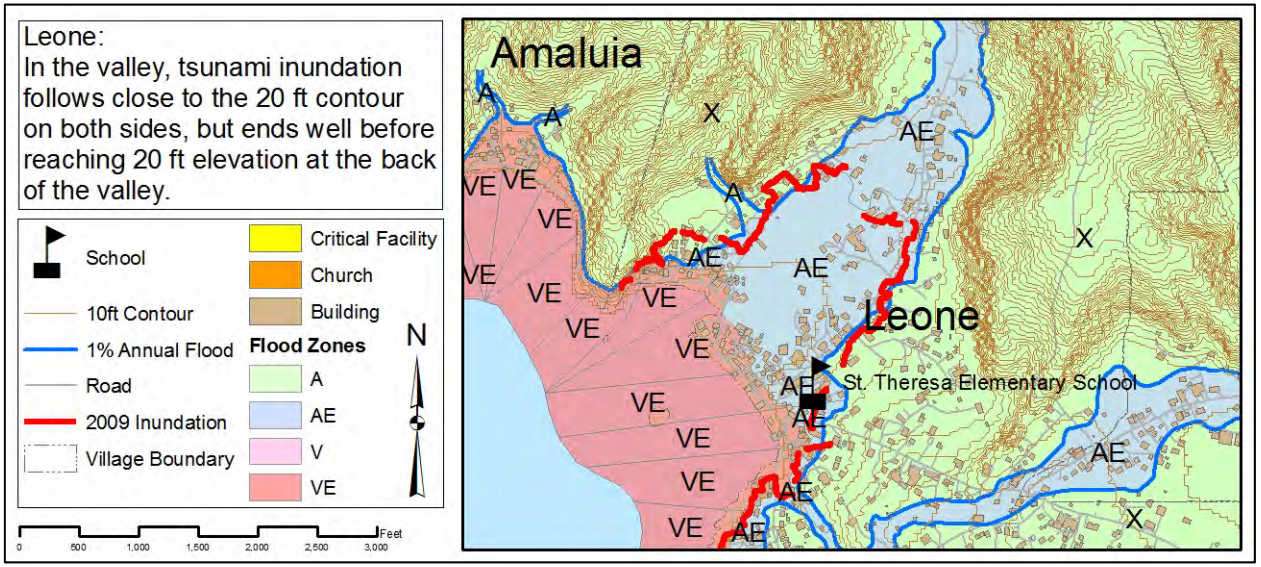


Figure 3.8 - 2009 tsunami inundation and FEMA 1% annual chance flood lines in Leone (EA/HHF, 2011)

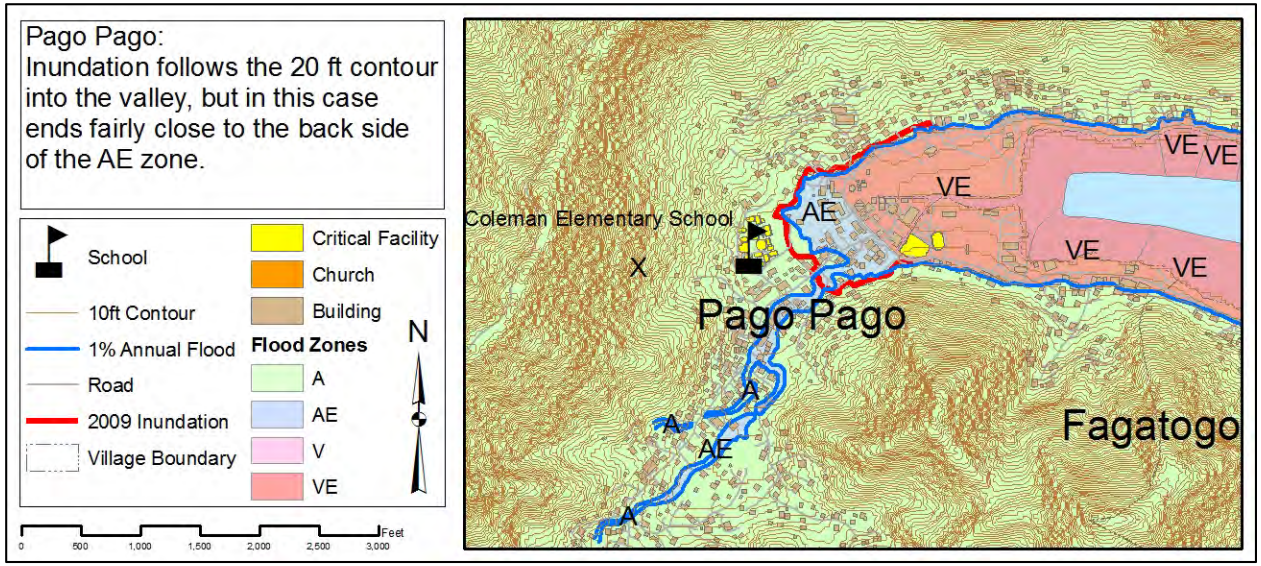


Figure 3.9 - 2009 tsunami inundation and FEMA 1% annual chance flood lines in Pago Pago (EA/HHF, 2011)

Table 3.6 – Schools Most Impacted By the 2009 SPT

School Impacted	# of Buildings Impacted
Alataua Lua Elementary	3
Afono Elementary	Unknown
Le'atele Elementary	3
Masefau Elementary	Unknown
Taputapu Elementary*	5
Matatula Elementary	2

**Taputapu Elementary is being relocated.*

Table 3.7 - Land Use & Structural Design Challenges
Limited land for relocation
Current construction norms and preference
Inadequate definition for coastal high hazard zones
Structural modification needed for homes and commercial buildings in tsunami hazard zones
High number of commercial buildings in Pago Pago and Fagatogo are in the tsunami hazard zone
Shelters, schools, churches in hazardous locations
Clearing or misuse of mangroves

3.7 Warning & Evacuation

3.7.1 Warning

Tsunamis are monitored by a vast array of networks around the globe. The combination of monitoring seismic data and sea level data allows for very accurate warnings for distant tsunamis. The Pacific Tsunami Warning Center, in Ewa Beach, Oahu, provides warnings for distant tsunamis to countries around the Pacific Rim, Indian Ocean, and most Pacific Island states, including American Samoa.

Figure 3.10 – Village-based warning practices can be highly effective (EERI, 2009)

The American Samoa emergency alert system (EAS) is comprised of the regional NWS office (WSO), emergency operations center (EOC), communication networks (telephone and UHF radios) between key EAS agencies, individuals with NOAA Weather Radios (NWR) responsible for leading evacuations, agency heads, AM/FM radio and TV broadcasts, and the use of bells and bullhorns by village leaders. (Figure 3.10)

Satellite-activated warning sirens are now in place (post-2009-SPT) and provide an additional source for emergency communications. Radio is an effective way to reach the public, but coverage is incomplete. ASG is working with FEMA to resolve coverage issues. The tsunami warning process for American Samoa is shown in Figure 3.11.

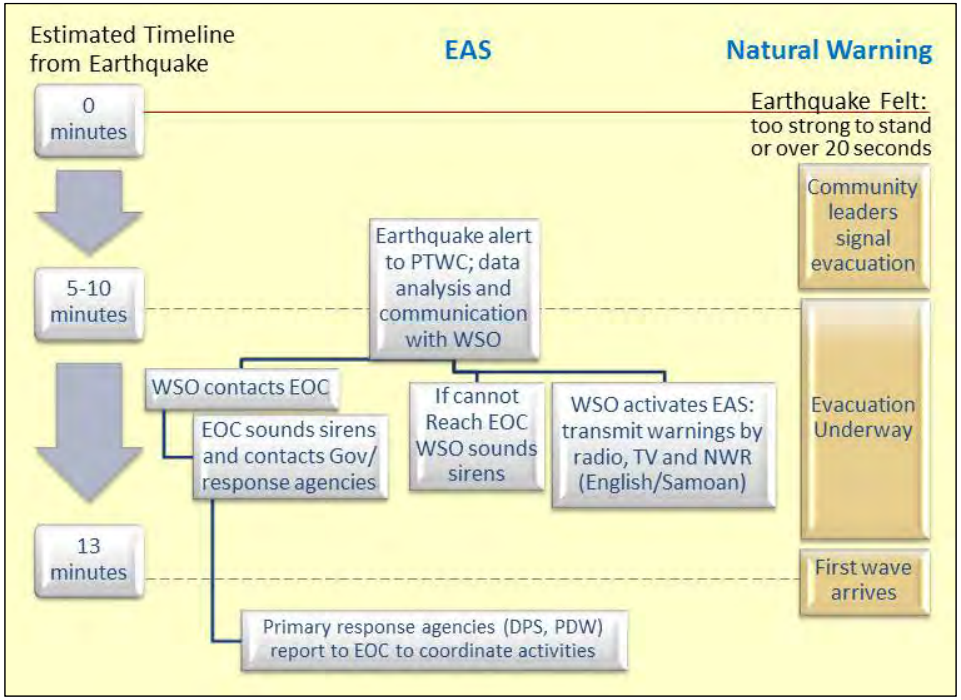


Figure 3.11 – Tsunami Warning Process in American Samoa (EA/HHF, 2011)

3.7.2 Evacuation

> "The people of American Samoa and Samoa did the right thing after they felt the early morning earthquake—they self-evacuated from the coast to higher ground in the 10 to 15 minutes before the tsunami arrived. This instance of self-evacuation underscores that education saves lives." (Jaffe, 2009)

The timing of the event, education, and awareness training undertaken by key agencies in the months prior to the 2009 tsunami contributed greatly to limiting the number of lives lost. Adequate evacuation plans and drilling practices are underway for some key agencies (e.g. ASDOE), but documentation and practicing of such plans is under addressed by several agencies. Evacuation maps, being prepared by ASDHS/TEMCO and DOC, are not yet available for all vulnerable communities. Evacuation signage and route development are underway. ASDHS/TEMCO and DOC are currently inventorying evacuation routes and identifying maintenance responsibility. DOE developed protocol for evacuating special needs students. Villages are aware of special needs individuals and informal evacuation protocols exist. Protocol for evacuating day care facilities is unknown, as are evacuation plans for hotels and commercial enterprises. Assessments of shelter capacity, locations, adequacy of public facilities at evacuation sites, and transportation plans for special needs populations are needed. Oversight is needed for the development of EOPs to address all areas of disaster management including evacuation planning, sheltering/mass care operations, and coordinating response efforts. There is a need for better documentation, awareness, and practicing of EOPs, as well as outreach to populations with higher vulnerability, including the elderly, disabled, caretakers, visitors, and migrants. Major challenges are summarized in Table 3.8.

