SOPAC Member Countries National Capacity Assessments:

Tsunami Warning and Mitigation Systems

Samoa

Samoa

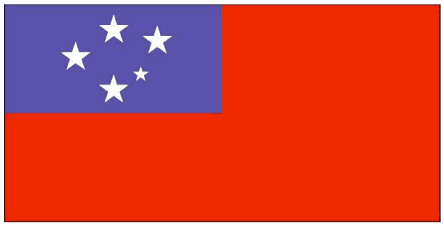
AUSTRALIA

SOPAC

SOPAC Member Countries National Capacity Assessments: Tsunami Warning and Mitigation Systems

SAMOA

Apia, 28 April – 1 May 2008



Australian Government
AusAID

Australian Government
Bureau of Meteorology

Australian Government
Attorney-General's Department

SOPAC

Document Control

Approved for release:	Branch Head, Weather Services Branch, Australian Bureau of Meteorology	Date: 7 July 2009
Corrections & comments:	Cherie O'Brien Project Manager - SOPAC Member Countries Tsunami Capacity Assessments Australian Bureau of Meteorology GPO Box 1289 Melbourne VIC 3001 E-mail: c.o'brien@bom.gov.au Phone: +61 (3) 9669 4065 Fax: +61 (3) 9669 4695	
Distribution:	Samoa Tsunami Capacity Assessment Workshop Participants, Australian Bureau of Meteorology, AGD, AusAID, SOPAC, Disaster Risk Management Partnership Network, UNESCO/IOC, GA	

Version	Date	Author	Comments
0.1	16 April 2009	C. O'Brien	Initial Draft, including comments from Filomena Nelson in Table 1 and review of recommendations
0.2	27-29 April 2009	C. O'Brien	Inclusion of team review comments: • Prue Harley (AGD) • Garry Clarke (Data Comms Expert) • Andrew Gissing (State Emergency Services) • Rob Webb (Bureau) • Bryan Boase (Bureau)
0.3	12 May 2009	C. O'Brien	Formatting and inclusion of review comments from: • Filomena Nelson (NDMO, Samoa) • Michael Bonte-Grapentin (SOPAC)
0.3	17 July 2009	C. O'Brien	SOPAC sign-off. No changes.

For bibliographic purposes, this document should be cited as follows:

Australian Government Bureau of Meteorology 2009, *SOPAC Member Countries National Capacity Assessment: Tsunami Warning and Mitigation Systems, Samoa, Apia, 28 April – 1 May 2008,* research report prepared by C. O'Brien, Australian Government Bureau of Meteorology, Melbourne.

Acknowledgements:

The Bureau of Meteorology wishes to acknowledge the contribution of all those who participated in the assessment workshop, particularly those who made their time available to help organise the workshop and to deliver presentations. The Bureau also acknowledges the efforts of the Visiting Assessment Team and continued support from partners AGD and SOPAC and funding body AusAID as well as UNESCO/IOC, the WMO and ISDR for their input into the original questionnaire on which the project was based.

Bureau of Meteorology (ABN 92 637 533 532)
700 Collins St Melbourne
Phone 03 9669 4000 • Fax 03 9669 4695

(Printed on paper of 50% post consumer waste and 50% FSC certified fibre)

Table of Contents

Acronyms

AFTN	Aeronautical Fixed Telecommunication Network
AGD	Australian Attorney-General's Department
AM	Amplitude Modulated
ATWS	Australian Tsunami Warning System
AusAID	Australian Agency for International Development
Bureau	Australian Bureau of Meteorology Bureau
CEO	Chief Executive Officer
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
D	Document (e.g. Document 39 = D39)
DAC	Disaster Advisory Committee
DFAT	Australian Department of Foreign Affairs and Trade
DMO	Disaster Management Office
EMA	Emergency Management Australia
EMWIN	Emergency Managers Weather Information Network
FM	Frequency Modulated
GA	Geoscience Australia
GDP	Gross Domestic Product
GIS	Geographic Information System
GSN	Global Seismic Network
GTS	Global Telecommunications System
HF	High Frequency
ICG	Intergovernmental Coordination Group
IMS	International Monitoring Station
IOC	Intergovernmental Oceanographic Commission
IPES	Institution of Professional Engineers of Samoa
IPsec	Secure Internet Protocol
ISCS	International Satellite Communications System)
ISDR	International Strategy for Disaster Reduction
ITIC	International Tsunami Information Centre
ITSU	ICG for the Tsunami Warning System in the Pacific
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
LiDAR	Light Detection and Ranging
MMI	Modified Mercalli Intensity Scale
MNRE	Ministry of Natural Resources and Environment
MoU	Memorandum of Understanding
Mw	Moment Magnitude
MWCSD	Ministry of Women, Community and Social Development
NDC	National Disaster Council
NDMP	National Disaster Management Plan
NEOC	National Emergency Operations Centre
NGOs	Non-Government Organisations
NLA	National Legislative Assembly
NOAA	National Oceanic and Atmospheric Administration
NZ	New Zealand
PGSP	Pacific Governance Support Programme
PICs	Pacific Island Countries
PTWC	Pacific Tsunami Warning Centre
PTWS	Pacific Tsunami Warning and Mitigation System
RANET	Radio and Internet for the Communication of Hydro-Meteorological Information for Rural Development
RTH	Regional Telecommunications Hub

Acronyms (Continued)

SLISE	Samoa Lithospheric Integrated Seismic Experiment
SMS	Short Message Service
SOPAC	Pacific Islands Applied Geoscience Commission
SOPs	Standard Operating Procedures
SPSLCMP	South Pacific Sea Level and Climate Monitoring Project
UHF	Ultra High Frequency
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
USGS	United States Geological Survey
UTC	Coordinated Universal Time
VCP	Voluntary Cooperation Program
VHF	Very High Frequency
WMO	World Meteorological Organisation

1. Results Outline

1. Results Outline

1.1. Executive Summary

The National Capacity Assessment of Pacific Islands Applied Geoscience Commission (SOPAC) Member Countries: Tsunami Warning and Mitigation Systems project aims to work in collaboration with the member countries of SOPAC to assess their capacity to receive, communicate and respond effectively to tsunami warnings. The Tsunami Capacity Assessment of the ability of the Independent State of Samoa (hereafter referred to as "Samoa") to receive, communicate and effectively respond to tsunami warnings took place in a workshop held from 28 April – 1 May 2008 in Apia, Samoa.

The workshop was facilitated by a team of visiting experts and attended by some twenty Samoa Government agency representatives, Non-Government Organisations (NGOs), regional and international organisations and the private sector to discuss key areas of tsunami warning and mitigation in Samoa by completing a comprehensive questionnaire in session, presentations and site visits.

As well as outlining Samoa's current status, strengths and opportunities for improvement with regard to tsunami warning and mitigation, a list of recommendations were formulated by the Visiting Assessment Team in consultation with national participants. The aim of these recommendations is to guide further capacity development programs to target ongoing improvements in Samoa's tsunami warning and mitigation system.

Samoa's National Tsunami Plan (2008, D5, D5.1) states that anecdotal evidence indicates a total of 60 tsunami events have been recorded in Samoa between the years 1937 and 1980. Samoa is susceptible to tsunami from local, regional and distant sources. The Tonga trench, lying to the south of Samoa, is the country's most significant regional source of potential tsunami (Thomas and Burbidge, 2009). In its National Disaster Management Plan (NDMP, 2006, D1) and National Tsunami Plan (2008, D5, D5.1), Samoa has rated tsunami, as an "extreme risk". The National Tsunami Plan (D5, D5.1) states that "the main areas at risk of a tsunami are all low-lying coastal areas of the inhabited islands of Samoa; that is areas less than 10 metres above sea level". Samoa's national response to the Tonga Trench tsunami (May 2006) and the Solomon Islands tsunami (April 2007) were reviewed during the workshop to enable the Visiting Assessment Team gain an understanding of how Samoa's system operates in a real event.

Samoa's sound tsunami warning and mitigation system currently in place is underpinned by the country's Disaster and Emergency Act (2007, D3). The Act focuses on inter-agency cooperation, community awareness and engagement by high level political officials. The Act includes provisions for disaster risk reduction and preparedness in addition to emergency response. Other strengths of Samoa's current system include:

- A responsible agency for issuing tsunami warnings operating 24/7 under a comprehensive set of Standard Operating Procedures (SOPs);
- An active and effective Disaster Advisory Committee (DAC) and Disaster Management Office (DMO) exist, reporting to the National Disaster Council (NDC);
- A strong dissemination system to the population using Digicel and SamoaTel mass SMS broadcast in the first instance to key community leaders. The media, sirens, Church and school bells, boat horns and word of mouth are then used to reach the wider community;
- Samoa conducts regular tests of their tsunami warning system and follows up with appropriate evaluation;

- Response agencies are outlined in the NDMP and agency responsibilities for emergency response are clearly defined;
- Each response agency must prepare and implement a response agency plan;
- Mitigation projects such as Coastal Infrastructure Management Plans have already been completed for villages to assist in building the resilience of Samoa's coastal communities to natural hazards; and
- Community education and capacity building is being progresses through projects such as village Disaster Risk Management workshops (otherwise known as the "Village Program") which are planned to be rolled out in Samoa's 329 villages by the end 2013.

Participants in the workshop stated a number of priority areas for improvement that need to be addressed. Recurring themes included enhancement of seismic monitoring infrastructure, more funding for public awareness and relocation of the National Emergency Operations Centre (NEOC) to a safe location. In addition to ensuring maintenance of the strong current system already in place the workshop's resulting recommendations reflected the priorities raised by workshop participants. Very high priority recommendations made include:

- Investigate the permanent relocation of critical warning and response functions within Ministry of Natural Resources and Environment (MNRE) including the DMO and NEOC to a location outside of any likely tsunami impact;
- Investigate obtaining further resources to allow the Village Program to be completed within the designated timeframes (end 2013);
- That all agencies with key roles to play in the tsunami warning system be adequately resourced to carry out their legislated functions under the Disaster and Emergency Management Act and/or the NDMP;
- Continue development and implementation of tsunami public awareness and education in a multi-hazard context;
- That an analysis be undertaken on aspects of redundancy in the total tsunami warning system; and
- Continue the development of tsunami plans for local communities including warning and evacuation procedures.

Samoa workshop participants are encouraged to use this National Tsunami Capacity Assessment report to guide both national projects and aid funded projects to achieve targeted improvements on Samoa's tsunami warning and mitigation system. In turn, this will assist in improving systems for other high priority natural hazards.

Contingent on the availability of human and financial resources, the Bureau and project partners will aim to work with potential donors to bring the findings of this project to their attention on a country and regional scale. This will be done in the hope of further capacity development projects being undertaken.

1.2. Recommendations (including priority and resource intensity)

Table 2 outlines the priority and resource intensity for recommendations made to improve Samoa's tsunami warning and mitigation system. Both the priority and resource intensity are based on the consensus of the visiting Tsunami Capacity Assessment team after discussions held within the Tsunami Capacity Assessment Workshop. It is recognised that these rankings may not reflect the opinions of all individuals involved in the workshop as priorities vary depending on personal responsibilities and areas of interest. Each recommendation is important in its own right to achieve holistic improvements in Samoa's tsunami warning and mitigation system.

The priority ranking and resource intensity scale used as a basis for allocating a priority and resource intensity to each recommendation is explained in Table 1. The Very High priority recommendations should be seriously considered as requiring urgent completion. Low resource intensity recommendations are considered the 'low-hanging fruit' that are achievable with very few additional resources.

Table 1: Priority ranking and resource intensity scale

PRIORITY	RESOURCE INTENSITY
Very High	**Low –** Recommendation currently being progressed or could possibly be progressed within the capacity of existing in-country resources (funds and staff).
High	**Medium –** Recommendation could be progressed by existing staff or with a low to moderate number of additional staff and/or expertise and a moderate level of additional in-country funds. May or may not require external funding.
Medium	**High –** Recommendation would require a high level of additional staff and/or expertise and funds. External funding support is likely to be required.
Low	**Very High –** Recommendation would require a very high level of additional staff and funds. External funding support will be required.

Table 2: Priority and anticipated resource intensity for completion of recommendations made for improving Samoa's tsunami warning and mitigation system.

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
Very High	Share the findings of this report with international and regional organisations (those based in Samoa and others) to provide guidance on targeting future capacity development programs and projects for tsunami and other hazards.	Low	Regional and International Coordination	Multi-hazard	5
Very High	Investigate obtaining further resources to allow the Village Program to be completed within the designated timeframes (end 2013). Through the Village Program, continue to collect traditional knowledge about tsunami and warning signals.	Low	Public and Stakeholder Awareness and Education	Multi-hazard	33
Very High	A back up Emergency Managers Weather Information Network (EMWIN) system be placed at the Fire Services for receipt of PTWC and other warning messages. **(Update May 2009 –** Samoa is currently in process of negotiating with National Oceanic and Atmospheric Administration (NOAA) for an additional EMWIN system expected to be located at the Fire Service).	Medium	Communications	Multi-hazard	18
Very High	Investigate the permanent relocation of critical warning and response functions within MNRE including the DMO and NEOC to a location outside of any likely tsunami impact. A strong possibility is co-location at the new Fire Service building. Also consider the safety of locations of Red Cross Disaster Relief Depots.	High	Tsunami Emergency Response (including evacuation)	Multi-hazard	22
Very High	Samoa continues to maintain and strengthen the tsunami warning system in place and that the benefits of implementation of improvements in the warning system be incorporated across all hazards where appropriate.	High	Governance and Coordination	Multi-hazard	1

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
Very High	That all agencies with key roles to play in the tsunami warning system be adequately resourced to carry out their legislated functions under the Disaster and Emergency Management Act and/or the NDMP. In particular the DMO and Meteorology Division of the MNRE should closely analyse the resource requirements to maintain their functions effectively in the long term.	High	Governance and Coordination	Multi-hazard	2
Very High	Continue development and implementation of tsunami public awareness and education in a multi-hazard context including: **a.** Establishment of tsunami signage to international standards within populated coastal areas and tourism centres, such as the airport; **b.** Education on the operation of the tsunami warning system, procedures and expected community response; **c.** Education on environmental cues associated with local tsunami; **d.** Education after a tsunami event focused on the size of the event, impacts and reinforcing tsunami safety messages; **e.** Capitalising on existing regional and international education material; **f.** Development of programs tailored to groups such as maritime and tourism; and **g.** Provision of tsunami warnings and community awareness material on a website. **(Update May 2009** – Government improvement in July 2009 will improve internet speed).	High	Public and Stakeholder Awareness and Education	Tsunami specific	32

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
Very High	That an analysis be undertaken on aspects of redundancy in the total tsunami warning system including: **a.** An efficient mechanism for informing and updating key disaster management agencies during an event; **b.** A backup process by which PTWC tsunami information arrives in the country; **c.** Regular cross checks to make sure key links in the warning chain are working; **d.** Development of a contingency plan to ensure warnings can be issued to the community should Meteorology Division staff be forced to evacuate or experience systems failure; and **e.** Backups to key power sources.	High	Tsunami Warnings	Multi-hazard	11
Very High	Continue the development of tsunami plans for local communities including warning and evacuation procedures. Preparation of these plans should include the production of evacuation maps and community consultation. When completed plans should be made available to the public and evacuation maps displayed in prominent locations within communities.	High	Tsunami Emergency Response (including evacuation)	Tsunami-specific	23
Very High	Consideration should be given to running an integrated messaging system that manages SMS, e-mail, fax and voice messaging that could be the database for all emergency contacts (including satellite phones), with the possibility of expanding this system to allow for public subscription. This system should maintain the details of active staff at all agencies their roles and operational status and be accessed by the web.	High	Communications	Multi-hazard	20

