

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

Kingdom of Tonga



Kingdom of Tonga



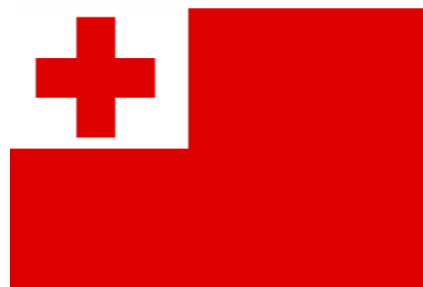


SOPAC Member Countries National Capacity Assessments: Tsunami Warning and Mitigation Systems

TONGA

Nuku'alofa

29 May – 1 June 2007



Document Control

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TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

Acronyms

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
D	Document (e.g. Document 39 = D39) as listed in Annexure 4
DFAT	Australian Department of Foreign Affairs and Trade
DRM	Disaster Risk Management
EMA	Emergency Management Australia
EMWIN	Emergency Managers Weather Information Network
FSPI	Foundation of the Peoples of the South Pacific International
GA	Geoscience Australia
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences
GTS	Global Telecommunications System
HF	High Frequency
ICG	Intergovernmental Coordination Group
IOC	Intergovernmental Oceanographic Commission
ISDR	International Strategy for Disaster Reduction
ITSU	Tsunami Warning System in the Pacific (previous name)
JICA	Japan International Cooperation Agency
JMA	Japanese Meteorological Agency
LiDAR	Light Detection and Ranging
MLSNRE	Ministry of Land, Survey, Natural Resources and Environment
MMI	Modified Mercalli Intensity Scale
MoU	Memorandum of Understanding
Mw	Moment Magnitude
NAP	National Action Plan
NDC	National Disaster Council
NDMP	National Disaster Management Plan
NEMC	National Emergency Management Committee
NEMO	National Emergency Management Office
NEOC	National Emergency Operations Centre
NGOs	Non-Government Organisations
NTC	National Tidal Centre
NZ	New Zealand
PGSP	Pacific Governance Support Program
PICs	Pacific Island Countries
PTWC	Pacific Tsunami Warning Centre
PTWS	Pacific Tsunami Warning and Mitigation System
SAMFS	South Australia Metropolitan Fire Service
SMS	Short Message Service
SOPAC	Pacific Islands Applied Geoscience Commission
SOPs	Standard Operations Procedures
TBC	Tonga Broadcasting Commission
TCC	Tongan Communication Corporation
TDS	Tonga Defence Service
TMS	Tongan Meteorological Service

Acronyms (Continued)

UNESCO	United Nations Educational, Scientific and Cultural Organisation
USA	United States of America
USAR	Urban Search and Rescue
USGS	United States Geological Survey
UTC	Coordinated Universal Time
VHF	Very High Frequency
WMO	World Meteorological Organisation



Section

1

1. Results Outline

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

1. Results Outline

1.1. Executive Summary

Between the 29 May and 1 June 2007, a team of international experts led by the Australian Bureau of Meteorology (the 'Bureau') completed an assessment of the Kingdom of Tonga's tsunami warning and mitigation system. Tonga was the first of 14 countries to be assessed and as such was treated as a pilot assessment. This report is the result of that assessment visit. The report aims to better guide national and donor funding and projects towards targeted enhancements in Tonga's tsunami warning and mitigation system by outlining the strengths, opportunities for improvement and recommendations.

The initial receipt and forwarding of tsunami advisories produced by the Pacific Tsunami Warning Centre (PTWC) in Hawaii is the responsibility of the Tongan Meteorological Service (TMS). The National Emergency Management Office (NEMO) leads emergency planning and mitigation efforts and coordinates emergency response. Seismic detection throughout the Kingdom is the responsibility of Geosource Tonga. All three of these agencies have significant skills in their fields, but are resource limited. Enhancement of coordination between national agencies could improve the use of existing resources and significantly improve tsunami warning, response and mitigation. Tonga is well connected to international and regional forums to aid cooperation in tsunami warning and mitigation efforts.

In-country, Tonga is working towards improving the legislative and planning framework as well as coordinating efforts at a national and local level for disaster management. Tsunami will be incorporated into this planning in the interest of maintaining a multi-hazard approach. Tonga would benefit from working towards a strategic plan (e.g. Disaster Risk Management (DRM) National Action Plan (NAP)) to guide priorities for improvement of their tsunami warning and mitigation system. Preferably, these priorities would be based on a better understanding of the risk of tsunami and other hazards to Tonga.