Table 3.8 - Warning & Evacuation Challenges
Inadequate EOP development, training, and coordination/ awareness between agencies.
Confusion about evacuation procedures and responsibilities.
Tsunami risk awareness of the general population.
Safety of school evacuation routes.
Transporting special needs students.
Unsupervised students at schools
Unavailable or inadequate evacuation routes.
Roadway congestion during evacuation
Evacuating special needs populations
Adequacy of existing shelters or assembly areas (AAs)
Inadequate restroom facilities at major designated AAs
Easily overwhelmed telecommunication systems
Inadequate radio coverage in eastern villages
Rapid warning transmission to a large audience.

3.8 Governance

American Samoan governance responsibilities are shared between *Matai* and elected/appointed officials (Governor and the Legislature, or Fono) in a fairly complex and nuanced process. Figure 3.12 is a simplified diagram of American Samoa's centralized government. Traditional village politics is a powerful component of regional governance and has far reaching influence on all aspects of society and the success of various initiatives. Within the framework of disaster management, there is an obvious need to recognize the roles and authority of the *Matai* in the villages; concurrently the central government must also provide broad guidance on Territorial issues.

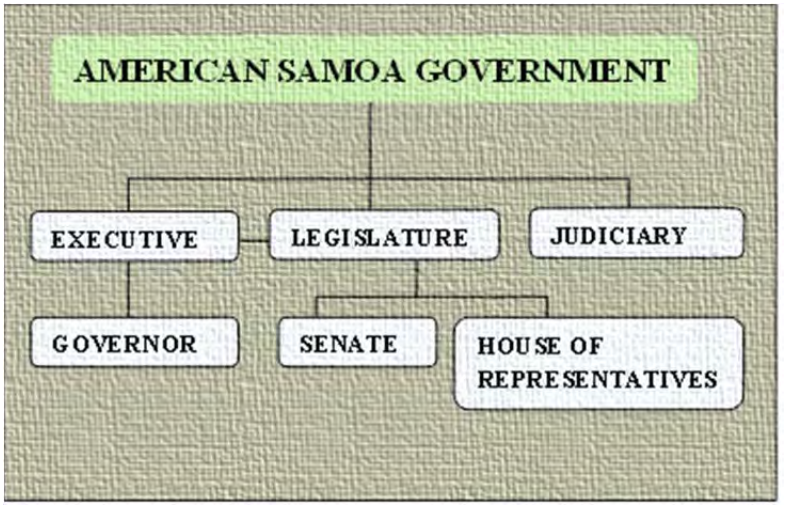


Figure 3.12 - Simplified organization chart of American Samoa's centralized government (EA/HHF, 2012)

Lack of coordination between agencies is a common impediment to resilience building efforts. The TAC indicated that a lack of information sharing between agencies reduces situational awareness and creates inefficiencies. Creating a system for coordinated EOP development, revision and practice and compiling disaster management resources in a centralized and accessible location can assist resilience building efforts. Major challenges related to Governance are shown in Table 3.9.

Governmental initiatives gain traction through policy and regulatory requirements. Policy needs can be guided by information collected in long-range development plans and community plans. Although American Samoa is addressing some important planning elements, there is a critical need for more long-term planning. The unique governance structures in American Samoa present challenges for incorporating traditional top-down and bottom-up leadership to align initiatives, channel knowledge and expertise, and build support for plans produced.

Table 3.9 - Governance Challenges
Inadequate EOP development, training, and awareness between agencies.
Confusion about evacuation procedures and responsibilities.
Lack of shared community vision for livelihoods and settlement patterns.
Land uses, business, and critical infrastructure in vulnerable areas
Coordinating top-down and bottom-up initiatives to maximize resilience efforts

3.9 Tsunami Recovery

Every disaster has different stages of recovery including short term (measured in days), intermediate (measured in weeks to months), and long term (measured in months to years). Following the 2009 SPT, short-term response and recovery moved quickly. Communities immediately began clean-up, Federal support arrived within 24 hours, water systems were repaired, most schools were reopened, and air and sea transportation were reestablished quickly. The economy of AS was temporarily buoyed by jobs created by outside funding for debris clean-up, infrastructure improvements, and providing goods and services to relief workers.

Long-term recovery in the economic sector, power systems, and health care is on-going (Figure 3.13). The majority of residents who lost homes did not have flood insurance and opted for a lump sum payment from FEMA to rebuild. Major infrastructure reconstruction projects require more time and funding, such as the reconstruction of the Satala Power Plant. Long-term disaster recovery may be hampered by the lack of a single access-point for information, lack of inter-agency coordination, and short-term funding cycles. Major challenges related to Tsunami Recovery are shown in Table 3.10.

Recovery time and costs can be minimized through agency coordination, land use regulation, secure critical infrastructure, economic diversity, and long term planning. Village support is also a critical component of disaster recovery.

Figure 3.13: Emergency generators delivered after loss of Satala power plant (EA/HHF, 2011)

Table 3.10 - Tsunami Recovery Challenges
Duplication of recovery efforts cost time and money. Agency outreach could be expanded, and available workers need to know where to go.
Critical infrastructure lies in the tsunami flood zone.
Villages are at risk for tsunamis.
Funding for recovery may be limited due to budget cuts.
Medical response may be delayed if transportation disrupted.
Disaster recovery should include environmental response to protect ecological resources and tourism areas.

3.10 Coastal Resource Management

The Federal CZMA defines American Samoa as entirely within the coastal zone. Due to the steep terrain, development on Tutuila is limited to 30% of the total land mass (Figure 3.14). It was within the narrow coastal plain that the tsunami took lives and caused extensive damage to property. Effective coastal resource management requires legislative actions, integrated multi-agency policy, coordinated engineering and infrastructure planning, and government and community support.

Figure 3.14 - Coastal development in tsunami hazard zones creates challenges for building resilience (EA/HHF, 2011)

Long line pelagic fishing industry supplies the tuna canneries and is vital to the American Samoa economy. A relatively small number of residents continue reef fishing for subsistence and small boat commercial fishing. Coral reefs and mangroves are the two main coastal habitats that support fisheries. Efforts to remove tsunami debris from the coral reefs continue. Federal funding is limited for post-disaster reef clean-up (Figure 3.15). Run-off/sewage problems are impacting water quality. Reef and mangrove health are essential to supporting fisheries for fishing related economic activity and subsistence food supply. Table 3.11 summarizes major challenges related to Coastal Resource Management.

Table 3.11 - Coastal Resource Management Challenges
Larger numbers of buildings in the coastal zone were destroyed resulting in fatalities.
Coastal debris damaged reefs and is expensive and challenging to clean-up due to funding/staff limitations.
Nutrient pollution remains a problem for human and ecological health.
Rubbish in streams and coastal areas damaged reefs, became hazards during tsunami.

Figure 3.15 - NOAA removed over 4 tons of tsunami-generated marine debris from coral reefs in November and December 2009 (NOAA, 2009)

3.11 Case Studies

Preparedness and response to tsunami and climate change was evaluated in Samoa and in the Pacific Northwest and Alaska, and then compared to that in AS. In Samoa, the use of cars for evacuation on near-shore belt roads caused higher fatalities than in American Samoa, where people generally evacuated to higher ground by foot.

Although less than 3% of Samoa's population was affected by the tsunami, many of the impacted communities chose to resettle in upland areas. Now, Samoa utilizes shoreline lands for business and upland areas for residences. This is not the case in American Samoa where land for relocation is very limited.

> "…researchers noticed a marked difference between the evacuation process in Samoa and American Samoa. While most villagers in Samoa knew to rapidly evacuate after experiencing an earthquake, only a month earlier they had been told that cars could help with evacuations, a deadly directive since most roads run parallel to the beach." (N. Fullbright, 2009)

Some Northwestern US Native American tribes are working to relocate their villages away from tsunami hazard areas as sea levels have risen (Figure 3.16). Availability of land, the costs of developing new infrastructure and socio-economic concerns are major issues when considering relocation.

Figure 3.16 - The Quilete Tribe, located on an estuary on the Olympic Peninsula, Washington State, is working to relocate its people onto higher ground (Quilete Tribe/news.opb.org, N.D.)

Some Northwestern US Native Americans installed rainwater catchment systems near emergency shelters and are allocating portions of energy allowances to the development of renewable energy systems and natural resources adaptation. In Samoa, water provisions are the primary constraint for relocated populations, many of which continue to receive transported water. Gravity-fed water catchment systems have been identified as a low tech solution to the water challenge (Figure 3.17).

Figure 3.17 - Rainwater catchment systems have been adopted in the plantations of Samoa where many have relocated. (Red Cross, N.D.)

Samoa produces about half of its energy from hydropower, so is less dependent on imported fossil fuels than American Samoa. Samoa's hydropower system was not affected by the tsunami. ASPA, currently depending almost entirely on imported fuel, is in the beginning stages of pursuing renewable energy sources such as photovoltaic, wind energy and converting solid waste to energy. The isolated Manu'a Islands regularly experience energy shortages due to fuel shipping delays and would benefit greatly from the development of local renewable energy systems..