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
High	Continue to ensure regularly updated SOP documentation is made available to any person or organisation playing a part in the tsunami warning process and is shared between all agencies involved.	Low	Governance and Coordination	Tsunami-specific	3
High	To reduce community panic and maintain practiced operational systems and community awareness when there is a long time between events include in tsunami warning processes, issuing of "No threat" messages to the public and media for the following events: **a.** Tsunami that do not have the potential to threaten Samoa; and **b.** Under-sea and felt earthquakes that do not have the characteristics to generate a tsunami.	Low	Tsunami Warnings	Tsunami specific	15
High	Samoa MNRE Mapping Services Section, in collaboration with the Geophysics Section, complete an inventory of the geospatial data available for tsunami and multi-hazard hazard risk assessments, modelling and mapping of populated areas.	Low	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	28
High	Continue active participation in the Southwest Pacific Tsunami Working Group (WG5) of the Intergovernmental Coordination Group (ICG) Pacific Tsunami Warning and Mitigation System (PTWS), Regional Meteorological Service Directors meetings and the Pacific Platform for Disaster Risk Management meetings, engaging Meteorological Division of MNRE as the responsible warning authority.	Medium (External assistance required)	Regional and International Coordination	Tsunami specific	4

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
High	That Samoa investigates the development of contingency plans that allow the issue of public warnings from another country thus building on lessons learned from the Tropical Cyclone Warning System.	Medium	Tsunami Warnings	Tsunami specific	10
High	Continue to develop and conduct national tsunami exercises which test emergency management arrangements at national and community level. Ensure each exercise is followed by an evaluation of the strengths and weaknesses of the tsunami system as well as recommendations for system improvements. Ensure these recommendations are implemented and that regular tsunami exercise regimes and exercise assessment processes are included in each agencies emergency response plan.	Medium	Tsunami Emergency Response (including evacuation)	Tsunami specific	24
High	Use the tsunami hazard studies that have been completed for the Southwest Pacific Nations to date, and any historical tsunami records (including physical evidence), to identify low-lying communities which may be potentially prone to tsunami impacts from all likely tsunami sources and commence tsunami mitigation, response and evacuation planning using local knowledge.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	27
High	Gain access to scenario based deep ocean tsunami modelling to assist in both risk assessment and warning decision making. Build the capacity within Samoa (the Meteorology Division and other relevant agencies) to analyse and use this tool.	Medium to High (for training requirements)	Tsunami Warnings	Tsunami specific	13
High	Continue plans to conduct a study into the interdependencies of critical infrastructure lifelines and services and incorporate this knowledge into the disaster planning process for all hazards.	High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	31

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
High	Continue to develop the mobile radio network to assist in communicating critical information to key individuals within the warning system. **(Update May 2009 –** The DMO has requested assistance from Australian Maritime for their High Frequency (HF) radio system. A Japan International Cooperation Agency (JICA) project is assisting the Weather Service to improve its radio (audio and e-mail). New Zealand (NZ) is assisting the Fire service with more repeaters for Ultra High Frequency (UHF)).	High	Communications	Multi-hazard	17
High	Continue the establishment of Samoa's seismic network ensuring the system meets the needs of Samoa's tsunami early warning system as well as shares seismic data internationally in real-time and suitable data formats.	Very High	Tsunami Monitoring Infrastructure	Multi-hazard	7
High	Continue the establishment of a volcanic monitoring capability within Samoa and evaluate the tsunamigenic potential of Samoa's volcanos.	Very High	Tsunami Monitoring Infrastructure	Multi-hazard	8
High	That existing last mile tsunami warning communication methods are strengthened (for example, implementation of an improved siren system attached to local fire stations).	Very High	Tsunami Warnings	Tsunami specific	12
High	Acquire the necessary baseline data for populated areas to fill identified gaps as part of a multi-hazard mapping activity. This will include acquiring high resolution topography (Light Detection and Ranging (LiDAR)) data of low-lying populated areas as well as high resolution bathymetry data for multi-hazard assessments, modelling and mapping (storm surge, tsunami, climate change).	Very High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	29

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
Medium	That an analysis be undertaken of the key individuals within agencies who would benefit from the Pacific Tsunami Warning Centre (PTWC) Short Message Service (SMS) alert service and the existing service be extended to those people.	Low	Tsunami Warnings	Tsunami specific	14
Medium	Ensure all agencies with satellite phones have them permanently on and operating with fixed external antennas when phone is indoors.	Low	Communications	Multi-hazard	21
Medium	Develop a national disaster recovery plan that further outlines arrangements for recovery, including the coordination of welfare, public health and infrastructure reconstruction.	Low	Tsunami Emergency Response (including evacuation)	Multi-hazard	25
Medium	Consider how Samoa can move towards determination of different threat levels in their tsunami warnings. For example, marine only or land inundation.	Low	Tsunami Warnings	Tsunami specific	16
Medium	That the licence requirements for primary communications means on boats are changed to radio.	Medium	Communications	Multi-hazard	19
Medium	That the MNRE use remote sensing data (such as high resolution satellite images) for post disaster damage assessments.	Medium to High	Tsunami Emergency Response (including evacuation)	Multi-hazard	26
Medium	Continue to actively engage with regional and international agencies that can assist with conducting scientific research and technical capacity building to enable Samoa to fully utilise cooperative research. Develop a protocol to ensure copies of scientific research reports are received.	High	Research Expertise	Tsunami specific	6

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 5
Medium	Samoa investigates access to Pacific sea level data for tsunami warnings via the Global Telecommunications System (GTS) or Bureau Registered User Website.	High	Tsunami Monitoring Infrastructure	Tsunami specific	9
Medium	Progress discussions with SOPAC regarding inundation modelling in Apia and investigate future, long-term options for completing tsunami inundation modelling for other large population and infrastructure centres. **a.** The long term aim is to conduct a comprehensive tsunami risk assessment and management study specific to Samoa. The risk assessment and management study should: **b.** Develop a comprehensive suite of hazard maps to assist planning; **c.** Be completed using a standard template that can be used in all areas and across all hazards; **d.** Include an assessment of all possible structural and non-structural management options; **e.** Investigate the incorporation of tsunami inundation and seismic hazard in land use planning instruments, in particular for critical infrastructure; and **f.** Feed findings into Samoa's national tsunami management strategy and community education.	Very High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	30

Section

2

2. Project Background

2. Project Background

2.1. About the Project

The National Capacity Assessment of SOPAC Member Countries: Tsunami Warning and Mitigation Systems project aims to work in collaboration with the member countries of SOPAC to assess their capacity to receive, communicate and respond effectively to tsunami warnings. The Bureau is the lead implementing agency, in partnership with the Australian Attorney-General's Department (AGD), (formerly Emergency Management Australia (EMA)), SOPAC, and with the assistance of the Intergovernmental Oceanographic Commission (IOC) a division of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The project is funded by the Australian Agency for International Development (AusAID) under the Pacific Governance Support Programme (PGSP). It is implemented under an agreement (Schedule 5 to the Record of Understanding 14304, June 2006) between AusAID and the Bureau). The fourteen SOPAC member countries participating in the project are the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu.

2.2. Broad Project Aim

By undertaking an assessment of the capacity of individual nations to manage tsunami events, the project aims to better guide donor funding towards achieving targeted improvements in the tsunami warning and mitigation systems in the respective countries.

2.3. Key Project Output

The key deliverable of the project is a comprehensive set of reports, including one national report specific to each country, detailing the strengths and opportunities for improvement of the country with regard to tsunami warning and mitigation. The national report for each country also includes recommendations to address priority issues. These reports will then feed into a consolidated Regional report that will aim to identify common issues across the Region with regard to tsunami warnings and mitigation.

2.4. Project Methodology

National assessments in each SOPAC member country are conducted by visiting teams including experts in the fields of tsunami warnings, emergency management, disaster risk reduction and data and warning communications. The visiting team meets with in-country experts during four-day workshop involving government agencies, the private sector, NGOs and regional and international organisations involved in tsunami and natural disaster management.

The workshop aims to complete a questionnaire covering all aspects of tsunami warning and mitigation and gather information to support questionnaire responses. This information then feeds into the national report. Consultation with individual countries before completion of the report is an integral part of the report writing process.

The questionnaire for the Pacific Island Countries (PICs) is a modified version of that used for the Indian Ocean equivalent project. The Indian Ocean questionnaire was jointly developed by UNESCO/IOC, SOPAC, the World Meteorological Organisation (WMO) and the International Strategy for Disaster Reduction (ISDR). Details of the Indian Ocean equivalent project can be found at http://ioc3.unesco.org/indotsunami/nationalassessments.htm

2.5. Underlying Policy Objectives of the Australian Tsunami Warning System Project

The Bureau in partnership with Geoscience Australia (GA) and AGD, has recently completed a four-year project to establish the Australian Tsunami Warning System (ATWS). One of the three policy objectives of the ATWS project was "To contribute to the facilitation of tsunami warnings for the South West Pacific" (DFAT, 2006). The Tsunami Capacity Assessment project and this report, contributes to the achievement of this policy objective. Also, as part of the implementation of the ATWS, Australia has and will continue to contribute to the facilitation of more effective tsunami advisory bulletins to Pacific Island nations through the provision of seismic and sea level observations to the PTWC in Hawaii.

2.6. Tsunami warnings in the Pacific

Tsunami messages for the Pacific Ocean are issued by the PTWC in Hawaii as the United States of America (USA) contribution to the PTWS. Individual countries are then responsible for using this advice to distribute national tsunami warnings to their communities. PTWC messages can be Tsunami Warnings, Tsunami Watches, Tsunami Advisories and Tsunami Information Bulletin/Statement. For the purpose of this report, products from the PTWC will be referred to generically as 'tsunami messages'. A full definition of each PTWC product products can be found at http://www.prh.noaa.gov/ptwc/about_messages.php

2.7. International Tsunami Forums

Under the auspices of the IOC, the ICG/PTWS (formerly known as ICG for the Tsunami Warning System in the Pacific (ITSU)) was first convened in 1968 (IOC, 2009). This is an international cooperative effort involving many IOC Member States of the Pacific Region. The ICG/PTWS meets regularly to review progress and coordinate activities resulting in improvements of the service (IOC, 2009).

The Working Group on Tsunami Warning and Mitigation in the Southwest Pacific Ocean was formed at the ICG/PTWS-XXI meeting in Melbourne in early May 2006 with the aim of enhancing tsunami warning and mitigation in the Southwest Pacific Ocean. The membership of the working group is composed of representatives from IOC Member States and other countries in the region (as members and observers). SOPAC provides secretariat support. The Working Group is currently chaired by a representative of NZ, with vice-chairs from Fiji and Samoa.

The Working Group has a number of Terms of Reference and this project is directly relevant to the following Terms of Reference:

- To evaluate capabilities of countries in the Southwest Pacific Region for providing end-to-end tsunami warning and mitigation services;
- To ascertain requirements from countries in the Southwest Pacific Region for the tsunami warning and mitigation services;

- To facilitate capacity building and the sharing of tsunami information in the region;
- To support the further development of the virtual centre of expertise in a multi-hazards context within SOPAC in line with the Regional Early Warning Strategy; and
- To facilitate the inclusion of tsunami hazard and response information into curricula, and development and dissemination of education materials.

3. Country Background and the Tsunami Threat

3. Country Background and the Tsunami Threat

3.1. About Samoa

The Independent State of Samoa (referred to as Samoa throughout this report) in the South Pacific Ocean has a total land area of 2,850 square kilometres, with its two main islands being Savaii and Upolu, two smaller inhabited islands of Manono and Apolima and several uninhabited islets lying off the coast. Samoa has a total population of 176,848 (2001 estimate) with the state's capital, Apia being the most highly populated urban area (Government of Samoa, 2009). 70% of Samoa's population and infrastructure are located on low lying coastal areas (D5).

On the 1 January 1962 the then named Western Samoa became independent from a United Nations Trusteeship administered by NZ. This milestone saw Western Samoa become the first independent sovereign state in the Pacific. The prefix "Western" was dropped in July 1997 and the country renamed itself the Independent State of Samoa. The main languages spoken are Samoan and English (Government of Samoa, 2009 and DFAT, 2009).

Samoa's Head of State is His Highness Tui Atua Tupua Tamasese Efi, who was elected by the National Legislative Assembly (NLA) in June 2007 for a five-year term. The NLA, the only legislative parliamentary chamber, is elected under universal suffrage (all adults over 21 years of age are entitled to vote) for five year terms. All but two of the 49 seats are reserved for matai, who are the recognised chiefs of Samoan villages. The Samoan Government is administered by the Cabinet, which consists of the Prime Minister and 12 Ministers selected by the Prime Minister. The current Prime Minister (since 1998) is the Hon Tuilaepa Lupesoliai Sailele Malielegaoi MP. In elections held in 2006, the Human Rights Protection Party, which has governed Samoa since 1982, was returned to power with an increased majority. Samoa's parliament does not currently have a formal opposition (Government of Samoa, 2009 and DFAT, 2009).

Samoa has a small and developing country economy with Gross Domestic Product (GDP) in 2008 of around US$537 million and real GDP growth of 4.5 per cent in 2008 (figures from the International Monetary Fund). Samoa is expected to move from United Nations "Least Developed Country" to "Developing Country" status in 2010 (DFAT, 2009).

Samoa's indigenous exports consist primarily of fish and agricultural products. However, Samoa is reliant on foreign imports and has a large trade deficit. Remittances from Samoan communities in developed countries, tourism and foreign development assistance also play important roles in Samoa's economy (DFAT, 2009). The economy is susceptible to the impacts of natural disasters. In 1989, heavy floods caused extensive damage to the country's roads and bridges infrastructure. This was followed by the cyclones Ofa (1990), Val (1991) and the gale force winds of Lyn (1993) (Government of Samoa, 2009).

The highest point in Samoa is Mount Silisili (1857 metres). The centre of Samoa's islands are characterised by mountain ranges. The islands are volcanic in origin and surrounded by coral reefs. Samoa has two seasons, the wet season (November to April) and the dry season (May to October). Average monthly temperatures range from 20 to 30 degrees Celsius (Government of Samoa, 2009).

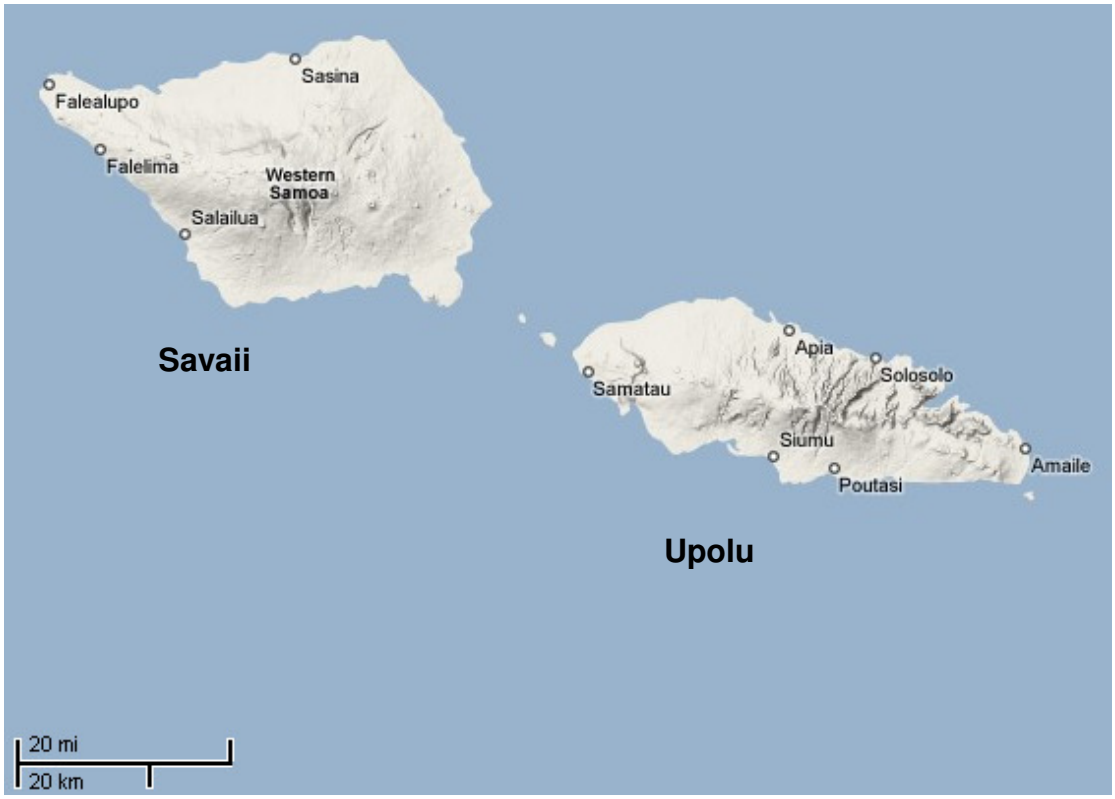


Figure 1: The Independent State of Samoa (Source: www.maps.google.com)

3.2. Tsunami Threat Sources and Tsunami History in Samoa

An overview of potential tsunami threat sources and tsunami history in Samoa is outlined below. This information should be treated as general background only and does not attempt to complete a comprehensive picture of tsunami hazard and vulnerability for Samoa. Such a study is outside the scope of this project.