A preliminary Tsunami Hazard Assessment of the Southwest Pacific was completed in 2007 by SOPAC and Geosciences Australia. This used deepwater tsunami propagation models to identify critical sources for Tonga. These models can be used as input into local inundation modelling to understand potential risk and impacts. However, high resolution bathymetry and topography data are needed to undertake tsunami inundation modelling to identify the tsunami risk faced by local Tongan communities. This type of data is currently only available for Tongatapu.

International tsunami information bulletins are received by Tonga and 24/7 arrangements are in place to disseminate national warnings to the Tongan population. However, national media operations, which are the main source of warning dissemination to the community, are not manned 24/7. Tonga's national tsunami warning system would benefit from improvements in last mile tsunami warning dissemination methods to the community (e.g. formalising the use of Church bells and Short Message Service (SMS) to alert then public). Technical system redundancies could also be significantly improved to ensure robustness (e.g. back-up power supplies, essential computing and communication equipment, etc). Although some seismic monitoring infrastructure exists in Tonga that could potentially be used for characterising locally generated tsunami, this data is generally not used in real time to inform the tsunami warning process nationally. The data is also not shared internationally to enhance PTWC warnings.

A draft tsunami response plan exists for Tonga. Finalisation and acceptance of this plan and regular, coordinated national testing exercises would be beneficial to enhance planning and preparedness. Whilst the community is already extremely resilient and prepared for other natural hazards, such as cyclones, further community preparedness and awareness is required for

tsunami. Tsunami evacuation plans for some population centres exist, but require significant consideration and improvement for implementation. Community (including media) awareness programs are conducted for other hazards within Tonga. Incorporation of tsunami into these programs is required to enhance the communities understanding of how to respond to a warning and how to react to locally felt earthquakes. Once the community is further educated about the tsunami threat from the nearby Tonga Trench, officials will need to advise the public when to take to avoid perceived 'false alarms'.

Tonga workshop participants are encouraged to use this National Tsunami Capacity Assessment report to guide both national projects and aid funded projects to achieve targeted improvement in Tonga's tsunami warning and mitigation system. In turn, this will assist in improving systems for other 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 Tonga’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 Tonga’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 by Tonga 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 to improve Tonga’s tsunami warning and mitigation system.

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Review of DRM related legislation and National Disaster Management Plan (NDMP) to facilitate finalisation of agency roles and responsibilities in relation to tsunami and other hazards.	Low	Authority and Coordination	Multi-hazard	1
Very High	Establishment of a formal national tsunami management consultative committee, on which key agencies, organisations, and at-risk communities are represented to lead development of tsunami response plans and procedures for Tonga. Once these plans are endorsed, include tsunami warning and mitigation topics under the three National Emergency Management Committee (NEMC) working groups, ensuring all key agencies are involved and a mechanism developed to link the work of these groups to communities and vice versa.	Low	Authority and Coordination	Tsunami specific	2
Very High	Continue to demonstrate the benefits of DRM to Government, to facilitate commitment to the DRM agenda in order to deliver tangible benefits to the community.	Low	Authority and Coordination	Multi-hazard	4
Very High	Continue to build the credibility of Tonga’s national tsunami warning provider with the public through actions such as on air broadcasts for TMS staff both routinely (to raise awareness) and during an event. The impact of the warning can be amplified by hearing it direct from an expert. In this regard closer relations between the TMS and the Tonga Broadcasting Commission (TBC) and Tonga Communication Corporation (TCC) should be pursued to facilitate effectiveness of warning dissemination.	Low	Tsunami warnings	Multi-hazard	14

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Finalisation of the draft Tonga Tsunami Response Plan (2007) including mitigation, preparedness, response (including evacuation) and recovery.	Low	Tsunami Emergency Response (including evacuation)	Tsunami specific	22
Very High	Development of improved 'last mile' warning methods. This should include an evaluation of different warnings methodologies which would be best used in the Tongan context. Ideally, multiple mediums should be used, some of which are technology infrastructure independent (such as church bells). Technology options include: <ul style="list-style-type: none"> • Implementing a broadcast option for SMS text warnings • Using 24/7 manned Coastal Marine Radio Station with identified capability of operating out of hours on public frequencies. 	Low – High (depending on action taken)	Tsunami warnings	Multi-hazard	15
Very High	Analysis of adequate staffing at TMS needs to be undertaken to allow the office to maintain 24/7 arrangements for tsunami and other warnings. The analysis should then support requests to the National Government for increased funding.	Medium	Tsunami warnings	Multi-hazard	11