Reconstruction of tsunami-endangered or damaged housing is a critical issue for American Samoa, Samoa and the Northwestern US Native American tribes. Native American tribes such as the Hoh, Quilete, Swinomish and various Alaskan indigenous communities have initiated planning forums and have received some funding from Federal agencies for relocation. In Samoa, efforts at rebuilding have been successful with the partnering of New Zealand Habitat for Humanity (HFH) and the Samoa Government. These organizations can work rapidly in Samoa; HFH was able to build more homes using less money and in a shorter timeframe than federally constructed homes in American Samoa (Figure 3.18). Table 3.12 shows challenges identified through Case Studies.

One of the recommendations made in this study is to develop replacement housing design guidelines, with siting criteria, to assist permanent housing redevelopment efforts undertaken in the future. DOC is in the process of developing standards for what it refers to as the "Samoa Home" which could become a prototype for replacement housing.

Figure 3.18 - One of the 41 FEMA-funded replacement homes under construction. The Federally funded reconstruction of new homes in American Samoa faced challenges with land use constraints. (Photo: FEMA, N.D.)

Table 3.12 - Case Study Related Challenges
Disaster coordination with Samoa and other South Pacific nations can be challenging due to communication breakdowns.
Relocation is the most challenging and least popular option, but the most effective.
Relocation without infrastructure can increase health risks due to lack of water/sanitation.
Isolated areas face additional challenges due to water/power system disruptions.

3.12 Society & Economy

Traditional social roles played an important part in the capacity of villagers to respond to the 2009 SPT, particularly for the *pulenu'u* in warning and evacuation, the *aumaga* in evacuation and emergency response and the M*atai,* in general. Ninety eight percent of all American Samoans are Christian and in a faith-based society, religion can be a powerful tool for coping with disaster, as well as a mobilizing force for recovery. (Figure 3.19) Trauma counseling became important following the tsunami and locally trained counselors (DHSS) served the population for more than a year after the event. There was a distinct focus in stabilizing the psycho-social health of impacted children.

Figure 3.19 - Christianity is practiced on a daily basis in American Samoa. (Samoa News, N.D.)

The dichotomy between the need to assimilate into a global economy and the desire to retain *fa'asamoa* is a constant challenge to the economic stability and development of American Samoa. The "one-sector" economy, dependent on fishing and fish processing, is highly vulnerable to disaster impacts and economic globalism. For American Samoa specifically, the implementation of Federal legislation, particularly the raising of minimum wages, has diminished the global competitive edge of the tuna canneries, one of two major employers on the islands. (Figure 3.20)

Figure 3.20 - Star Kist Samoa Inc. tuna cannery remained open after Chicken of the Sea cannery closed in 2009. (Tafananai, N.D.)

Economic diversification is a basic principle of economic resilience. Viable economic diversification opportunities for American Samoa include: tourism, agriculture, manufacturing, and knowledge industries. The American Samoa Government has had success in implementing several key actions towards economic diversification in all areas, however, several challenges remain.

There is a need to correlate the socioeconomic means/aspirations of villagers and the economic plans of the American Samoa Government.

The lack of broad federal policy for economic development in insular areas and application of specific yet perfunctory developmental programs (e.g. tariff and quota concessions, federal corporate tax concessions, and territorial authority over the minimum wage and immigration), with no framework to monitor the success or demise of these programs, threaten economic durability in these areas. A National Economic policy for the insular areas—to include economic development, education, health care, environmental and political status considerations—that acknowledges the remoteness and relative economic disadvantages in insular areas is needed to support local economic development efforts.

Recordkeeping is essential to the growth and viability of the different industries. The long term health of tourism and agriculture sectors requires sustained funding sources. Capital improvements for expanding different sectors, including manufacturing and tourism, involve expensive infrastructure improvements as well as leadership to sustain the momentum needed for such long-term projects. Major challenges related to Society & Economy are shown in Table 3.13.

Table 3.13 - Society & Economy Challenges
Lack of support for implementation of a comprehensive economic strategy.
Insufficient funding for tourism industry growth; lack of community support.
Marketing of AS products and place for international business.
Limited use of BLAST (Broadband Linking the American Samoa Territory) technology
Decline in or lack of subsistence and commercial agricultural and fishery activity.
Lack of foreign investment in manufacturing sector; heavy infrastructure requirements.
Need for more workforce training and retooling programs.

Chapter 4

Implementation Framework and Recommendations

Church and tsunami hazard warning sign along a coastal road - Central Tutuila
(EA/HHF, 2011)

4. Implementation Framework and Recommendations

Tsunami hazard mitigation practices are well developed or underway in American Samoa and include a wide range of efforts such as emergency and evacuation planning and drills, risk awareness outreach, alert and communication system enhancements, floodplain management, evolving construction standards, shore protection, first responder training, and village capacity building efforts. This study addresses ways to bolster these efforts, but emphasizes that these recommendations can only supplement existing practices and do not resolve the land use constraints or economic needs unique to American Samoa.

Working papers were used to identify ways to build resilience and develop recommendations for next steps; final recommendations were categorized into eight focus topics related to disaster management functions. Recommendations from working papers were reviewed with TAC members and, in some cases, discussed with subject matter experts. The final list includes 62 recommendations.

Sortable recommendations list available at: http://astsunamiresilience.org

Many resilience-building efforts are underway in American Samoa.

This study identifies additional strategies where ongoing initiatives can be enhanced.

Resilience limitations in American Samoa are largely due to land use constraints and economic capacity.

4.1 Overarching Strategy and Guiding Principles

4.1.1 Principles of the Implementation Framework

Community resilience is an organic process (not an end state) that requires a programmatic and comprehensive approach to foster and sustain resilience building efforts. Natural disasters stress the "weakest link of the chain" which underscores the need for a comprehensive approach. Recommendations need to be prioritized and programmed in a logical sequence so that orderly progress can be made, starting with the items most critical to life safety, with achievable expectations. Other parameters/principles considered in creating the implementation framework include:

- **Sense of Urgency -** Scientists predict that it's only a matter of time until the next major tsunami is generated in the South Pacific. The 2009 disaster was devastating to American Samoa. It could have been much worse if steps hadn't been taken to prepare the population for the effects, and it is gradually recovering from the disaster through the hard work and dedication of its leaders and citizens. But more can be done to prepare for, protect against, respond to, and recover from the next disaster.
- **Recognizing unique geographic and economic constraints -** The topography and isolated location of American Samoa present unique challenges to building resilience. Steep slopes and unstable soils limit the amount of developable land forcing residential, commercial, and industrial uses onto narrow coastal plains. The size and isolation of the American Samoan islands contributes to challenges in building a robust and diverse economy, critical to disaster resilience.
- **Cultural Appropriateness -** Recognition of fa'asamoa, and the inherent resilience of the village unit. A successful resilience plan requires the active participation and support of the village leadership (Matai). As demonstrated in the 2009 tsunami, village leadership's foresight in preparing villagers for a tsunami disaster was pivotal in reducing loss of life, as well as leadership's ongoing role in fostering the recovery to pre-disaster conditions. The importance of the village role is particularly critical in the case of near field tsunami such as the 2009 event, where the first waves hit within minutes of the earthquake. Support to village leaders to build local resilience, and the governmental technical resources to support that process, is a cornerstone of the report's recommendations.

- **Blending tradition and technology -** Related to fa'asmaoa is the need to blend traditional forms of resilience with appropriate, state-of-the-art technologies and disaster planning techniques (e.g., satellite-activated early warning systems, the use of internet and computer-aided technologies, etc.) as additional tools for warning and response communications and protocol—not to erode or pre-empt traditional, perhaps more sustainable practices (such as the use of village bells for warnings, *aumaga* preparedness training, etc.). Oral traditions through storytelling and song, along with other indigenous forms of communication, have proven to be extremely effective in fostering local resilience and saving lives. At the same time, as the economy grows, a growing percentage of the population is not familiar with traditional systems and needs to have some kind of safety net—that will likely need to be provided by the government.
- **Commitment to process improvement –** Process improvement, at all levels of society, is a prerequisite for success. Families have a responsibility to develop an emergency evacuation plan and practice it regularly. Village leaders have a responsibility to ensure that effective emergency evacuation routes and temporary refuges are in place, and maintained, and that villagers are well trained to use them. The territorial government, and particularly the Governor, has the lead role in ensuring that the Territory can better withstand the next disaster, and recover more quickly from it. Integrated and coordinated government services and response in the event of a natural disaster, such as a tsunami, are critical. To ensure that this is done effectively and efficiently, agencies need to be aware of each other's roles and responsibilities as documented in emergency plans. The Governor is also the focal point of the federal disaster response framework and therefore plays a key role in guiding disaster preparedness and management activities. The Governor's role includes offering support and leadership to the overall process, in addition to providing overall technical assistance. Repetitive practice, assessment, and education at each of these levels will, over time, increase community resilience.