In its NDMP (2006, D1) and National Tsunami Plan (2008, D5, D5.1), Samoa has rated tsunami, as an "extreme risk". Other hazards Samoa has included in the "extreme risk" category include cyclone, volcanic eruption, urban fire (Apia), public health crisis and environmental crisis (invasive species). The National Tsunami Plan (D5, D5.1) states that "the main areas at risk of a tsunami are all low-lying coastal areas of the inhabited islands of Samoa; that is areas less than 10 metres above sea level".

Samoa's National Tsunami Plan (2008, D5, D5.1) states that anecdotal evidence indicates a total of 60 tsunami events have been recorded in Samoa between the years 1937 and 1980. The National Tsunami Plan also quotes examples of tsunami affecting Samoa. In 1917, a 8.3 magnitude earthquake on the Tonga Trench (Refer Figure 3) reached Samoa in 10 minutes, affecting the village of Satupaitea (southeast Suvaii) resulting in 3 metre run-ups that destroyed native houses and crops. The 1960 tsunami generated by an earthquake off the coast of Chile impacted upon Samoa, primarily Fagaloa Bay, advancing roughly 80 metres through the village with an estimated wave height of approximately 4 to 4.5 metres (Keys, 1963). The literature states that no loss of life was recorded for either of these events.

Thomas, Burbidge and Cummins (2007) completed *A Preliminary Study into the Tsunami Hazard faced by Southwest Pacific Nations*. Scenarios for an 8.5 Moment Magnitude (Mw) and 9.0 Mw earthquakes were used to investigate normalised offshore (to a notional depth of 50 metres) wave amplitudes for tsunami caused by earthquakes along subduction zones (Refer Figure 2). For Mw 8.5 events Samoa was placed in Category 4 (normalised amplitude of 150 - 250cm). For Mw 9.0 events, Samoa was placed in Category 4 (normalised amplitude of 150 - 250cm).

A further study completed by Thomas and Burbidge (2009) attempts to answer the question "which Pacific nations might experience offshore amplitudes large enough to potential result in hazardous inundation, what are the probabilities of experiencing these amplitudes and from which subduction zones might these tsunami originate". The report states that the Tonga trench, lying to the south of Samoa, is the countries only significant regional source of potential tsunami (Thomas and Burbidge, 2009). The report states "the southern coastlines of Savaii and Upolu have the highest hazard, with maximum amplitudes at a 2000 year return period in the order of 2.3 to 3.4 metres" (Thomas and Burbidge, 2009). Maximum amplitudes on the northern coastlines are lower, but still significant, with amplitudes of up to 2 metres on Upolu (Thomas and Burbidge, 2009).

Investigation of the Bureau's deep ocean model-based tsunami prediction system conducted by Dr. Jane Warne in 2008 (ATWS Project Network Design Manager) reiterated that the main regional subduction zone threat source for Samoa is the Tonga Trench (Refer to Figure 2b). Warne concluded that moderate threat may also exist from a northern New Hebrides Trench source. Travel times for tsunami from these sources vary but are typically between 0.5 to 2 hours from the Tonga Trench and 3.5 to 4 hours from the New Hebrides Trench (Warne, 2008). Distant sources, such as the Peru-Chile Trench (Refer to Figure 2a) also pose a hazard to Samoa with travel times of greater than 10 hours from the source (Warne 2008).

Potential Hydro-explosive volcanic activity, flank collapses (Hill and Tiffin 1993, Keating, Helesley and Karogodina 2000) or lava platform collapse may also generate local tsunami. These processes can happen at the active submarine volcano Mount Vailulu'u and the new volcano

Nafanua that has formed within the Vailulu'u crater lying approximately 200km east of Tau in the Manu'a Island group and other parts of the Samoa Island Group.

There has been a number of relatively small tsunami events recorded in recent years on the Apia sea level gauge operated by the Bureau. The most notable being a tsunami that occurred as a result of a magnitude 7.9 earthquake on the Tonga Trench on 3 May 2006 at 15:26 UTC (04:26 local time in Apia) (Refer to Table 3, Figure 3a and 3b). The earthquake was reportedly felt in Samoa at both Apia and Mulifanua (USGS, 2008). A maximum wave height (peak-to-trough) of approximately 14cm was recorded on the Bureau of Meteorology's tide gauge in Apia (Refer Figure 3a and 3b). The first PTWC tsunami warning was issued for Samoa at 05:31 local time for a tsunami expected to arrive in Apia nine minutes prior (05:22 local time) (PTWC, 2008). This event was used throughout the tsunami capacity assessment of Samoa as a case study.

Figure 2a: The subduction zones (in orange) of the Pacific Ocean

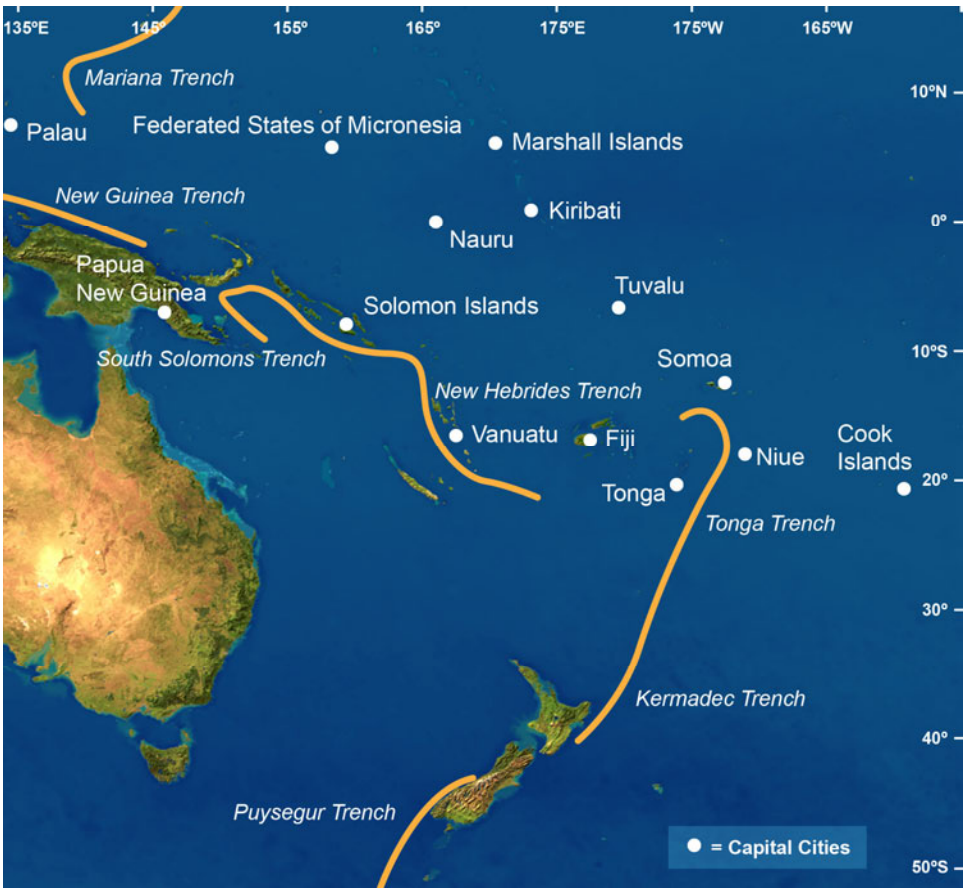


Figure 2b: The location of Samoa and other Pacific Island Countries in relation to regional and local subduction zones (in orange)

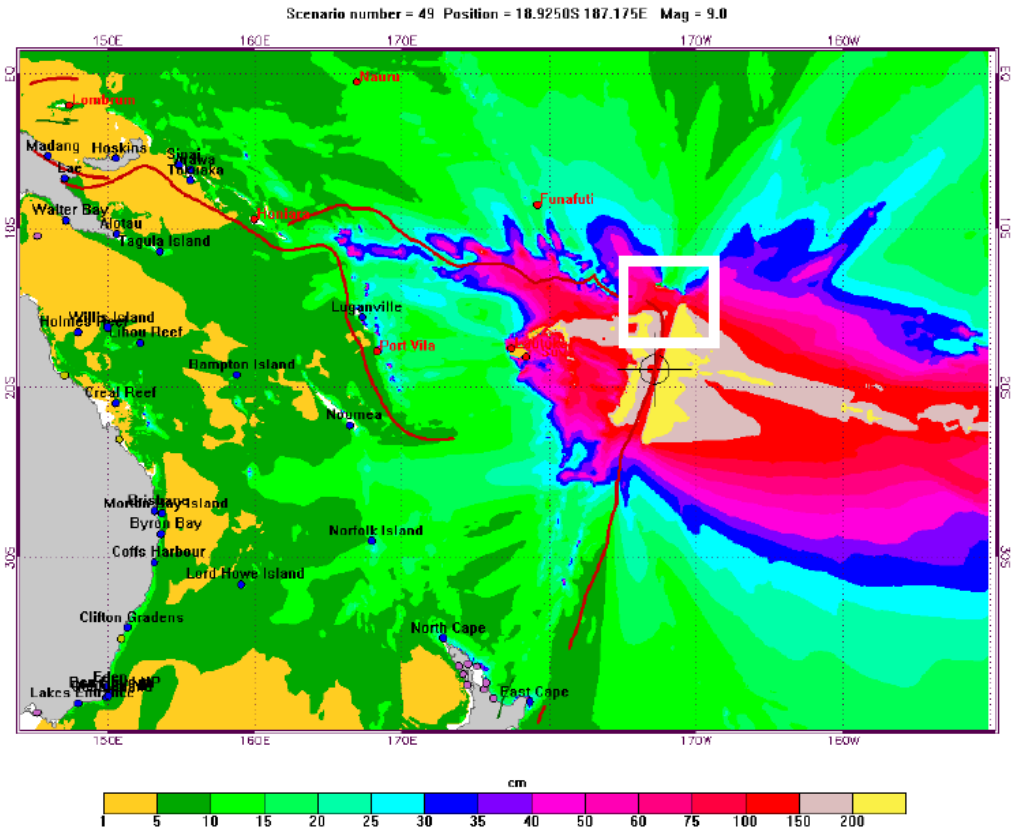


Figure 3: A deep water tsunami model scenario for a magnitude 9 earthquake occurring on the central Tonga Trench. Samoa is located within the white square. (Source: Greenslade *et al.*, 2007).

Event	Local Samoa Time
Earthquake **(as per USGS, 2008)**	**4.26am**
PTWC Warning issued including Samoa **(based on warning issued time on PTWC warning (PTWC, 2008), not time warning was received by Samoa as no procedures we in place at the time)**	**5.31am**
Predicted arrival time – Apia **(Predicted arrival time on PTWC 5.31am warning (PTWC, 2008))**	**5.22am**
Actual arrival time – Apia **(based on 1st sign of abnormal sea level activity at the Apia sea level gauge (Refer Figure 3a and 3b)**	**Approx 5.30am**
Largest wave height of 14cm* **(recorded on Apia sea level gauge)** *Note that USGS 2008, on their website, state that a tsunami was generated with recorded wave heights in meters (peak-to-trough) of 0.42 at Apia tide station. A time for this recording is not stated.	**Approx 6.50am**

Table 3: Basic timeline for events in Samoa during the Tonga Trench earthquake and tsunami of 3 May 2006

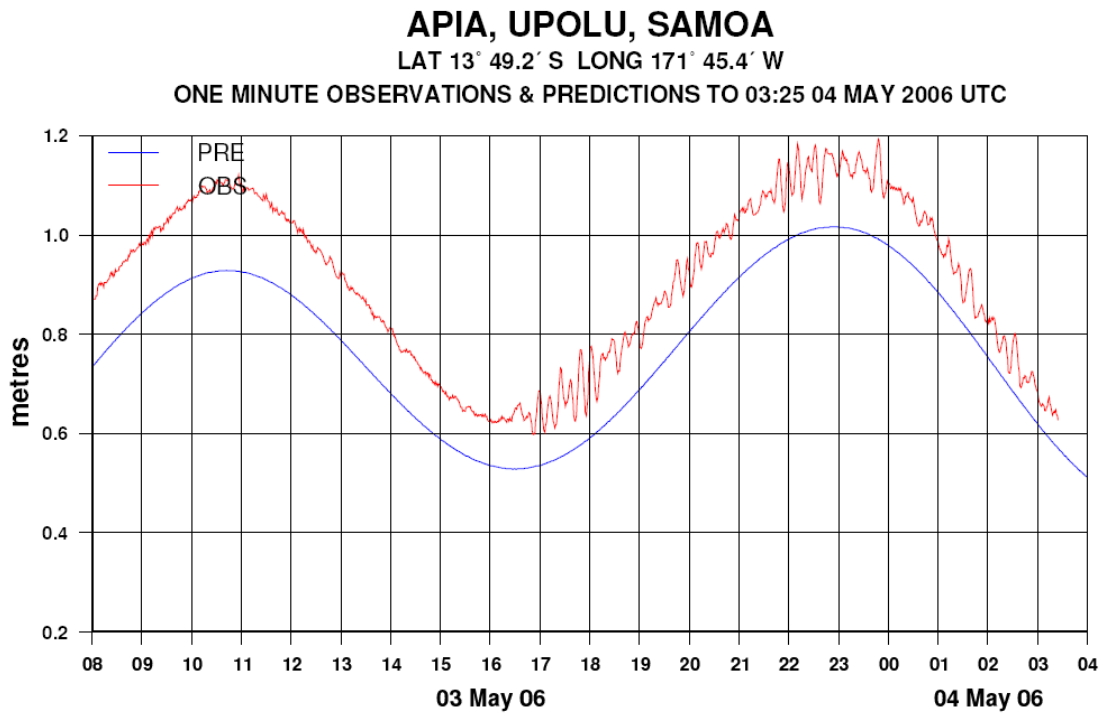


Figure 3a: 1 minute sea level observations and predictions recorded at Apia, Upolu, Samoa to 03:25 UTC (16:25 on 3 May local time) on 4 May 2006 (Source: National Tidal Centre, Australian Bureau of Meteorology).