4.1.2 Implementation Framework

An implementation framework, led by the Governor, is needed to organize and sustain this programmatic and comprehensive approach to resiliency. The recommendations provided on the following pages represent a starting point—but will be lost if they are not sustained by an ongoing planning process that provides opportunities to test new approaches and technologies, engages new stakeholders and, of course, learns and improves. As outlined in

recommendation 1.1, through an Executive Order, the ASG should establish a policy to annually review, revise, and reprioritize the recommendations from this report. To support this process the following actions are recommended:

- Through Executive Order, or similar directive, the Hazard Mitigation Council, an existing Governor-appointed committee that served as the nucleus of the Tsunami Advisory Committee, will be expanded to include additional American Samoan organizations involved in disaster management (to include Council of Churches, DOE, and UHC as participating members).
- Existing HMC responsibilities will be broadened to include oversight, coordination and implementation of recommendations made in the American Samoa Tsunami Study, monitor progress, ensure accountability of participating organizations, and regularly update the implementation program, allowing the expanded committee to more holistically address disaster management (e.g. emergency planning or long-range risk based planning). The expanded committee will help align the efforts of and information sharing between agencies with disaster management roles.
- The expanded HMC will meet on at least a semi-annual basis, to review and discuss the status of recommendations and lessons learned, and update the recommendations as appropriate, including resetting the top priority actions for the next year. The updated recommendations, and any associated guidance the committee deems appropriate, would be submitted to the Governor for review and approval. The Governor would transmit the annual report with his recommendations to the Fono by the start of each legislative session. The Fono would be briefed on the annual report so it is fully informed on the status of the implementation program and can reassess its legislative priorities for the year if needed.

4.2 Support for On-going Efforts

Recognition must be given to tsunami hazard mitigation practices that are well developed or underway in American Samoa, including a wide range of efforts such as emergency and evacuation planning and drills, risk awareness outreach, alert and communication system enhancements, floodplain management, evolving construction standards, shore protection, first responder training, and village capacity building efforts. Study recommendations present ways to bolster existing resilience building efforts, within the context of geographic and economic constraints unique to American Samoa.

4.2.1 On-going Efforts Recognized in Recommendations

Challenges and recommendations were developed throughout the study based on research into the events surrounding the 2009 SPT, research on best practices, review of ASG documents, and consultation. In some cases, ongoing resilience-building efforts in American Samoa are already addressing study team recommendations. Many of these initiatives are also highlighted in the recommendations as high priorities, as a means to reaffirm the importance of their continuance, but were not designated top priorities because they are already underway. The study team acknowledges these important ongoing programs:

- Territorial Emergency Operations Plan revision
- Coordinating agency emergency plans that align with National Response Framework (NRF) ESFs
- Evacuation route mapping
- Preparing and gathering funding for inundation modeling and mapping
- Enhancing post-disaster counseling and outreach services
- DOE tsunami risk and response education program
- School evacuation planning, drills and evaluation of route safety
- Improving pedestrian evacuation routes, assembly areas, mapping, and signage
- Refining warning systems between local authorities
- Building economic resiliency through economic diversification
- Evaluating incentives to stimulate economic development and diversification
- Inventorying and managing critical infrastructure
- Identifying job training needed for local job creation in AS and developing training programs
- Identifying limited mobility populations and coordinating outreach for evacuation planning
- Village-based emergency response training and capacity building programs
- Coordinating EMS response capacity building
- Developing wireless emergency alert systems
- Inspecting and improving wastewater systems

4.2.2 Resilience Building Efforts and Village Capacity

The overarching goal of the Tsunami Study is to identify ways to increase community resilience to tsunami hazards. Achieving this goal is dependent on the effectiveness of reaching residents throughout American Samoa and improving the ability of the collective community to prepare for, protect against, respond to, and recover from tsunami hazards. The Tsunami Study approached resilience building through a high-level review of what is being done and investigations into what more could be achieved. Implementing the recommendations will build on the existing efforts being undertaken to help build resilience at the village and individual levels through many channels. The Tsunami Study recognizes the importance of building resilience at the village level and aligns with/supports ongoing initiatives focused on grassroots capacity building such as:

- NOAA/UH DURP Village Capacity Building for Resilience – The ongoing, village-level efforts by NOAA and UH (to develop community planning practices that promote community resilience within a sustainable ecosystem framework) are recognized as an extremely important initiative that should be expanded to all the villages in American Samoa. The Tsunami Study recognizes the importance of understanding and working with the Matai in achieving the broad societal change necessary to embrace resiliency and includes recommendations to promote and expand this initiative.
- NOAA Community Resilience toward Climate Change Impacts – A two part pilot project, started in Amouli village, includes digital elevation modeling and sea level rise modeling and a participatory, bottom-up community planning component to address potential impacts. The village planning committee is developing its Village Climate Resiliency Responses and Actions Plan, scheduled for completion before April 2012.
- NDPTC & Volunteer Responders – NDPTC's ongoing efforts to provide technical training to the *aumaga* and the broader community are commendable and need to be continued and broadened. Groups of volunteer responders are being developed and trained through initiatives such as Community Emergency Response Teams (CERT) and Citizen Corps. Tsunami Study recommendations promote the continuance and expansion of village-based training initiatives.
- PRiMO – The PRiMO Executive Director and members provided steadfast support for the Tsunami Study initiative by fostering communication between related parties and providing valuable input to discussions. They also recognize and are actively involved in supporting efforts to develop grass-roots, village-based awareness of natural disaster threats, and the means to build community resilience. The coordination framework and technical support provided under the PRiMO umbrella married well with the on-island advisory committee framework created by Governor Togiola.

- Role of churches in capacity building – American Samoa's churches are a central component of the Samoan society – and play a key role in disaster preparedness and response. Rooted at the village-level, the churches are recognized as a vital team player in building coastal community resilience. Tsunami Study recommendations recognize this vital role.

4.3 Recommendations

Recommendations were formulated through directed research provided by the working papers, input from the TAC and other stakeholders, PRiMO partner agencies, and review of what other jurisdictions are doing. The recommendations were categorized into eight focus topics related to disaster management functions.

Top priority recommendations were selected to highlight actions that are considered most important for saving lives, increasing public safety, sustaining resilience building efforts, or helping to build economic diversity and durability. Recommendations and respective ranking were reviewed with TAC members and TAC feedback on greatest concerns or challenges was considered in determining top priority recommendations.

Figure 4.1 - Recommendation resilience facets and focus topics (EA/HHF, 2011)

Each of the recommendations identified during the study was classified by six data elements described in Table 4.1 below. Resilience facets and associated focus topics are discussed in Chapter 1 and summarized in Figure 4.1.

The study recommendations were assigned priority rankings, general cost ranges, implementation timeframe, and type as described below.

Priority: Four priority rankings were identified: Top, High, Medium, and Low. While all recommendations are considered important, the study team believes that implementation of top priority recommendations will achieve the highest increment of resilience in the shortest amount of time and accordingly, should be initiated in the first year and are based primarily on actions that enhance life safety. High, medium, and low designations are notionally categorized based on level of urgency, corresponding benefit, and cost effectiveness. Many ongoing initiatives are included in the recommendations table and are ranked as high to acknowledge the importance of continuing these efforts.

Cost: Three cost categories were created as summarized below. Some recommendations require recurring costs and are indicated by (R) (e.g., recommendation 1.3 – build/update central registry of disaster management-related documents).

- < $50K – policy development/amendment or minor studies
- ≤ $400K – major studies, minor projects, and smaller scope plans
- > $400K – large scope/multi-year initiatives

Timeline: Three general timeline categories were identified to describe when a recommendation should be initiated (first year, < 5 years, < 10 years). As top priority recommendations are identified to begin in the first year following the study, recommendations that may require phasing or implementation over a longer period of time—such as comprehensive plans—are identified to occur within the first five years following the study.

Type: Three basic recommendation types were identified including:

- Study – investigation/assessment/evaluation to determine existing conditions and inform decisions on further action
- Policy – guiding rules or principles to achieve public goals, with evaluation metrics
- Plan/Project
  - Plan – outlines or details goals and objectives to achieve a desired state
  - Projects – including physical action like construction, structural modification, relocation or demolition, or programs such as recommendation 1.4. expansion of critical infrastructure database

Table 4.1 summarizes the six data elements used to classify the recommendations.

Table 4.1 – Recommendation Classification Elements

Resilience Facets	Focus Topics	Priority	Cost	Timeline	Type
Learn	1. Information Management 2. Emergency Planning	1. Top 2. High 3. Medium 4. Low	1. < $50K 2. ≤ $400K 3. > $400K	1. First Year 2. < 5 Years 3. < 10 Years	1. Study 2. Policy 3. Plan/ Project
Withstand	3. Land Use & Structural Design 4. Utilities 5. Response Capacity				
Rebound	6. Economy 7. Health Services 8. Clean-up				

4.4 Top Priority Recommendations

All recommendations and further explanations are provided in Section 4.4. Fourteen of these recommendations were identified as top priorities and are listed on the following pages, organized by resilience facet, focus topic, and priority:

Table 4.2 – Top Priority Recommendations by Resilience Facet: the means to learn from the event

	Focus	Recommendation	Priority	Cost	Timeline	Type
1. Information Management	1 - Sustaining Resilience Efforts	Adopt formal policy to increase diversity of membership and scope/responsibilities of the existing HMC to coordinate the implementation of recommendations made in the report, monitor progress, ensure accountability of participating organizations, and update the implementation program.	Top	< $50K (R)	1st Yr	Policy
			Participating AS Organizations: Governor **Participating Outside Organizations:** NA			
	2 - EOP Reporting	Adopt formal policy requiring Governor designated HMC representative to report plan and training status to the Fono annually to increase public awareness, help the coordinator gain traction in bringing accountability to other agencies responsible for developing SOPs that align with FEMA's ESFs, contribute to information sharing, and help identify needed EOP training/practicing.	Top	< $50K (R)	1st Yr	Policy
			Participating AS Organizations: Governor **Participating Outside Organizations:** NA			
	3 – Information Sharing	Compile disaster management related documents on centralized website—and periodically update—to assist in coordinating resilience building efforts and aid information sharing between agencies.	Top	< $50K (R)	1st Yr	Pln/Prj
			Participating AS Organizations: Governor, HMC **Participating Outside Organizations:** NA			
	4 - Critical Infrastructure	Continue to expand critical infrastructure database; inventory and manage critical infrastructure (e.g. CI-ACAMs) to ensure effective management and hardening/relocation as needed.	Top	≤ $400K (R)	1st Yr	Pln/Prj
			Participating AS Organizations: ASPA, ASTCA, ASDHS/ TEMCO, DOE, DOH, DPA, DPW, Governor, LBJ, OSA **Participating Outside Organizations:** DHS, DHSS, NWS-WSO, USACE			
2. Emergency Planning	1 – Village Preparedness	Continue to work through OSA and village leadership (Matai and Pulenuu) to encourage the development of comprehensive tsunami preparedness plans and response practices in all vulnerable villages; support ongoing efforts of UH DURP capacity building, NDPTC training, and NOAA TsunamiReady programs.	Top	< $50K (R)	1st Yr	Plan
			Participating AS Organizations: OSA, ASDHS/TEMCO **Participating Outside Organizations:** FEMA, NDPTC, NOAA, UH,			
	2 - Evacuation Plan Awareness	Include the development of informational bulletins for at risk villages (multilingual) in ongoing outreach; provide evacuation plans on a centralized website and make critical information publically available (e.g. in phone books).	Top	< $50K (R)	1st Yr	Policy
			Participating AS Organizations: DOC, OSA, ASDHS/ TEMCO **Participating Outside Organizations:** FEMA, NWS-WSO			
	3 - Evacuation of Commercial Enterprises	Establish formal policy requiring evacuation plan development and implement outreach at vulnerable commercial enterprises (e.g. canneries, hotels, and major commercial centers).	Top	< $50K (R)	1st Yr	Policy
			Participating AS Organizations: ASDHS/TEMCO, ASVB **Participating Outside Organizations:** COC			

Table 4.3 – Top Priority Recommendations by Resilience Facet: the capacity to withstand the event

	Focus	Recommendation	Priority	Cost	Timeline	Type
3. Land Use & Structural Design	1 - Tsunami Modeling	Conduct a tsunami inundation modeling study to determine inundation extents for several high magnitude tsunami scenarios.	Top	> $400K	1st Yr	Study
			Participating AS Organizations: ASDHS/TEMCO, DOC **Participating Outside Organizations:** FEMA, NOAA, USGS, UH, USACE			
	2 - Relocations	Prepare critical facility assessment (including school and church shelters, Tafuna EOC and hospital) to identify tsunami vulnerability, suitable locations for facility relocation (if indicated and feasible), and recommendations for structural modifications where relocation is not feasible.	Top	≤ $400K	1st Yr	Study
			Participating AS Organizations: ASDHS/TEMCO, DPW **Participating Outside Organizations:** DOE, DOI-OIA, FEMA, NOAA, NWS-WSO, UH, USACE			
	3 - Building Techniques	Develop a structural modification guidebook for coastal homes in American Samoa and provide outreach to homeowners and builders.	Top	≤ $400K	< 5 Yrs	Pln/Prj
			Participating AS Organizations: DPW **Participating Outside Organizations:** UH, USACE			
4. Utilities:	1 - Radio	Prepare radio coverage analysis to identify areas where warning communication improvements are needed; make recommendations for radio transmission upgrades to ensure emergency messages reach all villages; ensure key officials and village leaders have NOAA Weather Radios.	Top	≤ $400K	1st Yr	Study
			Participating AS Organizations: DOC, ASDHS/TEMCO, Governor, OSA **Participating Outside Organizations:** FCC, FEMA, NOAA, NWS-WSO			
5. Response Capacity	1 - Program-matic Agreements	Develop programmatic agreements between Federal agencies (such as OIA, NPS, NOAA, DOD, DOT, and FAA) and ASDHS/TEMCO to establish emergency response roles to more effectively utilize available on-island resources during disaster response.	Top	< $50K	1st Yr	Pln/Prj
			Participating AS Organizations: ASDHS/TEMCO **Participating Outside Organizations:** OIA, NPS, NOAA, DOD, DOT, and FAA			
	2 - Clinic Expansion	Expand the facilities/services and utilization of medical clinics in outlying areas; increase emergency responder training and the clinic roles in emergency response to reduce dependence on LBJ Tropical Medical Center and provide outreach to raise awareness of services.	Top	> $400K (R)	< 5 Yrs	Pln/Prj
			Participating AS Organizations: UHC-DOH/ LBJ **Participating Outside Organizations:** NA			

Table 4.4 – Top Priority Recommendations by Resilience Facet: the ability to rebound from impacts

	Focus	Recommendation	Priority	Cost	Timeline	Type
6. Economy	1 – Comprehensive Plan	Consolidate existing economic plans into a comprehensive economic development strategy, overseen by the Governor's Office; incorporate broad scale public outreach/participation at the village level to build public support.	Top	≤ $400K	< 5 Yrs	Pln/Prj
			Participating AS Organizations: DOC, EAC **Participating Outside Organizations:** COC, UH			
7. Health	1 Counseling/ Outreach	Support a comprehensive, coordinated and cohesive mental health infrastructure which includes continued efforts to bolster post-disaster counseling services, training and outreach on available health resources.	Top	≤ $400K	< 5 Yrs	Pln/Prj
			Participating AS Organizations: UHC-DHSS **Participating Outside Organizations:** NDPTC, UH			

4.5 Recommendations by Focus Topic

The following tables list all recommendations by focus topic and priority (Top, High, Medium, and Low)—including the top priority recommendations discussed previously. Because of the amount of overlap between the research areas developed in the working papers, as shown in Table 1.1, focus topics were developed to correlate recommendations made in the working papers with more distinctive disaster management functions. Explanations of these focus topics and correlating recommendation tables for each focus topic are offered below.

4.5.1 Information Management

Information management is required to capture the overall processes undertaken and frameworks used to manage tsunami resilience building efforts. An overarching recommendation is to broaden HMC membership and duties. Expansion of HMC membership should include Council of Churches, DOE, and UHC. Study recommendations can help build resilience to a range of natural disasters, in addition to tsunamis, and it is assumed that the HMC will implement, and develop new recommendations, with a wider purview. In several cases, agency specific Standard Operating Procedures (SOPs), defining agency emergency response plans, do not align with NRF ESFs creating gaps and overlaps in agency responses to emergency situations. It is critical that agencies with similar response roles coordinate on the development of SOPs so that facilities, equipment, personnel, procedures, and communications teams operate within a common organizational structure. Currently, EOC operations do not follow the National Incident Management System (NIMS) Incident Command System (ICS) format; this situation can result in the loss of critical decision-making time in executing the response. Agency-specific Incident Management Teams (IMTs) currently operate from “local readiness centers”. Coordination at the EOC (including action orders and assistance requests) is handled by agency representatives/liaisons that communicate with IMT personnel at readiness centers. Ideally, the EOC should be set up to facilitate Command, Operations, Planning, Logistics, and Finance/Administration activities. Coordinating these functions through the EOC helps streamline activities and assistance requests and helps outside organizations allocate funds and reimbursements. An assessment of how best to align agency response and EOC activities is needed to ensure that emergency situations are managed in the most effective and efficient manner.

Top priorities in this focus topic address the need to adequately document, practice, revise, and share information to foster awareness and the preparation of related material. (Table 4.5) Recommendations 1.5 and 1.6 are included as general considerations to be applied in all areas, and are not meant as an assumption that such practices do not exist. 1.5 speaks to the benefit of having established recording and reporting frameworks, in all sectors, to track progress and establish resource bases for interagency coordination. 1.6 promotes the goals of and is fostered by 1.5 in that ideal reporting and exchanging of information will contribute to more efficient and effortless coordination of capital improvement projects that may receive outside funding during disaster recovery.

Table 4.5 – Information Management Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
1.1 - Sustaining Resilience Efforts	Adopt formal policy to increase diversity of membership and scope/responsibilities of the existing HMC to coordinate the implementation of recommendations made in the report, monitor progress, ensure accountability of participating organizations, and update the implementation program.	Top	< $50K (R)	1st Yr	Policy
		Participating AS Organizations: Governor Participating Outside Organizations: NA			
1.2 - EOP Reporting	Adopt formal policy requiring Governor designated HMC representative to report plan and training status to the Fono annually to increase public awareness, help the coordinator gain traction in bringing accountability to other agencies responsible for developing SOPs that align with FEMA's ESFs, contribute to information sharing, and help identify needed EOP training/practicing.	Top	< $50K (R)	1st Yr	Policy
		Participating AS Organizations: Governor Participating Outside Organizations: NA			
1.3 - Public Awareness	Compile disaster management related documents on centralized website—and periodically update—to assist in coordinating resilience building efforts and aid information sharing between agencies.	Top	< $50K (R)	1st Yr	Plan/ Proj
		Participating AS Organizations: Governor, HMC Participating Outside Organizations: NA			
1.4 - Critical Infrastructure	Continue to expand critical infrastructure database; inventory and manage critical infrastructure (e.g. CI-ACAMs) to encourage effective management and hardening/relocation as needed.	Top	≤ $400K (R)	1st Yr	Plan/ Proj
		Participating AS Organizations: ASPA, ASTCA, ASDHS/ TEMCO, DOE, DOH, DPA, DPW, Governor, LBJ, OSA Participating Outside Organizations: DHS, DHSS, NWS-WSO, USACE			
1.5 - Accountability	Assess recordkeeping, tracking, and reporting policy enforcement and revise process as needed.	High	≤ $400K	< 5 Yrs	Policy
		Participating AS Organizations: All Participating Outside Organizations: DOI-OIA, UH			
1.6 - Capital Improvements	Coordinate capital improvement projects and funding to maximize allocations.	High	< $50K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: HMC Participating Outside Organizations: NA			

4.5.2 Emergency Planning

Pre-event preparedness and action plans that contribute to resilience by providing coordinated response and recovery protocol are critical to disaster management and should be developed in all sectors. Given the proximity to the Tonga Trench, the potential source of local tsunamis, and the limited amount of reaction time when a local tsunami occurs, it is critical that evacuation plans are well developed and practiced on both institutional and individual levels. Evacuation planning should identify the most direct route to safety and ensure impediments to evacuation do not exist, particularly for special needs individuals including very young children, elderly, and disabled. Other critical planning areas include warning dissemination, law enforcement, medical response, search and rescue, clearing critical roadways and ports, emergency transportation alternatives, receiving and distributing resources, mass care and sheltering, siting emergency functions, clean-up, and redevelopment of homes, businesses and institutions.