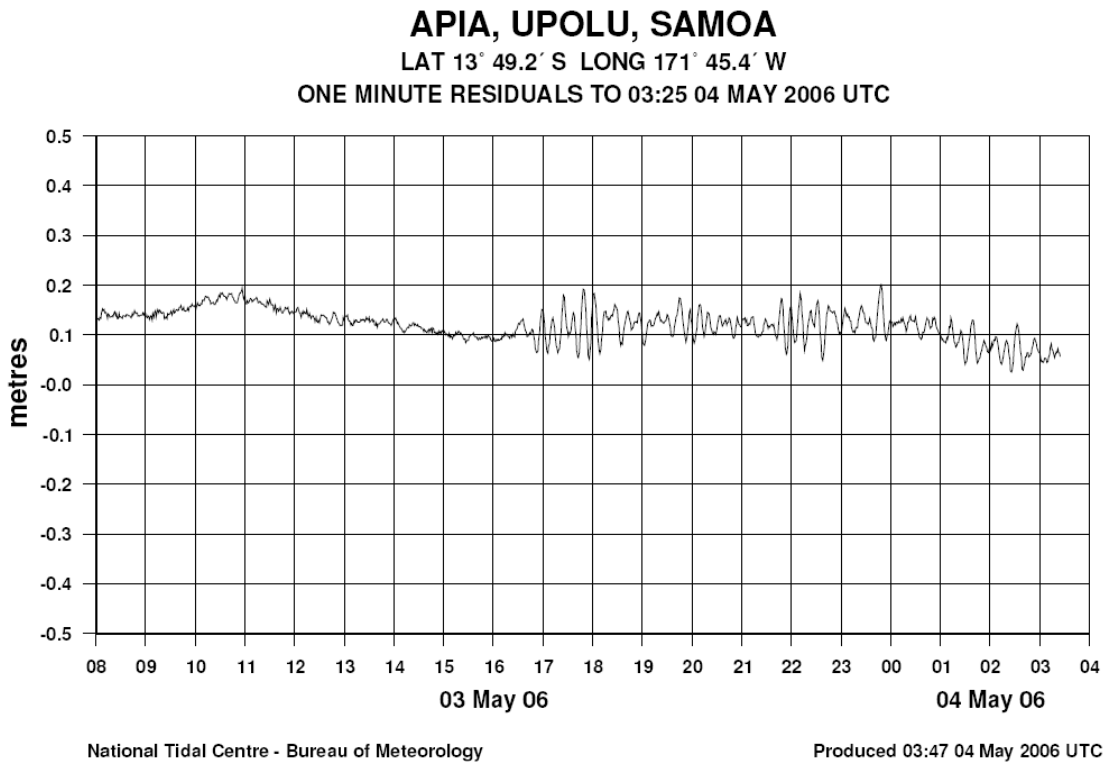


Figure 3b: 1 minute sea level residuals (variation between predicted and observed) recorded at Apia, Upolu, Samoa to 03:25 UTC (16:25 on 3 May local time) on 4 May 2006.

Section

4

4. The Samoa Tsunami Capacity Assessment

4. The Samoa Tsunami Capacity Assessment

4.1. Date and Location

The tsunami capacity assessment of the ability of Samoa to receive, communicate and effectively respond to tsunami warnings took place from 28 April to 1 May 2008 at the MNRE Conference Room, Level 5, Development Bank of Samoa Building Apia, Samoa.

4.2. Visiting Assessment Team and Participants

The Visiting Assessment Team was made up of those outlined in Annexure 2. The focal point in Samoa for the completion of this project was Ms Filomena Nelson (Principal Disaster Management Officer, Samoa DMO). A full list of workshop participants can be found in Annexure 1.

4.3. Workshop Summary

For a copy of the full agenda for the workshop see Annexure 3.

4.3.1. Day 1 (28 April 2008)

Filomena Nelson was the Master of Ceremonies for the opening of the workshop. The conference was opened by the Chief Executive Officer (CEO) of the Ministry of Natural Resources and Environment Tu'u'u Dr. Ieti Taule'alo. Team Leader of the Visiting Assessment Team, Rob Webb responded and the meeting was declared open. A closing prayer was offered by Mulipola Ausetalia Titimaea, Assistant CEO, Meteorology Division.

After refreshments, presentations were given by Samoan representatives Filomena Nelson and Siosina Lui (Senior Scientific Officer – Geophysics) regarding the tsunami warning and mitigation system in Samoa. Rob Webb presented background on the ATWS and the tsunami capacity assessment project. Noud Leenders (Community Risk Management Adviser, SOPAC) presented on the tsunami causes and threat in Samoa. Focus groups were then run which discussed Samoa's priorities for the country's tsunami warning and mitigation system. The workshop participants then commenced discussing and recording answers to the questionnaire (refer to Attachment 1a).

In the afternoon Rob Webb provided a presentation on tsunami warning systems and Garry Clarke (Data Communications Expert, Visiting Assessment Team) presented on data communications for warning systems in the Pacific Islands context. The assessment team was given access to key documents and during the evening pre-answered many of the questions in the questionnaire. This enabled the team to provide draft ideas to the assembled group for confirmation in the following days.

4.3.2. Day 2 (29 April 2008)

Workshop participants discussed and recorded answers to further questions in the questionnaire (refer to Attachment 1a). This included a focus group exercise that looked at strengths, weaknesses, opportunities and threats to Samoa's existing tsunami warning and mitigation system. Field visits were undertaken in the afternoon by the Visiting Assessment Team and relevant in-country contacts to locations including:

- Tide gauge;
- Seismic station;
- Meteorology Section, MNRE; and
- Geophysics Section.

4.3.3. Day 3 (30 April 2008) (Morning only)

Day 3 commenced with three separate presentations including:

- Vanessa Coli (Emergency Management Expert, Visiting Assessment Team) – Emergency Management and Preparedness;
- Andrew Gissing (Emergency Management Expert, Visiting Assessment Team) – Emergency Preparedness in New South Wales, Australia; and
- Rob Webb – Tsunami Warning in New South Wales, Australia.

The remaining questions were then answered and the formal participation was completed at lunch time to allow the team to prepare their report.

4.3.4. Day 4 (1 May 2008)

The final day saw the assessment team deliver their preliminary report to the workshop and, following feedback from the group, the workshop was officially closed.

Some of the team then took part in further site visits to locations including:

- **Fagaloa Bay** was the site of maximum run-up from the 1960 tsunami. Fagaloa Bay is also the location of the pilot program for evacuation tests conducted by the DMO.
- The new **Fire Station at Apia** has been built in an area away from the coast. There is a possibility of establishing a new NEOC at the site to reduce the risks of the existing DMO/NEOC site being incapacitated in a tsunami or tropical cyclone event.

4.4. Workshop Photos (Apia April/May 2008)

Tsunami Capacity Assessment Workshop participants

Fagaloa Bay. Site of the maximum run-up from the 1960 tsunami. Also the location of the pilot program for the evacuation tests conducted by the DMO.

Tsunami Capacity Assessment Workshop participants

Visit to the Apia sea level gauge

The workshop in progress

5. Assessment Results

5. Assessment Results

5.1. Status of Key System Components

The Tsunami Capacity Assessment Workshop results are summarised below in Table 4 in which the status of key components of the Samoa tsunami warning and mitigation system are outlined (as at the date the Tsunami Capacity Assessment Workshop was held in April 2008, updates between then and the publication of this report are as marked).

Table 4: Summary of current status of key components of Samoa's tsunami warning and mitigation system as at April 2008.

Rating

Yes - fully realised
Partially realised
No - not realised

Key Component	Rating	Comment
Authority, Coordination and NGO Role		
Legislation in place for tsunami warnings and response	**Yes**	The Disaster and Emergency Management Act (D3) provides for the management of disasters and emergencies in Samoa by effective planning and risk reduction, response and recovery procedures and the promotion of coordination amongst the response agencies. The Act allows for the establishment of the NDC, DAC and DMO. On advice of the DAC, the NDC may endorse one or more facilities to be a NEOC. The Act legislates response agencies. Each agency must prepare a response agency plan under the Act and be responsible for its implementation. For response there are specific recovery provisions and these are coordinated by the DAC in accordance with any directions from the NDC and subject to controls by the Ministry of Finance (international aid assistance funds).

Key Component	Rating	Comment
Authority, Coordination and NGO Role (Continued)		
Continued: Legislation in place for tsunami warnings and response	**Yes**	The Act also requires the development of a NDMP for Samoa. The NDMP details disaster risk management arrangements to ensure the sustainable mitigation of, preparedness for, response to and recovery from the impact of hazards. It also includes response agency plans which outline the specific roles of each agency. Tsunami is rated as a high risk hazard under this plan. The NDMP makes provision for any agency, organisation or person to exercise powers provided under the plan for the period of the emergency. The DAC is responsible for review of this plan every three years and after each disaster. The National Tsunami Plan also forms a part of the policy framework. This specifies agency roles and includes SOPs for 24/7 Meteorology Division for warning dissemination (specific to the tsunami hazard). Note - There is no Meteorology Act. This is in the process of being developed, however the Disaster and Emergency Management Act would override the provisions in any Meteorology legislation developed.
Tsunami coordination committee or effort at a National and local level	**Yes**	At a National level, an informal Tsunami Working Group exists, working under the DAC (who can appoint working groups) and the NDC. This group was formed to facilitate the development of the tsunami warning system and exercise in 2007. At the local level, disaster management teams in the villages are led by the Village Mayor. The Village Mayor and Women Representatives are required to report annually on status of preparedness in each village through the Ministry of Women, Community and Social Development (MWCSD). These reports are coordinated with the DMO and the DAC and are then fed to the NDC.
Agency responsibilities clearly defined	**Yes**	Agency responsibilities are clearly defined in the NDMP, Tsunami Plan and the various agency response plans that exist.

Key Component	Rating	Comment
Authority, Coordination and NGO Role (Continued)		
NGOs and Red Cross Society have a defined role in tsunami warning dissemination, preparedness and awareness and emergency response	**Yes, depending on which NGO**	The role played by each NGO differs between organisations. NGOs are involved in community preparedness and awareness through the running of community based workshops in collaboration with the DMO. NGOs are also included on the DAC. Some NGOs are included on the warning distribution list and therefore have a responsibility to pass this information on. NGOs have a role in emergency response through supporting agencies, assisting with evacuation, disaster victim recovery etc. Again, this depends on the NGO in question. Involvement of the Samoa Red Cross Society is covered by a Memorandum of Understanding (MoU) with the Samoa Government as well as the Geneva Convention. The Red Cross Response Plan (D14) outlines response functions such as using the International Red Cross Tracing Program to manage enquiries about affected people. The plan also includes provisions for training and public awareness as well as locations of resource and disaster relief depots.
International and Regional Cooperation		
Country represented at an international and regional level to aid cooperation in tsunami warning and mitigation efforts	**Yes**	Samoa is involved in a number of international forums and partnerships. Samoa became an IOC Member in 1978. Samoa is actively involved in the PTWS and Southwest Pacific Working Group. United Nations and regional organisations that are based in Samoa are included on the DAC. Samoa also has MoUs with both Australia (for the South Pacific Sea Level Climate Monitoring Project (SPSLCMP)/ATWS) and China (for seismic monitoring cooperation) that will assist to enhance Samoa's capabilities.

Key Component	Rating	Comment
Priorities		
Priorities established for implementation of tsunami warning and mitigation system at a National level	**Yes**	In an all hazards context, Samoa's NDMP outlines specific agency responsibilities when it comes to disaster risk reduction. Under this plan, a five year implementation plan (D40) was developed by each agency to implement the NDMP and associated plans. There has been significant work completed in-country on tsunami and, through activities such as exercises (D11), priorities have been established. Priorities were also discussed in the Tsunami Capacity Assessment Workshop. Some of the priorities expressed by participants included: • More funding for public awareness and education of communities (awareness programs in schools); • More monitoring equipment (in particular the upgrade and installation of the seismic network); • More technical training regarding operation of equipment; • Strengthening of collaboration between DAC members; • Increased awareness of roles of different agencies and industries; • DAC need to analyse different scenarios before, during and after events; • Needs to be a mobile or second emergency centre established because current centre is within area at risk; and • Need to identify the most vulnerable areas and hold community workshops focused on these areas.
Multi-hazard Approach		
Tsunami warning capabilities are being established within a multi-hazard framework	**Yes**	The National Tsunami Plan is a sub-plan of the NDMP which is multi-hazard. Plans exist for other hazards such as Tropical Cyclones (D24).
Research Expertise		
Active research is being undertaken within the country for seismology and tsunami to strengthen the tsunami warning and mitigation system	**Partially**	Samoa also has two temporary research seismic stations deployed on the island of Savaii. The instruments were installed under the Samoa Lithospheric Integrated Seismic Experiment (SLISE). Data has to be taken off the Seismometer (not real time). Other research on tsunami and seismology in Samoa is limited.

Key Component	Rating	Comment
Tsunami monitoring infrastructure		
Existence of seismograph stations and integration of real time data from these stations into the tsunami warning process	**Yes**	Samoa hosts one International Monitoring Station (IMS) / Global Seismic Network (GSN) auxiliary seismic station (AFI AS095) linked to Vienna via satellite phone and a local dial-up option. This information is available to United States Geological Survey (USGS) and will be used by PTWC for generation of warnings. Samoa has no direct access to this data in real time, except via a web interface. The data can be downloaded directly from the station however, there is a limited ability to interpret this data. The data is not integrated into Samoa's tsunami warning process. For earthquakes below the PTWC threshold, Samoa uses the Modified Mercalli Intensity (MMI) and Japan Meteorological Agency (JMA) Scale to determine whether a watch or warning will be issued. Samoa currently does not issue a no-threat bulletin. Samoa Government (MNRE) has signed an MoU with the China Earthquake Administration (D17). The MoU is to jointly establish four broadband seismic stations and two portable short period seismic stations. All data derived from the network will be processed, analysed and stored in the Data Management Centre in Apia. The MoU states that the "Parties jointly share the data produced by the seismic system for the purpose of research and disaster management". **(Update May 2009 –** Samoa is in the process of completing the final detailed proposal (deadline June 2009) and are hoping to have network up by December 2010).
Existence of sea level stations and integration of real time data from these stations into the tsunami warning process	**Yes**	One sea level station is located in Apia (3rd party, Australian Bureau of Meteorology). Samoa MNRE Meteorology Division receives one minute data via a dedicated personal computer and via registered user web pages run by the Bureau. This data is also made available to the GTS for the international community. However, this information is not integrated into Samoa's tsunami warning process at present.
Sharing of seismic and sea level data internationally to facilitate improvement of PTWC tsunami messages for the region	**Yes**	The seismic station is linked to Vienna via satellite phone and a local dial-up option. This information is available to USGS and will be used by PTWC. The sea level station data is made available by the GTS for the international community. Samoa plans to share the data from the new seismic monitoring network internationally.

Key Component	Rating	Comment
Warnings		
Nation receives PTWC messages	**Yes**	The National Weather Section of MNRE's Meteorology Division receives PTWC messages via alarmed EMWIN, facsimile and e-mail. The Principal Disaster Management Officer receives these messages via RANET (Radio and Internet for the Communication of Hydro-Meteorological Information for Rural Development) SMS and e-mail. Samoa's PTWC warning forecast point is Apia.
24/7 operational staff at warning receipt and dissemination location	**Yes**	The National Weather Section of MNRE's Meteorology Division is 24/7. DMO is on call 24/7. DMO acts as a back up to the National Weather Section at present.
Disseminate national tsunami warnings as guided by a Standard Operating Procedure	**Yes**	The National Weather Section of MNRE Meteorology Division (see SOPs D4 and D8) is responsible for verification of the threat through calculation of local tsunami parameters. In the first instance, warnings are based on PTWC guidance solely, unless there is a felt earthquake or staff find out in another way. **Felt Earthquakes** SOPs outline action to be taken if there is a felt earthquake. In this instance a warning or watch may be issued based on the MMI/JMA Scale and USGS website. **PTWC Messages** The Meteorology Division sends "Advisories" from PTWC to the DAC. Message dissemination via fax and telephone. E-mail and SMS are used to distribute PTWC "Watches" and "Warnings" to a comprehensive list (updated monthly) including the DAC, the NDC and key village representatives. SMS are sent via both cellular providers Digicel and SamoaTel. Acknowledgement of receipt of PTWC messages is completed via facsimile and Aeronautical Fixed Telecommunication Network (AFTN). **Distant Sources** Issuance of tsunami warnings from distant sources are completed when the tsunami is anticipated to reach Samoa within three hours (D8). Distant tsunami procedures are focused on attempting to confirm the existence of a tsunami before issuing a warning.