Volunteer groups of residents can make remarkable contributions to these efforts when adequately planned for and trained. Resilience is most significantly built from the community level and the preparedness of each individual contributes greatly to the efforts of each organization involved in response and recovery. Many ongoing efforts to build village preparedness are underway (e.g. NOAA/UH DURP capacity building initiative, NOAA Community Resilience toward Climate Change Impacts, NDPTC training, and NOAA TsunamiReady program) and should continue to be promoted wholeheartedly.

All plans developed need to be documented, shared with related parties, practiced with after-action reports, and revised as needed with an established frequency dependent on plan type and determined need. It may be important to share developed plans with other organizations—beyond those immediately related, in order to provide models of plan content and layout. By using existing models, other organizations will be able to develop plans more efficiently. The ability of agencies to respond most effectively is influenced by the extent to which these SOPs are coordinated with related agencies and the extent to which the SOPs align with Federal ESFs. Two noteworthy examples of agency specific SOPs include those developed by DHSS, DOH and LBJ under the UHC to address ESF 8 (Public Health & Medical Services) and those being pursued by the American Samoa Petroleum Cooperative, the Territorial Energy Office and ASPA to address ESF 12 (energy). ASCJ has well defined SOPs and valuable response resources and should be considered for inclusion in the TEOP as an emergency responder. Study recommendations related to emergency planning are shown in Table 4.6.

Table 4.6 – Emergency Planning Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
2.1 – Village Preparedness	Continue to work through OSA and village leadership (Matai and Pulenuu) to encourage the development of comprehensive tsunami preparedness plans and response practices in all vulnerable villages; support ongoing efforts of UH DURP capacity building, NDPTC training, and NOAA TsunamiReady programs.	Top	< $50K (R)	1st Yr	Plan
		Participating AS Organizations: OSA, ASDHS/TEMCO Participating Outside Organizations: FEMA, NDPTC, NOAA, UH,			
2.2 - Evacuation Plan Awareness	Include the development of informational bulletins for at risk villages (multilingual) in ongoing outreach; provide evacuation plans on a centralized website and make critical information publically available (e.g. in phone books).	Top	< $50K (R)	1st Yr	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DOC, OSA Participating Outside Organizations: FEMA, NWS-WSO			
2.3 - Evacuation of Commercial Enterprises	Establish formal policy requiring evacuation plan development and outreach at vulnerable commercial enterprises (e.g. canneries, hotels, and major commercial centers).	Top	< $50K (R)	1st Yr	Policy
		Participating AS Organizations: ASDHS/TEMCO, ASVB Participating Outside Organizations: COC			
2.4 – EOC Operations and SOPs	Conduct a FEMA supported assessment to identify how best to align agency SOPs with NRF ESFs and correlating EOC activities with the NIMS ICS framework.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO Participating Outside Organizations: FEMA			
2.5 - Redevelopment	Develop plans for post-disaster redevelopment strategies to address protocol and siting for emergency and replacement housing, critical infrastructure/ facility redevelopment; assess standard replacement housing design.	High	< $50K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOC, DPW, OSA Participating Outside Organizations: FEMA, UH			
2.6 - Medical Services	Continue to identify risks and response protocol for emergency medical services in the event that outside assistance is unavailable or delayed in reaching American Samoa after a disaster event.	High	< $50K	< 5 Yrs	Study
		Participating AS Organizations: UHC-LBJ Participating Outside Organizations: ASVOAD			
2.7 - Port Contingency	Identify protocols for emergency response if the airport/harbor is heavily damaged and document contingency plans in the TEOP.	High	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: DPA, DPW, ASDHS/TEMCO Participating Outside Organizations: FEMA			
2.8 - Special Needs	Continue planning for chronic health needs/supplies in disaster management planning.	High	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: DOH, LBJ, OPAD, OSA Participating Outside Organizations: NA			
2.9 - Special Needs	Continue to identify limited mobility populations and coordinate outreach for evacuation planning.	High	< $50K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: OPAD, OSA, ASDHS/TEMCO Participating Outside Organizations: NA			
2.10 - School Drills	Continue monitoring school evacuation planning and drills; ensure that drills happen regularly and that routes are safe.	High	< $50K	< 5 Yrs	Policy
		Participating AS Organizations: ASDHS/TEMCO, DOE Participating Outside Organizations: NA			
2.11 - Medical Services	Continue to develop and coordinate EMS response planning as the system transitions from DOH to LBJ Tropical Medical Center.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: UHC-DOH/LBJ Participating Outside Organizations: NA			

4.5.3 Land Use & Structural Design

Recommendations in this section focus on how the physical locations, materials and design, and modifications of structures or natural elements can contribute to tsunami resilience. The study identified many critical facilities located in tsunami hazard zones, including the hospital, schools, power supply and communication facilities, and shelters. Relocation of all critical facilities to less hazardous locations is not be practical in all cases, but assessments of these facilities, and possible relocation areas or needed structural modifications, can provide documentation and guidance for addressing these concerns in the short term and may assist response and recovery efforts in the event of future disasters. Mapping areas and pursuing agreements with Matai and landowners could help establish possibilities and plans for relocations. Such assessments can contribute to long range land use planning and management in making determinations on where future development should occur and where emergency uses can be located.

Schools are a particular concern for many reasons, most immediately, large numbers of children may be in school when a tsunami hits (48% of population is 19 years old or under, 2000 Census) and schools, in many cases, serve as emergency shelters. If kids are safe, there may be fewer cars on the road and phone calls made during tsunami response. The EOC is located in a tsunami evacuation zone and personnel have to evacuate and operate remotely during tsunami warnings. Communications and operations are compromised. LBJ Tropical Medical Center is also located in a tsunami evacuation zone. Patient evacuation is troublesome and can further endanger critical care patients.

Tsunami modeling, and the data gathered through such modeling, is a vital component of implementing top priority recommendations made by the Tsunami Advisory Committee to safeguard life and property. The American Samoa Government is in the process of acquiring detailed topographic and bathymetric data (referred to as LiDAR[1]) to base the tsunami modeling on (in addition to using it for a range of other important planning purposes). Through the Governor's LiDAR Consortium, ASG has essentially acquired the topographic data and is now in the process of raising funds to acquire the bathymetric data. Securing funding for bathymetric LiDAR is a priority near-term task.

The 13 recommendations made for the Land Use & Structural Design focus topic are shown in Table 4.7.

[1] Light Detection And Ranging, a remote sensing technology that provides accurate measurements of the earth's surface.

Table 4.7 – Land Use & Structural Design Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
3.1 - Tsunami Modeling	Conduct a tsunami inundation modeling study to determine inundation extents for several high magnitude tsunami scenarios.	Top	> $400K	1st Yr	Study
		Participating AS Organizations: ASDHS/TEMCO, DOC Participating Outside Organizations: FEMA, NOAA, USGS, UH, USACE			
3.2 - Relocations	Prepare critical facility assessment (including school and church shelters, Tafuna EOC and hospital) to identify tsunami vulnerability, suitable locations for facility relocation (if indicated and feasible), and recommendations for structural modifications where relocation is not feasible.	Top	≤ $400K	1st Yr	Study
		Participating AS Organizations: ASPA, ASTCA, DOC, DOE, DOH, DPA, DPW, EAC, LBJ, OSA, ASDHS/TEMCO Participating Outside Organizations: DOE, DOI-OIA, FEMA, NOAA, NWS-WSO, UH, USACE			
3.3 - Building Techniques	Develop a structural modification guidebook for coastal homes in American Samoa and provide outreach to homeowners and builders.	Top	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DPW Participating Outside Organizations: NOAA, UH, USACE			
3.4 - Building Regulations	Increase coordination between DOC and DPW to standardize permitting more effectively in the coastal zone and require resilient construction methods; increase education and outreach on more resilient building techniques.	High	< $50K	< 5 Yrs	Policy & Plan
		Participating AS Organizations: DOC, DPW, OSA Participating Outside Organizations: NA			
3.5 – Replacement Housing	Develop design guidelines and siting criteria for permanent replacement housing.	High	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: DOC, DPW Participating Outside Organizations: NOAA, UH, USACE			
3.6 - Shore Protection	Conduct a study to identify where shoreline hardening could build resilience to tsunami hazards, with special attention to critical facilities and infrastructure, and make recommendations for improvements.	High	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: ASPA, ASTCA, ASVB, DPA, DPW Participating Outside Organizations: DHS, USACE			
3.7 - Long Range Land Use	Develop long range land use plans addressing the future economy, population growth and natural resources to help guide future development away from tsunami hazard areas.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOC, OSA Participating Outside Organizations: COC			
3.8 - Hospital Modification	Identify costs for structural modification or vertical evacuation possibilities at LBJ Tropical Medical Center.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOH, Governor, LBJ Participating Outside Organizations: DHSS, FEMA			
3.9 - Tsunami Loss	Conduct a tsunami loss estimation study to estimate the cost of home and business losses and potential economic impacts.	Med	< $50K	< 5 Yrs	Study
		Participating AS Organizations: ASDHS/TEMCO, DOC Participating Outside Organizations: FEMA, NOAA, UH			