Key Component	Rating	Comment
Warnings (Continued)		
System redundancies in place for receipt of PTWC messages and dissemination of National warnings	**Partially**	No robust backup is in place for the National Weather Section of MNRE Meteorology Division. Current back-up arrangements are through SMS messages from PTWC being sent to the Principal Disaster Management Officer of DMO. Technically the DMO can then action warning dissemination through Digicel and SamoaTel if the National Weather Section is incapacitated but this process is not documented. Some more thought is required regarding robust redundancies in this system. A viable option may be to have a back-up EMWIN system placed in the Fire Services (who are 24/7 and mandated for emergency response). **Update Feb 2009 -** DMO now have an Emergency Communications Trailer at the new fire station. The Trailer includes satellite phone and radio communications (excluding the internet at this stage).
Redundant 24/7 methods available for dissemination of warnings to community (e.g. public radio, sirens etc.)	**Yes**	Watch and Warning SMS are sent to pre-selected representatives in the villages which includes village mayors, church ministers, school principals, hotels/motels/beach resorts representatives as well as the key personnel of the member agencies of the DAC and all members of the NDC. This list is updated monthly. Sirens, Church and school bells (tsunami is the only hazard these bells are used for), national radio, TV and word of mouth are then used to inform the population. Current sirens are located at the Fire Services and on the airport roof. Plans are to place new sirens at the new Fire Station and on the other main island. Sirens are used for other hazards also but will be sounded continuously for tsunami.
Effective warning dissemination to remote communities	**Yes**	SMS messages are sent to key village representatives who then use Church and school bells (only used for tsunami warnings), word of mouth etc. to reach their communities.
Communications coverage of whole country that is effectively utilised for the dissemination of tsunami warning messages	**Partially**	Cellular services cover 95% of the country. **Update February 2009 -** Samoa has recently investigated using the District Health Centres HF Radio link as a back up communications mechanism to reach communities. Unfortunately, these HF links no longer exist. DMO now have an Emergency Communications Trailer.
Issue of marine tsunami warnings and guidance for vessels, harbours and ports	**Yes**	Samoa use Marine Band Radio Channel 16VHF (Very High Frequency), 2182HF as well as doorknocking of vessels in harbour. The vessels would also, more than likely hear the sirens. The Fisheries license system sets a condition that each boat must have a communication system but this could still mean cell phone. Cell phone coverage is limited at sea.

Key Component	Rating	Comment
Emergency Response and Evacuation		
Disaster preparedness and emergency response system has been reviewed and opportunities for improvement and training identified	**Yes**	The National Tsunami Plan identifies that the DMO in collaboration with the DAC will organise and conduct training on the nature of tsunami, safety procedures and first aid skills through Samoa's Village Program. Exercises have been conducted (D11) with the aim of assessing warning dissemination and response at a local level.
Tsunami emergency response, evacuation and recovery plan exists	**Yes**	The National Tsunami Plan covers preparedness and response arrangements (including warning dissemination and evacuation). Recovery provisions are included in the NDMP. There are future plans to develop a National Recovery Plan for Samoa. In addition village and school plans exist. More recently, disaster plans for schools have been incorporated into village plans, private schools disaster plans will be developed separately and urban areas will keep their school specific plans. D21 "Disaster Management Office and the National Emergency Operations Centre Evacuation Strategy" outlines the procedures for the evacuation of the DMO or NEOC if the office itself is under threat or damaged.
The designated agency for evacuation is identified and have authority by law	**Yes**	The National Tsunami Plan identifies the Ministry of Police and Prison as being responsible for the coordination of evacuation within the Apia urban area. Outside of Apia it is the responsibility of the Village Mayor to coordinate evacuations. These bodies have authority by law (the Disaster and Emergency Management Act). The DMO can directly issue instructions for evacuation with Police and Fire Services assisting.
Plans have been made for safe evacuation of population centres including aspects such as maps, routes and signage	**Partially**	A tsunami evacuation exercise was conducted in Apia (D11). It was assessed that it took approximately 19 minutes to evacuate the some 9000 people from Apia from the time the tsunami warning bulletin was received from PTWC. An Apia evacuation map exists (including safe areas and routes, D25). Shelters for small communities are also identified during community workshops. Also, in the Village Program currently being run, evacuation is included as part of the Village Disaster Plan.
Procedures are tested and exercised to improve the response through better planning and preparedness	**Yes**	Tsunami exercises are run annually. The most recent exercise involved the whole country (D11). The system was tested in two villages before the national test. These two villages included Sapulu in Savaii and Maasina, Fagaloa in Upolu (D11). Recommendations for improvements to the system were made based on the village exercises before the national test. Observations and lessons learned were completed after each exercise and a list of recommendations made. These recommendations were intended to be the next steps in improving the system. Plans also exist to run exercises for districts and local communities when workshops are held.

Key Component	Rating	Comment
Emergency Response and Evacuation (Continued)		
Land use policies and building codes are in place to mitigate against the tsunami hazard	**No**	Samoa is working towards an improved National Building Code. The code will be updated after completion of the seismic assessment project being completed by SOPAC. This project will include tsunami. The Ministry of Works is responsible for implementation of the Building Code. Several other projects may assist in improving this aspect of Samoa's end to end system.
Tsunami hazard, vulnerability and risk		
Completion of studies to assess the tsunami hazard in the country or Region	**Yes**	"A Preliminary Study into the Tsunami Hazard faced by Southwest Pacific Nations" has been completed by Geoscience Australia. Geoscience Australia has also completed "A Probabilistic Tsunami Hazard Assessment of the Southwest Pacific Nations". Both studies include Samoa.
Local risk assessments have been completed for at risk communities	**No**	In Samoa's NDMP, all coastal areas of Samoa have been graded as high threat. Selection of evacuation sites is based on elevation and location. Ability to undertake local risk assessments is limited in Samoa. All villages in Samoa have gone through the Coastal Infrastructure Management Planning consultation process where some risk assessment has been done. The village based Disaster Risk Management awareness programmes then selection hazards for each village based on the Coastal Infrastructure Management Planning outcomes.
Adequate data exists and local inundation modelling has been completed for population centres	**No**	No inundation modelling has been completed in Samoa. Samoa is currently in discussions with SOPAC regarding plans to complete inundation modelling for Apia. Both the bathymetry and topography data cover the whole of Samoa. The bathymetry chart was completed by SOPAC in 2007 up to about 20m depth (shallow water and channels missing) and topography is reasonably good (last updated 1999, 2m contours around the coastline and 20m inland).

Key Component	Rating	Comment
Public and stakeholder awareness and education		
Measures have been taken to ensure the public understand and take action in the event of a tsunami warning being issued	**Yes**	A team made up of various departments is delivering Disaster Risk Management workshops (otherwise known as the "Village Program") to all villages. This program focuses on education and training in risk reduction measures specific to the hazards applicable to each village. Coastal infrastructure management plans have also been developed in the last five years (D15). These plans have incorporated consideration of natural hazards and have been developed in consultation with villages. Village Programs are generally arranged with important community members, the Village Mayor and Women Representatives. This project is due for completion in 2013. This is an all hazard approach and will focus on preparedness. National drills for tsunami will be conducted annually. Media campaign (funded by AusAID) includes developing TV and radio programmes on safety procedures for all hazards. UNESCO will be putting further funds into the UNESCO Cluster Office for the Pacific States in Samoa. The UNESCO office will also assist Samoa DMO in further developing and rolling out its Village Program.
Community level education and preparedness programs exist for tsunami	**Yes**	See above.
Training programs for the National media exist for natural hazard and tsunami	**Yes**	Press releases to TV and radio, as well as newspaper articles (D39), on current disaster management issues are ongoing. Workshops on geohazards and cyclones are held annually. DMO and UNESCO organised a Samoa Media Disaster Management Capacity Building Workshop in Apia in October 2008. UNESCO will be putting further funds into the UNESCO Cluster Office for the Pacific States in Samoa. This office will work with the Samoa Disaster Management Office to trial a project with the Samoa media with regard to media education and development of unique disaster management plans for each media organisation.

5.2. Case Study – Tsunami System Operation in Samoa for Tonga Trench and Solomon Islands Tsunami Events

Throughout the Tsunami Capacity Assessment Questionnaire completed in Samoa, the country's response to the Tonga Trench event of May 2006 and Solomon Islands event of April 2007 was reviewed. The aim of this review was to gain an understanding of the operation of the system in a real time event. In Samoa's case, it is interesting to note the changes in the operation of the country's warning system between the 2006 and 2007 events.

The two tsunami events used for the case study included:

1. Tonga Trench Event – Magnitude 7.9, 160km northeast of Nuku'alofa (Tonga), 15:26:39 Coordinated Universal Time (UTC), Wednesday 3 May 2006 (4.26am Samoa local time)
2. Solomon Islands Event – Magnitude 8.1, 45km south-southeast of Gizo (Solomon Islands), 20:39:56 UTC, Sunday 1 April 2007 (1 April, 9.39am Samoa local time)

For both events the PTWC bulletin was received. For the Tonga event, the PTWC warning for Samoa was issued just over an hour after the earthquake occurred (see Table 3). Samoa's tsunami plan was put in place in late 2006. At the time of the Tonga event, Samoa had no tsunami procedures in place. For the Solomon Islands event Samoa's tsunami procedures were in place but SMS capability was not. Therefore no national tsunami warning was issued for Samoa for the Tonga event. For the Solomon Islands event, a tsunami watch was issued to high level officials in country. The watch was not disseminated to the population. For the Tonga event the Prime Minister called a State of Emergency and subsequently people stayed at home. Because this event happened early in the morning a public holiday was declared. No reports of damage or physical observation of the tsunami were recorded for the Tonga event.

Seismic data was evaluation before a tsunami watch was issued for Samoa during the Solomon Islands event but the data was most likely not used. The Samoa sea level gauge had not been upgraded when the Tonga event occurred and thus sea level data was not used. Much of the response was driven by word of mouth around the Pacific. During the 2007 Solomon Islands earthquake and tsunami confirmation that PTWC had issued a tsunami warning was received from American Samoa.

A timeline for the earthquake, warnings, estimated arrival and actual arrival times for Samoa for the Tonga event is outlined in Table 3. It is interesting to note that Samoa was included in the PTWC warning that was issued 11 minutes after the estimated tsunami arrival time in Apia, Samoa. The May 2006 Tonga earthquake was felt in Samoa. For locally generated events the warning sign must be the felt earthquake to enable appropriate community response in adequate timeframes. Samoa is working towards educating the community to understand this aspect of tsunami.

Samoa has demonstrated a sound ability to learn from events and exercises and apply the lessons learned to ensure system improvements are implemented through incorporation into implementation plans. Significant work has been completed to enhance the country's tsunami warning and mitigation system. The country's reaction to the 2006 or 2007 event would not likely reflect their response if an event was to occur tomorrow.

5.3. Strengths, Opportunities for Improvement and Recommendations to Progress the Tsunami Agenda in Samoa

Based on the discussions during the workshop with in-country participants and the supporting documentation collected during the visit, the visiting team, in consultation with Tsunami Capacity Assessment workshop participants formulated the following strengths, opportunities for improvement and recommendations under key topics which they believe will progress the tsunami agenda in Samoa. These are outlined in Table 5.

Table 5 –Strengths, opportunities for improvement and recommendations under key topics

5.3.1. Governance and Coordination	
Strengths:	**Opportunities for Improvement:**

• There is a strong "stakeholder owned" tsunami warning and mitigation system in place in Samoa that is supported by the government and actively engages the community.
• Roles and responsibilities are clearly defined through legislation (the Disaster and Emergencies Act, Police Service Act, Communications Act, Planning and Urban Management Act etc.) and the NDMP and Samoa National Tsunami Plan. Under the NDMP, each agency must establish a five year implementation plan (D40).
• Samoa's community is experienced at preparing for, and responding to disasters with a well-exercised weather warning service (Tropical Cyclones).
• Samoa has a formal disaster management organisational structure which includes:
  ○ The NDC – governance, oversight, strategic direction.
  ○ The DAC – implementation, operational management.
  ○ The DMO – coordination, support, administration.
• The MNRE, which includes the active and effective DMO and Meteorology Division, oversees the tsunami system and reports to the DAC made up of many stakeholders.
• An informal tsunami working group exists under the NDC. The group includes representatives from a number of key agencies involved and is chaired by DMO.
	• Reporting between community level structures and national structures for disaster risk management could be improved.
	• Samoa does not currently have a Meteorology Act. Work is moving towards establishing this.

Governance and Coordination (Continued)	
Strengths:	**Opportunities for Improvement:**
• At the community level, disaster workshops have been setting up village committees to address all hazards. This is generally arranged with the village mayors and contains important community members. • It is the role of the MWCSD to support, monitor and liaise with Village Councils and organisations as they implement disaster management activities, and to keep the DAC informed of the level of village preparedness. • Good partnerships with NGO's who are represented on the DAC and are primarily involved in community preparedness and awareness through the running of community based workshops in collaboration with the DMO. Some NGOs are included on the warning distribution list and therefore have a responsibility to pass this information on. Some NGOs have a role in emergency response through supporting agencies, assisting with evacuation, disaster victim recovery etc.	• (Refer above)

Recommendations:

1. Samoa continues to maintain and strengthen the tsunami warning system in place and that the benefits of implementation of improvements in the warning system be incorporated across all hazards where appropriate.
2. That all agencies with key roles to play in the tsunami warning system be adequately resourced to carry out their legislated functions under the Disaster and Emergency Management Act and/or the NDMP. In particular the DMO and Meteorology Division of the MNRE should closely analyse the resource requirements to maintain their functions effectively in the long term.
3. Continue to ensure regularly updated SOP documentation is made available to any person or organisation playing a part in the tsunami warning process and is shared between all agencies involved.

5.3.2. Regional and International Coordination

Strengths:	Opportunities for Improvement:
• PTWC provide Samoa with tsunami warnings and have up to date international contacts. • During tsunami warnings, the Meteorology Division informally verifies PTWC data and tide gauge information by calling neighbouring countries in the region. • Samoa coordinates with a number of international agencies with regard to earthquake and tsunami monitoring, evaluation, warning, response, hazard and risk assessments, community awareness and preparedness and tsunami structural and non-structural mitigation. Samoa has the advantage that some of these agencies are located in Samoa. • Samoa have a number of post disaster arrangements with international and regional counterparts, for example, a regional exchange of disaster management staff post disaster to support DMO. • Possible MoU with American Samoa in relation to Tsunami collaboration on procedures etc. (a draft is ready). • Samoa actively participates in the Southwest Pacific Tsunami Working Group (WG5) of the ICG PTWS, currently holding the position of vice chair. • Samoa became a member of the IOC on 10 April 1978.	• Samoa would be interested in further progressing international coordination with regard to tsunami numerical modelling, in particular, inundation modelling.