Focus	Recommendation	Priority	Cost	Timeline	Type
3.10 - Natural Resource Education	Increase public outreach on the value of mangroves (supporting coastal resources, lessen coastal flooding impacts, preventing tsunamis from pulling bulky hazardous debris to reefs) to prevent the clearing of this resource in the few areas where it exists.	Med	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: DOC, OSA Participating Outside Organizations: NOAA			
3.11 – Aquifer Vulnerability	Conduct an assessment to determine the vulnerability of aquifers in American Samoa to tsunami inundation.	Med	< $50K	< 5 Yrs	Study
		Participating AS Organizations: ASDHS/TEMCO, DOC Participating Outside Organizations: NOAA			
3.12 - Flood Mapping	Update FEMA FIRMs for American Samoa based on run-ups and inundation depth determined by tsunami inundation modeling (and determine established floodways based on riverine flooding).	Med	< $50K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOC Participating Outside Organizations: FEMA			
3.13 - Land Use Management	Conduct a feasibility study to identify applicable land use management tools including the identification of incentives for developing in low risk/ low impact areas of the islands.	Low	> $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOC, Governor Participating Outside Organizations: NOAA			
3.14 - Nutrient Pollution	Continue piggery/livestock outreach, inspections, and funding for structural upgrades to reduce nutrient loading in ground and stream water that can result from tsunami inundation or storm runoff/flooding.	Low	< $50K (R)	< 5 Yrs	Study
		Participating AS Organizations: ASEPA, DOC Participating Outside Organizations: USACE			

4.5.4 Utilities

Vulnerabilities in existing utilities reportedly caused problems during the 2009 SPT including radio, telecommunications, power, and airport VHF Omni-directional Radio and Tactical Air Navigation system and runway lights. Waste water systems in coastal plains that utilize cesspools can spillover when flooding occurs as with tsunami inundation. Potable water systems can be overwhelmed or ruptured and ground water source can be contaminated if adequate hardening of waste water systems if adequate hardening is not provided.

New SOPs regarding fuel and energy are being developed through the collaboration of the American Samoa Petroleum Cooperative, the Territorial Energy Office and ASPA. The SOPs developed will be incorporated into the TEOP and are intended to align with Federal response protocol defined in ESF 12 which will allow assisting outside organizations to more easily integrate with local efforts during response. This effort provides an ideal example of local and Federal agency coordination.

Recommendations identified in Table 4.8 address concerns related to Utilities.

Table 4.8 – Recommendations Related to Utilities

Focus	Recommendation	Priority	Cost	Timeline	Type
4.1 - Radio	Prepare radio coverage analysis/map to identify areas where warning communication improvements are needed; make recommendations for radio transmission upgrades to ensure that all villages clearly receive emergency messages; ensure key officials and village leaders have NOAA Weather Radios.	Top	≤ $400K	1st Yr	Study
		Participating AS Organizations: DOC, OSA, ASDHS/TEMCO Participating Outside Organizations: FCC, FEMA, NOAA, NWS-WSO			
4.2 - Telecom-munications	Enhance telecommunications capacity to be able to handle a higher call volume and continue grounding of telephone lines so lines are not disabled by the force of tsunami inundation.	High	> $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASTCA, Blue Sky Communications Participating Outside Organizations: NA			
4.3 - Power	Develop additional renewable backup power sources, especially on the Manu'a Islands.	High	> $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: AS Petroleum Cooperative, Territorial Energy Office, ASPA Participating Outside Organizations: NA			
4.4 - Airport	Upgrade airport utilities (e.g. runway lights and navigation systems) to be able to withstand tsunami inundation without losing function.	High	> $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DPA, DPW Participating Outside Organizations: FAA, FEMA			
4.5 - Emergency Alert System	Continue developing wireless emergency alert systems including text messaging and social media.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASTCA, ASDHS/TEMCO Participating Outside Organizations: FEMA			
4.6 - Wastewater	Continue inspection of water and wastewater systems, identify, and improve/harden infrastructure to reduce breakage potential and bacterial groundwater, stream, and ocean pollution when flooding (such as tsunami inundation) occurs.	Med	> $400K	< 10 Yrs	Plan/ Proj
		Participating AS Organizations: ASEPA, ASPA, DOH, DPW Participating Outside Organizations: NA			

4.5.5 Response Capacity

Responding to disaster situations, in the most effective and efficient way, requires well-coordinated actions. Documented protocol and agreements between assisting agencies brings clarity to the challenges of disaster response. Having facilities in place that are able to handle tsunami events (e.g., intensive care facilities, pedestrian and vehicular evacuation routes), pursuing training and education outreach so people are aware of risks and have instilled knowledge of what to do, and testing systems that will be needed in an emergency, all contribute to response capacity. New SOPs developed by the UHC (DHSS, DOH and LBJ) align with ESF 8 and exemplify local/Federal coordination.

It is noted that ASCJ funds village police and other response related individuals throughout the territory that could be of assistance during and after a tsunami event. It is important that ASCJ resources be utilized during emergency response. DPS and ASCJ should coordinate on response roles and responsibilities to fully utilize these resources.

Recommendations made for the Response Capacity focus topic are provided in Table 4.9.

Table 4.9 – Response Capacity Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
5.1 - Programmatic Agreements	Develop programmatic agreements between Federal agencies (such as OIA, NPS, NOAA, DOD, DOT, and FAA) and ASDHS/TEMCO to establish emergency response roles to more effectively utilize available on-island resources during disaster response.	Top	< $50K	1st Yr	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO Participating Outside Organizations: OIA, NPS, NOAA, DOD, DOT, and FAA			
5.2 - Clinic Expansion	Expand the facilities/services and utilization of medical clinics in outlying areas; increase emergency responder training and the clinic roles in emergency response to reduce dependence on LBJ Tropical Medical Center and provide outreach to raise awareness of services.	Top	> $400K (R)	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: UHC-DOH/ LBJ Participating Outside Organizations: DHSS, NDPTC, FEMA			
5.3 - Programmatic Agreement	Develop programmatic agreements with local businesses for emergency supply unloading at, and delivery from, the airport (and harbor if needed).	High	< $50K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DPA Participating Outside Organizations: NA			
5.4 - Evac Route Maintenance	Continue to map and inventory evacuation routes, continue to develop new routes where needed, and assign maintenance responsibility.	High	< $50K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DOC, DPW, OSA Participating Outside Organizations: NPS			
5.5 - Traffic Study	Conduct a traffic study to assess major thoroughfare capacity for day and night evacuation scenarios; identify areas where roadway improvements are justified.	High	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: ASDHS/TEMCO, DOC, DPW Participating Outside Organizations: FEMA			
5.6 - Response Capacity Training	Continue to support village-based emergency response training programs such as Community Emergency Response Teams (CERT), Citizen Corps, National Disaster Preparedness Training Program (NDPTC) aumaga training, TsunamiReady, and NOAA/ DURP Capacity Building for Village Resilience.	High	< $50K (R)	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOH, LBJ, OSA, ASDHS/TEMCO Participating Outside Organizations: FEMA, NDPTC			
5.7 - Evacuation Routes, Maps, Signage	Continue to improve upland pedestrian evacuation routes, mapping, and signage (route, safezone, assembly area).	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DOC, DPW, OSA Participating Outside Organizations: FEMA, NPS			
5.8 - Risk Education	Continue existing DOE tsunami risk and response education program.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DOE, Governor Participating Outside Organizations: DOE, FEMA			

5.9 - Warning Communications	Continue to test and refine warning systems with the Pacific Tsunami Warning Center and local authorities.	High	< $50K (R)	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO Participating Outside Organizations: NOAA			
5.10 - Facilities at Major Assembly Areas	Extend municipal water lines for potable water to and build restrooms at major assembly areas so that facilities are available when the assembly areas are used for extended evacuation; consider rain catchment cisterns to supply water to bathroom facilities as assembly areas.	Low	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DOE, DOH, DPW Participating Outside Organizations: FEMA			

4.5.6 Economy

Economy and relative quality of life are criteria upon which a community's level of recovery is measured after a disaster; the goal of a resilient community is to be able to recover quickly. Because of the direct relationship between economy and social well-being, society and economy serve as an essential element of resilience. The link between economics and tsunami hazards may seem to be vague, but a diverse and robust economy fosters rapid recovery after natural disasters, including tsunami. It is also recognized that a resilient economy can only be achieved with a healthy natural resource base. Coastal zone resources such as the reefs, beaches, and coastal strand are vital to brunt the force of tsunami waves, as well as provide recreational amenities and food sustenance. Protecting or enhancing the health of natural resources in American Samoa, from the mountains to the sea, will help sustain vital components of the local food supply and economy. It is also critical to assess their economic value and how the loss of these resources can play a crucial role in sustaining society and economy. The loss of these resources is often undervalued and not well documented during natural disaster events.

The following recommendations are presented with respect to the importance of coordinating efforts between the Territorial Government and village leadership to advance economic strategies and development. The recommendations also address the TAC's concerns over the impediments existing basic infrastructure may present to technological and economic progress. The recommendations build from viable economic opportunities already identified for American Samoan given its resources and its present and past economic situation. Economy related recommendations are provided in Table 4.10. It is noted that broad Federal economic policy for insular area economic development is needed.