Recommendations:

4. Continue active participation in the Southwest Pacific Tsunami Working Group (WG5) of the ICG PTWS, Regional Meteorological Service Directors meetings and the Pacific Platform for Disaster Risk Management meetings, engaging Meteorological Division of MNRE as the responsible warning authority.
5. Share the findings of this report with international and regional organisations (those based in Samoa and others) to provide guidance on targeting future capacity development programs and projects for tsunami and other hazards.

5.3.3. Research Expertise

Strengths:	Opportunities for Improvement:
• Seismic and volcanic research links with bodies such as the University of Colorado and Massey University. • DMO have conducted research with regard to community awareness effectiveness, through the completion of a survey. • Some capacity exists within country for research (for example, the former Senior Officer of Geophysics is completing their masters with the University of Canterbury).	• Limited scientific research expertise within Samoa. • No government sponsored research organisation that can contribute products or services to strengthen tsunami warning and mitigation. • Utilise the capacity building in data analysis and seismic equipment operation and maintenance for future research (China agreement).

Recommendations:

6. Continue to actively engage with regional and international agencies that can assist with conducting scientific research and technical capacity building to enable Samoa to fully utilise cooperative research. Develop a protocol to ensure copies of scientific research reports are received.

5.3.4. Tsunami Monitoring Infrastructure

Strengths:	Opportunities for Improvement:
• Collaboration on equipment and data provision links to agencies such as USGS, Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) and the Bureau. • Samoa hosts one IMS / GSN auxiliary seismic station (AFI AS095). Linked to Vienna via satellite phone and a local dial-up option. This data is available in real-time to Samoa's tsunami warning authority and data is also made available to USGS. • Samoa also has two temporary research seismic stations deployed on the island of Savaii. The instruments were installed under the SLISE. Data has to be taken off the seismometer. • Samoa has one sea level gauge is Apia that is operated by the Bureau. For this station MNRE Meteorology Division receives one minute sea level data updates via a dedicated personal computer. Information is also made available to the international community via the GTS. This equipment is covered under a MoU signed between Samoa and Australia. • Samoa has signed a MoU with the China Earthquake Agency for the supply of a fixed and mobile seismic network (have submitted a proposal for four short period and two long period stations).	• In the workshop Samoa requested that investigations take place to allow regularly updated tide gauge data available within Samoan Networks rather than on a stand alone personal computer. • Further development of Samoa's seismic network and volcano monitoring systems will be beneficial provided that available seismic information is shared internationally (real-time and in an appropriate format) and fed into Samoa's tsunami warnings. **(Update May 2009 –** Samoa is in the process of completing the final detailed proposal (deadline June 2009) and are hoping to have network up by December 2010).

Recommendations:

7. Continue the establishment of Samoa's seismic network ensuring the system meets the needs of Samoa's tsunami early warning system as well as shares seismic data internationally in real-time and suitable data formats.

8. Continue the establishment of a volcanic monitoring capability within Samoa and evaluate the tsunamigenic potential of Samoa's volcanos.

9. Samoa investigates access to Pacific sea level data for tsunami warnings via the GTS or Bureau Registered User Website.

5.3.5. Tsunami Warnings

Strengths:	Opportunities for Improvement:
• MNRE Meteorology Division, which operates 24/7, is the designated responsible agency for issuing tsunami warnings to Samoa. The Division has comprehensive SOPs. • Receipt of PTWC messages occurs via an alarmed EMWIN system at the MNRE Meteorology Division. Messages are also received via fax (MNRE Meteorology Division) and mobile SMS (Principal Disaster Management Officer, DMO). • PTWC "Advisories" are only sent to the DAC. PTWC "Watches" and "Warnings" are disseminated to the wider community. Warning SOPs include consideration of distant source tsunami and have methods to use felt earthquake magnitude estimations to develop warning criteria. • If MNRE Meteorology Division office is incapacitated, the DMO can request a warning SMS message be sent through telecommunications providers in English and Samoan. • Dissemination system is strong via Samoa specific tsunami warnings to the media. Samoa also has significant SMS coverage with an SMS mass broadcast capability via Digicel and SamoaTel that caters for both Samoan and English. SMS templates exist. • Sirens, Church and school bells (rang fast and continuously only for tsunami), SMS, National Radio, TV, boats/ferry at ports sounding horns and word of mouth are all used to disseminate warnings to the community. • During a disaster, the DMO has responsibility for translating technical information into instructions for the public (action statements and safety advice). This is facilitated using media releases issued by the Principal Disaster Management Officer. Media release templates exist. • In the event that a Declaration of Disaster or Emergency is made an all clear message will be issued from the DMO. The Meteorology Division issues cancellation based on PTWC and analysis of the situation. • Marine warnings are issued by the Ports Authority via Marine Band Radio Channel 16VHF, 2182HF as well as doorknocking of vessels in harbour. The Ports Authority does not have Inmarsat.	• At the time of the workshop tsunami warning SOPs did not outline the action taken if there is a felt earthquake. **(Update May 2009 –** This is now covered). • Some more thought is required regarding redundancies in this system if the Meteorology Division is incapacitated. • Review of who in-country receives international SMS messages is required. • There is potential for panic, false alarms and community complacency if Samoa's tsunami warning system does not include information bulletins for non-tsunamigenic events, felt earthquakes, tsunami that will not impact on Samoa and education post tsunami (regardless of the size of the tsunami). PTWC messages have the potential to be misinterpreted by media without local evaluation and interpretation. • Sometimes boats do not have radios and rely on cell phones. The Fisheries license system sets a condition that each boat must have a communication system. However, this could mean cell phone. Cell phone coverage is limited at sea. • Relevant Samoan agencies need the ability to access, interpret and feed real-time sea level and seismic information into tsunami warnings. • A back up to the SMS distribution system is required to ensure warning messages get down to the community level. • **Update May 2009 -** Geophysics has been tasked with completion of travel time maps, possible scenarios and local thresholds as well as review of Samoa's PTWC forecast warning points (southwest Savaii, southeast Upolo and Salailau required).

Tsunami Warnings (Continued)	
Strengths:	**Opportunities for Improvement:**
• Samoa has and uses Travel Time software as well as taking not of the travel times listed in the PTWC messages. • Samoa holds post event debriefings of tsunami events, even if no impact was observed.	• (Refer above)

Recommendations:

10. That Samoa investigates the development of contingency plans that allow the issue of public warnings from another country thus building on lessons learned from the Tropical Cyclone Warning System.

11. That an analysis be undertaken on aspects of redundancy in the total tsunami warning system including:

- **a.** An efficient mechanism for informing and updating key disaster management agencies during an event;
- **b.** A backup process by which PTWC tsunami information arrives in the country;
- **c.** Regular cross checks to make sure key links in the warning chain are working;
- **d.** Development of a contingency plan to ensure warnings can be issued to the community should Meteorology Division staff be forced to evacuate or experience systems failure; and
- **e.** Backups to key power sources.

12. That existing last mile tsunami warning communication methods are strengthened (for example, implementation of an improved siren system attached to local fire stations).

13. Gain access to scenario based deep ocean tsunami modelling to assist in both risk assessment and warning decision making. Build the capacity within Samoa (the Meteorology Division and other relevant agencies) to analyse and use this tool.

14. That an analysis be undertaken of the key individuals within agencies who would benefit from the PTWC SMS alert service and the existing service be extended to those people.

15. To reduce community panic and maintain practiced operational systems and community awareness when there is a long time between events include in tsunami warning processes, issuing of “No threat” messages to the public and media for the following events:

- **a.** Tsunami that do not have the potential to threaten Samoa; and
- **b.** Under-sea and felt earthquakes that do not have the characteristics to generate a tsunami.

16. Consider how Samoa can move towards determination of different threat levels in their tsunami warnings. For example, marine only or land inundation.

5.3.6. Communications

Strengths:	Opportunities for Improvement:
• Strong support from telecommunications industry to facilitate tsunami warning dissemination. Digicel and SamoaTel offered to provide the SMS for tsunami warnings free of charge. Digicel's capacity is 900 recipients within two minutes. • Receiving data through satellite system EMWIN – GOES West (main system relied upon for tsunami warning receipt). • Strong radio coverage across Samoa. National AM (Amplitude Modulated) (6am – 12am) and Frequency Modulated (FM) (run 24/7 but automated at times). • Satellite phones are owned by Red Cross, Digicel, SamoaTel, DMO and Peace Corps. DMO have a database of numbers. These are not kept on 24/7. Most are modern Iridium models (which are relatively expensive to use). • Mobile phone system with 95% coverage exists in Samoa. Telephone, Fax and SMS are all able to be used in Samoa. • The Telecommunications Act (2005) states "In case of a public disaster or state of emergency, service providers shall comply with any directions issued by the Commissioner of Police and/or the CEO of the Ministry responsible for disaster co-ordination to respond to or alleviate problems faced by the public or the Government related to such disaster or emergency" (D7, Part XIII, 70(1)). • SamoaTel have a Disaster Recovery Plan (D10) which provides the structure and procedures by which staff will be able, in the event of a disaster, facilitate resumption of essential communication services such as telephone and internet to critical customers. • Police and Fire Services both have VHF and HF that can be and are used in national emergencies. Fire stations are located in urban areas only. • Technical knowledge in country to support Samoa's communications infrastructure is good. • Samoa has international and national voice and SMS backup capability. There are two suppliers with totally separate systems and separate international gateways which provides good redundancy.	• Currently only using 'receive only' satellite systems. Have a Voluntary Cooperation Program (VCP) of the WMO request in place for a two way ISCS (International Satellite Communications System) system, which would give capability to send and receive. Donor funding has not been found by WMO to fund equipment etc. for this system. • Samoa does not have full GTS access (subset of GTS via a Secure Internet Protocol (IPSec) and e-mail. Use of Melbourne Regional Telecommunications Hub (RTH) secure user logins could improve this service. • HF and VHF are voice only systems in Samoa. Digital data cannot be sent or received. • None of the HF radio systems are enabled for e-mail. Samoa Meteorology Division is hoping to install a HF system that will be e-mail enabled and become part of the RANET HF network. • **Update February 2009 -** Samoa has recently investigated using the District Health Centres HF Radio link as a back up communications mechanism to SMS notification to reach communities. Unfortunately, these HF links no longer exist. DMO now have an Emergency Communications Trailer. • **Update May 2009** – Samoa is currently in process of negotiating with NOAA for an additional EMWIN system expected to be located at the Fire Service. • **Update May 2009 –** The DMO has requested assistance from Australian Maritime for their HF radio system. A JICA project is assisting the Meteorology Division to improve its radio (audio and e-mail). NZ is assisting the Fire service with more repeaters for UHF.

Communications (Continued)

Recommendations:

17. Continue to develop the mobile radio network to assist in communicating critical information to key individuals within the warning system. (Update May 2009 – The DMO has requested assistance from Australian Maritime for their HF radio system. A JICA project is assisting the Meteorology Division to improve its radio (audio and e-mail). NZ is assisting the Fire service with more repeaters for UHF.

18. .A back up EMWIN system be placed at the Fire Services for receipt of PTWC and other warning messages. **(Update May 2009** – Samoa is currently in process of negotiating with NOAA for an additional EMWIN system expected to be located at the Fire Service).

19. That the licence requirements for primary communications means on boats are changed to radio.

20. Consideration should be given to running an integrated messaging system that manages SMS, e-mail, fax and voice messaging that could be the database for all emergency contacts (including satellite phones), with the possibility of expanding this system to allow for public subscription. This system should maintain the details of active staff at all agencies their roles and operational status and be accessed by the web.

21. Ensure all agencies with satellite phones have them permanently on and operating with fixed external antennas when phone is indoors.

5.3.7. Tsunami Emergency Response (including evacuation)

Strengths:	Opportunities for Improvement:
• A proclamation of emergency can be made under Article 105 of the Constitution. • Agency responsibilities are clearly defined. Response agencies are outlined in the NDMP as Ministry of Police, Prisons and Fire Services with support from Ministry of Works Transport and Infrastructure, MWCSD, Red Cross. • A National Tsunami Plan exists that covers preparedness and response arrangements. Recovery arrangements are detailed in the NDMP and these are coordinated by the DAC in accordance with any directions from the NDC and subject to controls by the Ministry of Finance. • Sector plans and plans for schools are prepared within an all hazards framework (a requirement of the Disaster and Emergency Management Act). The National Tsunami Plan identifies some inclusions for sector response plans. • The NDMP requires each response agency to have agency response plans in place. For example, the Ministry of Health and National Health Service (D13), Ministry of Agriculture and Fisheries (D16). • The National Tsunami Plan identifies that the NDMO in collaboration with the DAC will organise and conduct training on the nature of tsunami, safety procedures and first aid skills. DMO is also, more generally, responsible for national training initiatives such as search and rescue and other joint disaster management training activities to ensure NEOC participants are ready for operation. • DMO provides facilities and staff for the NEOC. • National Tsunami Plan identifies the Ministry of Police and Prison as being lawfully responsible for the coordination of evacuation within the Apia Urban area. Outside of Apia this role is played by the Village Mayor to coordinate evacuations. • Tsunami exercises, which are run annually, have demonstrated that Apia's 9000 residents can be evacuated in approximately 19 minutes (D11) after the receipt of the PTWC message. Development of an multi-hazard exercise program is the responsibility of DMO in collaboration with the DAC. Exercises may be undertaken specific to target audiences such as industry sector groups. Exercises are reviewed after completion.	• Tsunami signage is currently not displayed. The National Tsunami Plan identifies this as a future requirement saying that "The DMO in collaboration with Samoa Red Cross and village mayors through MWCSD are responsible for the design and installation of these signs". • In general, critical infrastructure and lifeline support facilities have not been identified aside from some utilities that have looked at their own dependencies. • Continuation of the Village Program will ensure facilitation of warning education, response and evacuation arrangements in villages. • The DMO and NEOC office is physically located in a tsunami risk location.

Tsunami Emergency Response (including evacuation) (Continued)	
Strengths:	**Opportunities for Improvement:**

• An evacuation map exists for Apia and Salelologa urban areas with evacuation routes and safe areas at 60m or greater above sea level (D25).
• The Disaster and Emergency Management Act (D3) provides Police officers the power during an emergency to ensure safety of persons at risk by direction or with use of reasonable force and to take reasonable measures to protect property. The Act also provides for offences such as failing to comply with lawful direction during the period of an emergency.
• Instructions provided to the community for evacuation include:
  ○ Leave all vehicles, run or walk (Apia urban area);
  ○ Parents to evacuate instead of collecting their children from school;
  ○ Families to make arrangements for evacuation of elderly parents and others with special needs; and
  ○ Use all roads going inland to move to evacuation sites.
• Various GIS (Geographic Information System) layers are used as decision support tools during emergency response.
• Table 6 of the NDMP outlines the functions required during disaster response and recovery. Responsibility of reconnaissance and needs assessment of affected areas are delegated to agencies and industry sectors and overseen by the DAC.
• DAC has responsibility for coordinating recovery activities in the aftermath of any disaster or emergency.
• Ministry of Works Transport and Infrastructure – Maritime Division have a Service Continuity and Emergency Response Plan (D9) to ensure coordination of maritime search and rescue, assessment of damage to ports and harbours and restoration of port and harbour facilities.
	• (Refer above)

Tsunami Emergency Response (including evacuation) (Continued)

Recommendations:

22. Investigate the permanent relocation of critical warning and response functions within MNRE including the DMO and NEOC to a location outside of any likely tsunami impact. A strong possibility is co-location at the new Fire Service building. Also consider the safety of locations of Red Cross Disaster Relief Depots.

23. Continue the development of tsunami plans for local communities including warning and evacuation procedures. Preparation of these plans should include the production of evacuation maps and community consultation. When completed plans should be made available to the public and evacuation maps displayed in prominent locations within communities.