Table 4.10 – Economy Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
6.1 - Comprehensive Plan	Consolidate existing economic plans into a comprehensive economic development strategy, overseen by the Governor's Office; incorporate broad scale public outreach/participation at the village level to build public support; must include attention to the economic value of natural resources and the importance of the health of natural systems in maintaining fishery resources.	Top	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: DOC, EAC Participating Outside Organizations: COC, UH			
6.2 - Public Infrastructure	Identify opportunities to raise revenue for the development and maintenance of basic infrastructure to support economic development and enhance resilience.	High	≤ $400K	< 5 Yrs	Study
		Participating AS Organizations: ASPA, ASTCA, DOC, DOE, EAC, OSA Participating Outside Organizations: COC, UH			
6.3 - Tourism	Continue to build economic resiliency through tourism expansion and environmental resource management; allocate public funding for ASVB.	High	≤ $400K (R)	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASVB, DOC, EAC, Governor Participating Outside Organizations: COC			
6.4 - Natural Resource Valuation	Identify natural resources of interest/importance across watersheds to the extent of the coral reefs and analyze their ecosystem services. Undertake an economic valuation of these resources and assess implications of their potential loss from natural hazards.	High	> $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASEPA, DOC Participating Outside Organizations: NOAA			
6.5 - Community Goals	Develop community plans that evaluate informal economy and economic aspirations at village level; define goals for future economic development, sustainability and resilience; engage Matai as major stakeholders and incorporate public outreach and participation.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASCC, ASVB, DOC, EAC, OSA Participating Outside Organizations: NOAA, USDA, COC, UH			
6.6 - Agriculture and Fishing Outreach	Undertake market analysis for opportunities in commercial agriculture and fishing sectors; provide outreach programs for agriculture and fishery related businesses.	High	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASCC, DOC/DMWR Participating Outside Organizations: NOAA, USDA			
6.7 - Job Training/ Development	Continue to identify job training needed for local job creation in AS and develop vocational and technical training programs.	High	≤ $400K (R)	< 5 Yrs	Study
		Participating AS Organizations: ASCC, ASVB, DOE, EAC Participating Outside Organizations: DOE, COC			
6.8 - Economic Stimulation	Continue to evaluate incentives to stimulate economic development and diversification.	High	≤ $400K (R)	< 5 Yrs	Policy
		Participating AS Organizations: DOC, EAC Participating Outside Organizations: DOI-OIA, COC			
6.9 - Recovery Fund	Strengthen the existing disaster contingency fund (under American Samoa Code Annotated Title 26 Section 26.0107) to provide more meaningful assistance, improve awareness of this fund, and establish guidelines for use and accountability based on review of best practices.	Med	> $400K (R)	< 10 Yrs	Policy
		Participating AS Organizations: ASDHS/TEMCO, Governor Participating Outside Organizations: NA			

4.5.7 Health Services

Loss of human life, injury and psychological trauma from tsunami and other natural disasters are some of the most devastating and longest lasting impacts of natural disasters. The ability to rapidly respond to life-threatening tsunami can minimize the impacts, and recommendations for related efforts are covered under the Response Capacity and Emergency Planning topics. Health services provide counseling to help heal emotional wounds and build-up affected communities. Provisions of the services by trained experts and outreach to raise awareness of such services are critical to recovery. The recommendation to continue building these resources is addressed in Table 4.11.

Table 4.11 – Health Services Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
7.1 - Counseling/ Outreach	Support a comprehensive, coordinated and cohesive mental health infrastructure which includes continued efforts to bolster post-disaster counseling services, training and outreach on available health resources.	Top	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: UHC-DHSS Participating Outside Organizations: NDPTC, UH			

4.5.8 Clean-up

Clean-up immediately after a tsunami, or other natural disaster, is necessary to open up transportation routes and ports, and to remove hazardous material and other threats to health and human safety and begin the recovery process. Lessons learned after the 2009 SPT include the need to document damage prior to clean-up and clean-up efforts, as well as the need to establish formal agreements for responsibilities pre-event. Damage and debris after the tsunami was substantial, both on land and in the ocean. It was recognized that much of the marine debris generated by the tsunami was household waste that was not disposed of in a waste treatment facility. The accumulation of household debris on the coral reefs has affected subsistence fishing and the tourism industry. This topic illustrates how one generalized situation impacts an unrelated facet of resilience and impacts on the speed of disaster recovery. Recommendations in Table 4.12 address clean-up.

Table 4.12 – Clean-up Recommendations

Focus	Recommendation	Priority	Cost	Timeline	Type
8.1 - Refuse	Improve trash/bulky item pickup services to reduce the amount of debris pulled into streams, shorelines, and reefs by tsunami, strong storms, or other natural disasters (e.g, hurricanes).	High	≤ $400K (R)	< 5 Yrs	Policy & Proj
		Participating AS Organizations: ASPA Participating Outside Organizations: NA			
8.2 - Reef/Marine Debris	Develop programmatic agreements between local agencies involved in reef clean-up/marine debris removal and local businesses; establish clear protocol for documenting damage assessment and coordination of efforts following disasters.	High	< $50K	< 5 Yrs	Policy
		Participating AS Organizations: ASDHS/TEMCO, ASEPA, DOC, DPW, Governor Participating Outside Organizations: NDPTC, NPS, NOAA			
8.3 - Critical Facilities and Roads	Develop programmatic agreements between local agencies and business for debris clean-up at critical facilities and roads; establish clear protocol for effort coordination and documenting damage assessments before clean-up.	High	< $50K	< 5 Yrs	Policy
		Participating AS Organizations: ASPA, ASTCA, DOE, DOH, DPA, DPW, LBJ, Governor, ASDHS/TEMCO Participating Outside Organizations: DOE, NDPTC, USGS			
8.4 - CZM	Identify highly-ranked ecological sites (possessing important natural resources) and those natural areas important to tourism for Pre-event protection measures and priority clean-up for disaster response and recovery.	Med	< $50K	< 5 Yrs	Policy
		Participating AS Organizations: DOC/DMWR Participating Outside Organizations: NPS, NOAA			
8.5 - Equipment	Identify and store heavy machinery, needed for clean-up, outside of tsunami hazard areas, but accessible for immediate response.	Med	≤ $400K	< 5 Yrs	Plan/ Proj
		Participating AS Organizations: ASDHS/TEMCO, DPA, DPW Participating Outside Organizations: NPS			

Chapter 5

Conclusion

Tsunami Advisory Committee during TAC meetings #2, #3, and #4
(EA/HHF, 2011-2012)

5. Conclusion

The American Samoa Tsunami Study provides a comprehensive overview of key considerations relevant to building coastal community resilience in American Samoa and importantly, a comprehensive set of recommendations that will strengthen American Samoa's ability to prepare for, protect against, respond to, and recover from tsunami hazards.

As part of the study, a resource compendium was compiled comprising American Samoa resilience related documents, outside studies, 2009 SPT data, as well as work products and briefings created for the study. The compendium is available on a public website (hosted by the American Samoa government at the conclusion of the study) for community leaders and citizens to use for ongoing efforts at building community resilience. At the conclusion of the study, there were a total of 378 documents on the website, 79 of which contribute directly to community resilience building and 53 which are directly tied to American Samoa. It is hoped that this compendium will serve as an active resource for community resilience building; that it will inform future studies; and that it will be built upon and maintained to best suit the vision and growth of resiliency within the American Samoan community.

This report provides a comprehensive overview of key tsunami resilience considerations and serves as a resource to help agencies and organizations undertaking natural hazard management throughout the Territory launch further efforts.

The American Samoa-based, Governor-appointed advisory committee, the TAC, was formed to guide and inform the study and recommendations developed from focused research into coastal community resilience. TAC membership included representatives from the Governor's Cabinet, departmental officials, the Fono, and business and non-profit sectors. It was strongly supported with local federal representatives of the U.S. Department of Interior and the National Oceanic and Atmospheric Administration. The study team felt that the TAC members, most who had recently experienced the 2009 tsunami and its aftereffects as community members and community leaders, would be in the best position to guide and provide expertise on the study. The TAC and on-island federal representatives provided invaluable input and support to the study team. Through three TAC workshops, recommendations were fine-tuned to best reflect the specific resources, needs and limitations of American Samoa. Key guiding principles were identified to provide a framework for implementing these recommendations (e.g., a sense of urgency, realities of the territory's geographic and economic isolation, cultural appropriateness, blending of tradition and technology, and an overarching commitment to process improvement). The recommendations are comprehensive, prioritized by order of importance and include needed studies, policies, and projects, general cost estimates and lead agency implementation responsibilities.

Recommendations developed over the course of the study were aligned with the facets of resilience defined for this study: 1. the capacity to withstand the event, 2. the ability to rebound from impacts, and 3. the means to learn from the event. Top priority recommendations comprise actions that are recommended to be undertaken within the first year following the conclusion of the study.

Fully implementing these initiatives, and additional recommendations outlined in the report, requires a comprehensive and programmatic approach, involving strong leadership and commitment at the Territorial and Village level, over a sustained period of time. The study proposed that the HMC be expanded to assume the responsibility for overseeing, assessing and revisiting the recommendations on an annual basis. The productive working relationships forged with Federal

agencies, both on-island and through PRiMO, through the development of the study will be critical to the success of implementing the recommendations.

The recommendations made in Chapter 4 of this report represent a starting point for and build off of strong ongoing community resilience initiatives. This momentum will be lost if not sustained by an ongoing planning process that provides opportunities to test new approaches and technologies, engages new stakeholders and, of course, learns and improves. As outlined in recommendation 1.1, through an Executive Order or via Executive level support, the ASG should expand the HMC, broaden HMC responsibilities, and annually review, revise, reprioritize, and implement the recommendations from this report.

This study also acknowledges the significant efforts American Samoa, led by Governor Togiola Tulafono, is already undertaking toward creating a tsunami resilient community. Recognition must be given to tsunami hazard mitigation practices that are well developed or underway in American Samoa, including a wide range of efforts such as emergency and evacuation planning and drills, risk awareness outreach, alert and communication system enhancements, floodplain management, evolving construction standards, shore protection, first responder training, and village capacity building efforts. Study recommendations present ways to bolster existing resilience building efforts, within the context of geographic and economic constraints unique to American Samoa.