24. Continue to develop and conduct national tsunami exercises which test emergency management arrangements at national and community level. Ensure each exercise is followed by an evaluation of the strengths and weaknesses of the tsunami system as well as recommendations for system improvements. Ensure these recommendations are implemented and that regular tsunami exercise regimes and exercise assessment processes are included in each agencies emergency response plan.

25. Develop a national disaster recovery plan that further outlines arrangements for recovery, including the coordination of welfare, public health and infrastructure reconstruction.

26. That the MNRE use remote sensing data (such as high resolution satellite images) post disaster damage assessments.

5.3.8. Tsunami Hazard, Vulnerability, Risk and Mitigation

Strengths:	Opportunities for Improvement:

• The NDMP (Section 5) outlines Disaster Risk Reduction (Mitigation) Arrangements.
• Some measures are currently implemented through the risk reduction programmes of government and NGOs such as new developments being located further inland and away from coastal areas.
• A number of projects may assist future tsunami mitigation work. These include:
  ○ World Bank mapping of coastal infrastructure susceptible to storm damage and flooding;
  ○ Review and update the National Building Code for seismic design (planned – FY 08/09);
  ○ Complete a seismic assessment of existing buildings (planned – FY 08/09);
  ○ Establish a register of approved professional engineers endorsed by IPES (Institution of Professional Engineers of Samoa) (planned – FY 08/09);
  ○ Coastal Infrastructure Management Plans (for example, Gagaifomauga III District Implementation Guidelines (April 2007, D15)); and
  ○ Second Infrastructure Asset Management Project (SIAM-2) (D38).
• Kestrel all hazard desk study completed (including tsunami) with support of DMO and Geophysics and forms an appendix to the NDMP. Tsunami Hazard also identified in the review of Savaii volcanic hazard map.
• Both the bathymetry and topography data cover the whole of Samoa. The bathymetry chart was completed by SOPAC in 2007 up to about 20m depth (shallow water and channels missing) and topography is reasonably good (last updated 1999, 2m contours around the coastline and 20m inland).
• GA, SOPAC have completed some preliminary and probabilistic tsunami risk assessments of PICs, including Samoa.
• Historical records of earthquake and tsunami in Samoa are included in International Tsunami Database.
	• Limited technical capacity exists in Samoa to complete inundation modelling.
	• Near and on-shore numerical modelling has not yet been done, however numerical modelling based on different epicentres wave heights and amplitudes is mentioned in the Meteorology Division SOPs and National Tsunami Plan requires the Meteorology Division to create inundation maps. Future plans therefore exist (with no date) for Tsunami Hazard Zones and Inundation Mapping to be developed. This would be the responsibility of the Meteorology Division with possible support of SOPAC.
	• Existing information available from projects completed to date should be utilised to underpin emergency planning.

5.3.9. Tsunami Hazard, Vulnerability, Risk and Mitigation

Strengths:	Opportunities for Improvement:
• All villages in Samoa have gone through the Coastal Infrastructure Management Planning consultation process where some risk assessment has been done. The village based Disaster Risk Management awareness programmes then selection hazards for each village based on the Coastal Infrastructure Management Planning outcomes. • The Planning and Urban Management Act (D22) aims to ensure sustainability management plans are completed for developments by the Planning and Urban Management Agency including consideration of the suitability of the site for the proposed development including consideration of natural hazards such as flooding, earthquake, cyclone, subsidence, slip, drainage and erosion. • Impact assessments are completed in villages by response agency field personnel and reported back to national structures.	• (Refer above)

Recommendations:

27. Use the tsunami hazard studies that have been completed for the Southwest Pacific Nations to date, and any historical tsunami records (including physical evidence), to identify low-lying communities which may be potentially prone to tsunami impacts from all likely tsunami sources and commence tsunami mitigation, response and evacuation planning using local knowledge.

28. Samoa MNRE Mapping Services Section, in collaboration with the Geophysics Section, complete an inventory of the geospatial data available for tsunami and multi-hazard hazard risk assessments, modelling and mapping of populated areas.

29. Acquire the necessary baseline data for populated areas to fill identified gaps as part of a multi-hazard mapping activity. This will include acquiring high resolution topography (Light Detection and Ranging (LiDAR)) data of low-lying populated areas as well as high resolution bathymetry data for multi-hazard assessments, modelling and mapping (storm surge, tsunami, climate change).

30. Progress discussions with SOPAC regarding inundation modelling in Apia and investigate future, long-term options for completing tsunami inundation modelling for other large population and infrastructure centres. The long term aim is to conduct a comprehensive tsunami risk assessment and management study specific to Samoa. The risk assessment and management study should:

- **a.** Develop a comprehensive suite of hazard maps to assist planning;
- **b.** Be completed using a standard template that can be used in all areas and across all hazards;
- **c.** Include an assessment of all possible structural and non-structural management options;
- **d.** Investigate the incorporation of tsunami inundation and seismic hazard in land use planning instruments, in particular for critical infrastructure; and
- **e.** Feed findings into Samoa's national tsunami management strategy and community education.

31. Continue plans to conduct a study into the interdependencies of critical infrastructure lifelines and services and incorporate this knowledge into the disaster planning process for all hazards.

5.3.10. Public and Stakeholder Awareness and Education

Strengths:	Opportunities for Improvement:
• Some local knowledge of tsunami exists in South Savaii which has been previously affected by a tsunami. • The National Tsunami Plan suggests the communities take action if an earthquake is felt. • One week long Disaster Risk Management workshops (otherwise known as the "Village Program") are planned to be rolled out in Samoa's 329 villages by the end 2013 (to date two villages completed). This is an all hazard approach (depending on hazards the village is vulnerable to) and will focus on preparedness including the development of response plans and household booklets on disaster risk reduction and preparedness. After completion of this project community awareness will be assessed. $1.2M budget and will be assisted by UNESCO Cluster Office for the Pacific States. • The Village Program will also enable authorities to gather relevant information regarding village capabilities and vulnerabilities for disaster planning at the National level. • National drills for tsunami will be conducted annually. • Media campaign (funded by AusAID) includes developing TV and radio programmes on safety procedures for all hazards. Newspaper articles are also written (D39). • UNESCO will be putting further funds into the UNESCO Cluster Office for the Pacific States in Samoa. The UNESCO office will assist Samoa DMO in further developing and rolling out its Village Program and a trial project with the Samoa media. • Workshops on geohazards and cyclones are held annually for the media. • Review of curriculum in schools to develop new curriculum activities or programmes to address disaster management. This is current and will continue in financial year 08/09. To be implemented in the form of a series of workshops and coordinated by a local consultant with the Ministry of Education and the DMO. • Samoa has translated SOPAC and International Tsunami Information Centre (ITIC) materials into Samoan.	• Further funding and work is required to ensure community preparedness and awareness in remaining coastal villages for tsunami, feeding into the multi-hazard framework where possible. • Ongoing testing and assessment of community awareness is important to gauge the success of education programs and to focus efforts. • Tsunami risk assessment work completed for Samoa should be fed into public and stakeholder awareness and education programs.

Public and Stakeholder Awareness and Education (Continued)

Recommendations:

32. Continue development and implementation of tsunami public awareness and education in a multi-hazard context including:

- **a.** Establishment of tsunami signage to international standards within populated coastal areas and tourism centres, such as the airport;
- **b.** Education on the operation of the tsunami warning system, procedures and expected community response;
- **c.** Education on environmental cues associated with local tsunami;
- **d.** Education after a tsunami event focused on the size of the event, impacts and reinforcing tsunami safety messages;
- **e.** Capitalising on existing regional and international education material;
- **f.** Development of programs tailored to groups such as maritime and tourism; and
- **g.** Provision of tsunami warnings and community awareness material on a website. (Update May 2009 – Government improvement in July 2009 will improve internet speed).

33. Investigate obtaining further resources to allow the Village Program to be completed within the designated timeframes (end 2013). Through the Village Program, continue to collect traditional knowledge about tsunami and warning signals.

5.4. Additional Workshop Benefits

In addition to this report, benefits of the tsunami capacity assessment workshop in Samoa were:

- Improved understanding and documentation of capacity in Samoa to receive and respond to tsunami warnings;
- Enhanced working relationships with counterparts and associated agencies and organisations;
- Exchanged information on respective activities and capabilities;
- Open exchange of information on community awareness and preparedness planning as well as implementation and emergency response amongst workshop participants; and
- Enhanced working relationships between the Samoan participants, the Bureau, AGD and SOPAC.

5.5. Next Steps

Samoa will receive three key material outcomes from the Tsunami Capacity Assessment project:

1. The completed questionnaire in electronic format with scanned copies of all supporting documentation collected in-country;
2. A comprehensive National Report in a standard format which aims to summaries information collected from the visits and is consumable for non-technically minded recipients (this document); and
3. A copy of the final Regional Report which will outline common themes across the region.

At the agreement of the country project results will be posted on websites such as the Bureau and Pacific Disaster Net.

Once approved by the country the Bureau will facilitate dissemination of reports to regional and international donors and other stakeholders to ensure maximum exposure of results. Contingent on the availability of human and financial resources, the Bureau and project partners will aim to work with potential donors to bring the findings of this project to their attention on a country and regional scale. This will be done in the hope of further capacity development projects being undertaken based on the results of this project. .

6. Annexure

6. Annexure

6.1. Annexure 1: Record of Participants

Organisation	Position	First Name	Last Name	Postal Address	Telephone	Fax	Mobile	E-mail
Samoa Ports Authority	Marine Pilot	Captain Herman	Overhoff		64400 64440		7519622	spa@lesamoa.net
MNRE Met Division	PSO Weather	Sala Sagato	Tuiafiso	PO Box 3020 Meteorology Division, Apia, Samoa	20855/6	23141/20857	7772456	Sagato.tuiafiso@mnre.gov.ws
DMO (MNRE)	Principal Disaster Management Officer	Filomena	Nelson	Private Mail Bag, Apia, Samoa	685-20856 685-20855	685-23176 685-23141	7793003	Filomena.nelson@mnre.gov.ws
DMO (MNRE)	Disaster Management Officer – Operations	Rhoda	Lee-Chee	Private Mail Bag, Apia, Samoa	685-23176 685-20855	685-23176 685-23141	7223524	Rhoda.lee-che@mnre.gov.ws
Ministry of Agriculture & Fisheries	Senior Advisory Officer	Emmanuel Amosa	Ah Leong	PO Box 2778	20605/23416	20707	7791425 or 7515750	eahleong@gmail.com
Ministry of Agriculture & Fisheries	Fisheries Officer, Offshore Section	Iulia	Kelekoho	PO Box 9063	20369/22624	24292	7773438 or 7208494	ikelekoho@gmail.com
Ministry of Education, Sports & Culture	PEO – School Performance	Vaiaso	Finau	Po ox 2740	21911 Ext 785	21197	7771661	vfinau@hotmail.com

Organisation	Position	First Name	Last Name	Postal Address	Telephone	Fax	Mobile	E-mail
UNDSS	Regional Security Advisor	Sabir	Mughal	Private Mail Bag, Samoa	20505	20837	7785430	Sabir.mughal@undp.org
MNRE	Scientific Officer	Malaefatu	Leavasa	PO Box 3020	20855/20856	20857	7511547	Malaefatu. Leavasa@mnre.gov.ws
MNRE	Marine Conservation Officer	Isamaeli	Asofasuz				7511361	asofasuz@mnre.gov.wa
Digicel Samoa	Special Projects Manager	Waikato	Lefale	PO Box 847 Vaimea, Apia, Samoa	7775588	28005	7775588	Waikato.fatu@digicelsamoa.ws
MNRE	Senior Forestry Research Officer	Mr Setoa	Auvele	MNRE Private Bag	2105 & 22729		7717975	
MNRE	Senior Mapping Officer	Mr Petania	Tuala	MNRE	22481		7783139	Petania.tuah@mnre.gov.ws
WMO	WMO Rep	Mr Henry	Taiki	PO Box 3044 SPREP Centre	25706	25771	7525706	htaiki@wmo.mt
MNRE	Terristerial Conservation Officer	Miss Moeumu	Uli	MNRE Private Bag	23800		7716034	Moeumu.uli@mnre.gov.ws
UNDP	Disaster Management Program Officer	Ms Anna	Gero	Private Bag Matautu-uta Apia, Samoa	7599312		7599312	Anna.gero@undp.org
MNRE Met	Meteorology Advisor	Mr Yoshimichi	Kawano	PO Box 3020 Mulmu, Apia, Samoa	20855	20857	7778906	Yoshimichi.kawano@mnre.gov.ws
MWTI	Safety Inspector	Mr Tafai	Toilolo		21611		7770691	ttoilolo@tahoo.co.uk
MNRE	Snr Scientific Officer	Ms Siosina	Lui	MNRE	20996		7223567	Siosina.lui@mnre.gov.ws

6.2. Annexure 2: The Visiting Assessment Team

Team Position	Name	Position within Organisation	Organisation	Contact Details
Natural Hazard Warning Expert and Team Leader	Rob Webb	Supervising Meteorologist – New South Wales Regional Forecasting Centre	Australian Bureau of Meteorology	r.webb@bom.gov.au Ph. +61 2 9296 1528 Fax. +61 2 9296 1619
Emergency Management Expert	Vanessa Coli	A/Manager Emergency Coordination Incident Management Facility (IMF)	Emergency Management Australia	vanessa.coli@ema.gov.au Phone. +61 (0)2 6256 4679 Fax. +61 (0)2 6256 4755
Emergency Management Expert	Andrew Gissing	Manager Planning	New South Wales State Emergency Services	Andrew.gissing@nsw.ses.gov.au Ph. +61 2 4224 2270 Fax. +61 2 4226 2167
Data Communications Expert	Garry Clarke	International Operations Manager, Meteorological Service of New Zealand Ltd	For the Australian Bureau of Meteorology	Garry.Clarke@metservice.com Ph. +64 4 4700774
Regional Expert	Noud Leenders	Community Risk Management Adviser	South Pacific Applied Geoscience Commission	Noud@sopac.org agleenders@gmail.com Ph. +679 (338) 1377 Fax. +679 (337) 0040

6.3. Annexure 3: Agenda, Samoa Tsunami Capacity Assessment Workshop

National Capacity Assessment of Samoa's Tsunami Warning and Mitigation System

WORKSHOP AGENDA 28 April – 1 May 2008

DAY 1: Monday 28 April 2008

SESSION 1: OPENING CEREMONY AND INTRODUCTORY PRESENTATIONS

LOCATION: MNRE Conference Room, Level 5, Development Bank of Samoa Building

CHAIR: Rob Webb, Australian Bureau of Meteorology

Time	Item	Questionnaire Reference	Duration	Participation
9.00 – 9.30am	**Registration / Tea and Coffee**	NA	0.5hr	Open
9.30 - 10.30am	**Opening Ceremony**	NA	1hr	Open
10.30 – 11.00am	**Official Opening Morning Tea**	NA	0.5hrs	Open
11.00 – 11.30am	**Presentation – Visiting Assessment Team Leader** • *Introduction to the tsunami capacity assessment project* ***Presenter: Rob Webb & Noud Leenders***	NA	0.5hrs	Open
11.30 – 12.30pm	**Presentations – Filomena Nelson (Principal Disaster Management Officer) & Siosinamele Lui (Senior Geo-physics Officer)** • *Tsunami warning and mitigation in Samoa*	NA	1hr	Open

Time	Item	Questionnaire Reference	Duration	Participation
12.30 – 1.30pm	**Lunch**	**NA**	**1hr**	**Open**
SESSION 2:	**ORGANISATIONS, COMMITTEES, LEGISLATION, STRATEGY AND COOPERATION**			
LOCATION: MNRE Conference Room, Level 5, Development Bank of Samoa Building				
CHAIR: Rob Webb, Australian Bureau of Meteorology				
Time	**Item**	**Questionnaire Reference**	**Duration**	**Participation**
1.30 – 2.30pm	*Focus Groups – Samoa's priorities for implementing an effective tsunami warning and mitigation system*	*Section 4*	*1hr*	*Open*
2.30 – 3.30pm	**Capacity Assessment – Organisations, Committees and Legislation**			
	Organisations involved in tsunami warning and mitigation in Samoa	*Section 2, Part A*	*1hr*	*Open*
	Tsunami warning and mitigation coordination committees at National, and village level in Samoa	*Section 2, Part B*		
	Legislation relevant to tsunami warnings and emergency response	*Section 2, Part C*		
3.30 – 4.00pm	**Afternoon tea**	**NA**	**0.5hrs**	**Open**
4.00 – 5.00pm	**Capacity Assessment – Strategy, International and Regional Cooperation, All Hazards Approach**			
	Disaster risk reduction strategy in Samoa	*Section 2, Part D*	*1hr*	*Open*
	International and Regional cooperation for tsunami warning and mitigation in Samoa	*Section 2, Part E & F*		
	All-hazards approach	*Section 3*		
5.00pm	**CLOSE**			

DAY 2: Tuesday 29 April 2008

SESSION 3: RESEARCH, MONITORING AND WARNING

LOCATION: MNRE Conference Room, Level 5, Development Bank of Samoa Building

CHAIR: Vanessa Coli, Emergency Management Australia

Time	Item	Questionnaire Reference	Duration	Participation
9.00 – 9.30am	**Setting the Scene: Tsunami Warnings & Communication** ***Presenter: Rob Webb & Garry Clarke***	**NA**	**0.5hrs**	**Open**
9.30 – 11.30am	**Capacity Assessment – Research, Monitoring, Warning and Emergency Response**			
9.30 – 10.00am	*Research and development expertise*	*Section 5*	*0.5hr*	*Open*
10.00 – 10.30am	***Tsunami monitoring including:*** • *Tsunami monitoring infrastructure (seismic network, sea level network and utilisation of satellites for data communication)* • *Case Study – Use of this monitoring infrastructure for the 3 May 2006 Tongan Trench Event*	*Section 6, Part A, B, C & Case Study – Monitoring Systems*	*0.5hrs*	*Open*
10.30 - 11.00am	**Morning Tea**	**NA**	**0.5hrs**	**Open**
11.00 – 1.00pm	***Tsunami warning system in Samoa including:*** • *International communication cooperation* • *National tsunami warning centre* • *Receipt of advisories from PTWS* • *Procedures for dissemination of tsunami warnings Nationally, once received from PTWS*	*Section 7, Part A, B, C, D, E, F, G, Case Study – Tsunami Advisory Messages and Warnings & Part H*	*2hrs*	*Open*

Time	Item	Questionnaire Reference	Duration	Participation
	Tsunami warning system in Samoa <u>continued</u> including: • *Issuing warnings for marine vessels, harbours and ports* • *Case Study – Receipt of international advisories and dissemination of warnings nationally for the 3 May 2006 Tongan Trench Event* • *CONCLUSION – Strengths and weaknesses of tsunami warnings*	*As above*	*As above*	*As above*
1.00 – 1.30pm	**Lunch**	**NA**	**0.5hr**	**Open**
SESSION 4: SITE TOURS				
LOCATION: Various				
CHAIR: NA				
1.30 – 5.00pm	Visiting Assessment Team tours of sites and facilities important to tsunami warning and mitigation within Samoa including: Upolu Island Tide Gauge at Matatutu Wharf (Apia) Afiamalu Seismic Station (Afiamalu) Savaii Island Satupaitea	NA	3.5hrs	Relevant Agencies & Assessment Team

DAY 3: Wednesday 30 April 2008

SESSION 5: TSUNAMI EMERGENCY RESPONSE, MITIGATION AND PREPAREDNESS

LOCATION: MNRE Conference Room, Level 5, Development Bank of Samoa Building

CHAIR: Rob Webb, Australian Bureau of Meteorology

Time	Item	Questionnaire Reference	Duration	Participation
9.00 – 9.30am	**Setting the Scene: Community Awareness, Capacity Building & Risk Assessment Based Emergency Planning** ***Presenter: Andrew Gissing & Vanessa Coli***	**NA**	**0.5hrs**	**Open**
9.30 – 10.30am	**Emergency response to tsunami in Samoa** • *Assessing the capacity of the disaster management system in Samoa and identifying training needs* • *Emergency response and recovery plans* • *Evacuation (including evacuation legislation)*	**Section 8, Part A, B & C**	**1hr**	**Open**
10.30 – 11.00am	**Morning Tea**	**NA**	**0.5hrs**	**Open**
11.00 – 12.30pm	**Emergency response to tsunami in Samoa <u>continued</u> including:** • *GIS use for emergency response* • *Testing and exercising* • *Consideration of critical infrastructure* • *Tsunami mitigation efforts* • *The role of NGOs in tsunami warning and mitigation* • *Case Study – Preparedness and response for the 3 May 2006 Tongan Trench Event*	**Section 8, Part D, E, F, G, H & Case Study – Preparedness and Response**	**1.5hrs**	**Open**

Time	Item	Questionnaire Reference	Duration	Participation
12.30 – 1.30pm	**Lunch**	**NA**	**1hr**	**Open**
SESSION 6: TSUNAMI HAZARD, VULNERABILITY AND RISK AND COMMUNITY AWARENESS				
1.30 – 5.00pm	**Capacity Assessment – Hazard, Vulnerability and Risk Studies and Community Awareness**			
1.30 – 2.30pm	***Tsunami hazard, vulnerability and risk studies in Samoa including:*** • *Post tsunami surveys* • *Tsunami hazard, vulnerability and numerical modelling studies* • *Community participation in assessing the tsunami risk*	*Section 9, Part A, B, C, D, E, F*	*1hr*	*Open*
2.30 – 3.00pm	**Afternoon Tea**	**NA**	**0.5hrs**	**Open**
3.00 – 5.00pm	***Public and stakeholder awareness and education regarding tsunami in Samoa including:*** • *Assessment of public awareness* • *The role of public awareness in understanding warnings and taking action* • *Public awareness and education programs* • *Media education programs* • *Tsunami memorials and museums*	*Section 10, Part A, B, C, D*	*2hrs*	*Open*
5.00pm	**CLOSE**			

Time	Item	Questionnaire Reference	Duration	Participation
DAY 4: Thursday 1 May 2008				
SESSION 6: PRESENTATION OF PRELIMINARY ASSESSMENT FINDINGS				
LOCATION: MNRE Conference Room, Level 5, Development Bank of Samoa Building				
CHAIR: Rob Webb, Australian Bureau of Meteorology				
10.00 – 11.30am	**Preliminary summary presentation** from the Visiting Assessment Team – Samoa's strengths, needs, preliminary recommendations, priority review and next steps	**NA**	**1.5hr**	**Open**
11.30 – 12.00pm	**Questions and Feedback** from Samoa participants on preliminary summary presentation and the assessment process in general.	**NA**	**0.5hrs**	**Open**
12.00 – 12.15pm	**ACKNOWLEDGEMENTS AND CLOSE**	**NA**	**15mins**	**Open**
12.15 – 1.00pm	**CLOSING LUNCH**	**NA**	**45mins**	**Open**
1.00 – 4.00pm	Additional site visits (if required by assessment team)	NA	As required	Relevant Agencies and Assessment Team

6.4. Annexure 4: Supporting Documents Log

Ref.	Document Name	Copy Obtained (Y/N)	Format (H = Hard Copy) (E = Electronic)
D1	National Disaster Management Plan 2006	Y	E
D2 D2.1	National Disaster Management Plan Annual Implementation Plan (2 versions, 1 approved)	Y	E
D3	Disaster and Emergency Act	Y	E
D4	DNREM Emergency Response Plan	Y	E
D5 D5.1	Tsunami Plan 2 versions distant and regional	Y	E
D6	Police Act	Y	E
D7	Communications Act	Y	E
D8	Met Section SOPs – dealing with Tsunami – updated version	Y	E
D9	Ports Authority Response Plan	Y	E
D10	Communications Authority Response Plan	Y	E
D11	2007 Tsunami Evacuation Exercise Report	Y	E
D12	SamoaTel – Service Continuity and Emergency Response Plan – As per Doc 10	Y	E
D13	Department of Health – Service Continuity and Emergency Response Plan	Y	E
D14	Red Cross Response Plan	Y	E
D15	Coastal Infrastructure Management Plan - Gagaifomauga III District	Y	E
D16	Emergency Plan for Agriculture - preparedness	Y	E
D17	MOU regarding earthquake studies between China Earthquake Administration and Samoa MNRE	Y	E (took photos)
D18	Emergency Response Plan for the Ministry of Women, Community Services and Development	N	
D19	SOPs developed for a felt earthquake	N	
D20	Detailed Tsunami Warning Procedures – need to find out what the difference between a watch and a warning is.	N	
D21	DMO SOPs	Y	E
D22	Planning and Urban Management Act	Y	E
D23	Final Technical Report Review of Savai'i volcanic hazard map	Y	E
D24	National Tropical Cyclone Plan	Y	E
D25	Apia Urban Area Evacuation Area	Y	E
D26	Hazard Contingency Plan – Tsunami	N	
D27	"Mou" TBTO and USGS transferred 1965 (photo's)	N	
D28	IOC membership agreement	N	
D29	SOPAC AS 2007	N	
D30	Monitoring Network and Instruments.doc	N	
D31	SOPs for felt earthquake (to be gathered)	N	
D32	EMA International contact list	N	
D33	Tsunami Watch from the Solomons Event	N	
D34	Samoa flood modelling study (SOPAC)	N	

Ref.	Document Name	Copy Obtained (Y/N)	Format (H = Hard Copy) (E = Electronic)
D35	Project proposal/document for developing risk avoidance and mitigation activities	N	
D36	SIAM one/two doc	N	
D37	The Tsunami of 22 May 1960, In the Samoa and Cook Islands (J. G. Keys)	Y	E
D38	Second Infrastructure Asset Management Project (SIAM-2) Project Summary	Y	E (link to website)
D39	Tsunami Newspaper Article	Y	E
D40	NDMP Annual Implementation Plan 2008_2013_V5_20081208.xls	Y	E

6.5. Annexure 5: Definitions

Used in reports for SOPAC Member Countries National Capacity Assessment: Tsunami Warning and Mitigation Systems

Source: United Nations, International Strategy for Disaster Reduction, 2009

Capacity

A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

Capacity building

Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk.

In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.

Disaster

A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.
A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.

Disaster risk management

The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

Disaster risk reduction (disaster reduction)

The reduction of disaster risks and adverse impacts of natural hazards, through systematic efforts to analyse and manage the causes of disasters, including through avoidance of hazards, reduced social and economic vulnerability to hazards, and improved preparedness for adverse events

Early warning

The provision of timely and effective information, through identified institutions, that allow individuals exposed to a hazard, to take action to avoid or reduce their risk and prepare for effective response.

Early warning systems include of three primary elements: (i) forecasting of impending events; (ii) processing and dissemination of warnings to political authorities and population; and (iii) undertaking appropriate and timely actions.

Emergency management

The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation.
Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.

Geographic information systems (GIS)

Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced.
Geographical information systems are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.

Hazard

A potentially damaging physical event, phenomenon and/or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) and/or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.

Land-use planning

Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions.

Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.

Land-use planning can help to mitigate disasters and reduce risks by discouraging high-density settlements and construction of key installations in hazard-prone areas, control of population density and expansion, and in the siting of service routes for transport, power, water, sewage and other critical facilities.

Mitigation

Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.

Natural hazards

Natural processes or phenomena occurring in the biosphere that may constitute a damaging event.
Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.

Preparedness

Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary removal of people and property from a threatened location.

Prevention

Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters.

Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".

Public awareness

The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. This is particularly important for public officials in fulfilling their responsibilities to save lives and property in the event of a disaster.
Public awareness activities support changes in behaviour leading towards a culture of prevention. This involves public information, dissemination, education, radio or television broadcasts and the use of printed media, as well as, the establishment of information centres and networks and community and participation actions.

Recovery

Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.

Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.

Relief / response

The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

Resilience / resilient

The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Risk

The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable conditions.

Conventionally risk is expressed by the notation
Risk = Hazards x Vulnerability
Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.

Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes.

Risk assessment/analysis

A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.

The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability; and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capabilities pertinent to the risk scenarios.

Structural / non-structural measures

Structural measures refer to any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure.

Non-structural measures refer to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts.

Vulnerability

A set of conditions and processes resulting from physical, social, economic, and environmental factors, which increase the susceptibility of a community to the impact of hazards.

6.6. Annexure 6: References

- Australian Agency for International Development (AusAID) and Australian Bureau of Meteorology 2006, *Schedule 5 to the Record of Understanding 14304 in relation to cooperation between the Australian Bureau of Meteorology and AusAID for SOPAC Member Countries National Capacity Assessment: Tsunami Warning and Mitigation Systems,* AusAID, Canberra.
- Government of Samoa, Apia, Samoa, viewed March, 2009, <http://www.govt.ws>
- Greenslade D. J. M, Simanjuntak M.A., Burbidge D., and Chittleborough D., 2007, A First-generation Real-time Tsunami Forecasting System for the Australian Region, *BMRC Research Report No 126*, Bureau of Meteorology, Australia.
- Hill P.J., Tiffin, D.L., 1993: Geology, sediment patterns and widespread deformation on the sea-floor of Western Samoa revealed by wide-swath imagery. Geo-marine Letters 13: 116-125.
- Intergovernmental Oceanographic Commission, a division of the United Nations Educational, Scientific and Cultural Organisation, *Assessment of Capacity Building Requirements or an Effective and Durable Tsunami Warning and Mitigation System in the Indian Ocean, Consolidated Report for Countries Affected by the 26 December 2004 Tsunami,* viewed 2008, <http://ioc3.unesco.org/indotsunami/nationalassessments.htm>
- IOC's Tsunami Program, Intergovernmental Coordination Group for the Pacific Tsunami Warning System (ICG/PTWS), International Tsunami Information Centre October, viewed January 2009, <http://ioc3.unesco.org/itic/contents.php?id=179>
- Keating, B.H., Helesley, C.E., Karogodina, I. 2000: Sonar studies of submarine mass wasting and volcanic structures of Savaii Island, Samoa. Pure and applied geophysics 157: 1285-1313.
- Pacific Tsunami Warning Centre 2008, National Oceanographic and Atmospheric Administration (NOAA), U.S.A, viewed January, 2009, <http://www.prh.noaa.gov/ptwc>
- Samoa Country Brief – February 2009, Australian Department of Foreign Affairs and Trade, Canberra, viewed March, 2009, < http://www.dfat.gov.au/geo/samoa/samoa_brief.html>
- Thomas, C. and Burbidge, D. 2009. A Probabilistic Tsunami Hazard Assessment of the Southwest Pacific Nations. *Geoscience Australia Professional Opinion No. 2009/02.*
- Thomas, C., Burbidge, D., Cummings, P., 2007. *A Preliminary study into the Tsunami Hazard faced by Southwest Pacific Nations*. Risk and Impact Analysis Group, Geoscience Australia.
- Terminology: Basic terms of disaster risk reduction March 2004, United Nations, International Strategy for Disaster Reduction, viewed January, 2007, <http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm>
- Warne, J., 2008, Summary - Tsunami Threat Source for Samoa, Australian Government Bureau of Meteorology.

7. CD Attachment

7. CD Attachment - Supporting Documents

a. Assessment Questionnaire

b. Supporting Documents

c. Presentations