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	<p>Consideration should be given to boosting the resources available to the NEMO, including:</p> <ul style="list-style-type: none"> • Physical resources (computers, whiteboards, field radios etc.); • Adequate staff resources to allow for leave, sickness etc.; • Progressing the NEMO to 24/7 on call operations, including a mechanism for receiving emergency calls and warnings and subsequently activating the National Emergency Operations Centre (NEOC); and • Information management system software and data displays. 	Medium	Tsunami Emergency Response (including evacuation)	Multi-hazard	23
Very High	<p>Develop evacuation plans for Nuku'alofa and other coastal communities, based on risk assessment, Geographic Information System (GIS) information and evacuation modelling (if possible). This plan should be supported by an evacuation centre management plan, the production of evacuation maps and community consultation and communication of resulting plans.</p>	Medium	Tsunami Emergency Response (including evacuation)	Tsunami specific	24
Very High	<p>Tsunami plans and arrangements, once finalised, should be exercised at least at the strategic level on an annual basis. Full deployment exercises should be conducted (with the intention that they expose gaps and shortcomings) on a twice-yearly basis.</p>	Medium	Tsunami Emergency Response (including evacuation)	Tsunami Specific	26

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	<p>Establish a comprehensive, structured tsunami public awareness program to improve the awareness and preparedness of the Tongan population. Where possible, this program should:</p> <ul style="list-style-type: none"> • Be conducted in an multi-hazard approach; • Be integrated into existing programs (e.g. Natural Disaster Week) and educational frameworks such as school curriculum, vocational education and training; • Be based on scientific data including risk assessment and modelling; • Ensure the delivery methodologies follow best practice in Tonga (e.g. what has worked for other hazards?); • Be developed across agencies to include consideration of all components of tsunami warning and mitigation within Tonga; • Be evaluated to gauge its success; • Take advantage of material already developed by Regional and International bodies, including visual tools; and • Identify the key messages and target audiences for each activity. 	Medium (depending on scale)	Public and Stakeholder Awareness and Education	Tsunami specific	32
Very High	Make locally monitored seismic information available in real-time to international community through global networks.	High	Tsunami Monitoring Infrastructure	Tsunami specific	10

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	The effectiveness of the warning message could be improved by the addition of local content from other agencies. E.g., pre-prepared and agreed messages to the community regarding significant residual currents and tides when cancellations are issued.	Low	Tsunami warnings	Tsunami specific	13
High	Issuance of no threat advice to the public concerning small (felt) earthquakes as well as tsunami in the region, which do not have the potential to threaten Tonga. This will help prevent unnecessary public concern as awareness of threat and risk increases, and will reduce possible false alarms associated with felt earthquakes.	Low	Tsunami warnings	Tsunami specific	16
High	Ensure radio transceivers and satellite phones are accessible and operational 24/7 for the receipt of warnings.	Medium	Communications	Multi-hazard	19
High	Transfer of existing hazard and vulnerability database established in Ministry of Land, Survey, Natural Resources and Environment (MLSNRE) (GeoSource Tonga) into a decision making tool for relevant Government departments.	Medium	Tsunami Hazard, Vulnerability, Risk & Mitigation	Multi-hazard	28
High	Continue formulation of DRM structures and plans on the outer islands and district level that are formalised by legislation and involve the relevant District and Town Officers and other community members. Set-up of reporting arrangement between these remote committees and agencies with National responsibilities such as the NEMO.	Medium	Authority and Coordination	Multi-hazard	3
High	Investigate options for enforcement of the building code which would increase the overall level of the building standard and, as a result, make buildings more resilient to hazards such as earthquakes and tsunami.	Medium	Tsunami Hazard, Vulnerability, Risk & Mitigation	Multi-hazard	30

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Conduct a needs analysis for replacement of critical older communications equipment and communication redundancies and schedule into budget / funding plan where possible.	Medium – High (depending on needs)	Communications	Multi-hazard	21
High	<p>Ensure system redundancies are in place by undertaking a critical path analysis. Some steps may include:</p> <ul style="list-style-type: none"> • Define the parameters that determine success (e.g. a warning issued within x minutes) • Determine the elements that are critical to the success of the warning process (e.g. staff resources) • Determine what items contribute to the success of these individual elements (e.g. Meteorologist to analyse the warning information and issue the warning) • Determine how to ensure redundancies are in place for each item (e.g. back up arrangements for critical staff, on call staff arrangements) <p>This process can be repeated for hardware, software etc.</p>	Medium – Very High (depending on action taken)	Tsunami warnings	Multi-hazard	17
High	Include a training needs analysis for key front line agencies involved in tsunami warning and response in the National Tsunami Plan. In the plan, identify a strategy for development and implementation of competency based training including participating in training courses provided by regional and international organisations. In particular, training of NEMO's communications staff member is required to enable system maintenance.	High	Public and Stakeholder Awareness and Education	Tsunami specific	31

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Because the need to issue a tsunami warning occurs relatively infrequently it is important that a clear set of Standard Operating Procedures (SOPs) are provided to all operators in the warning centre and response agencies. The SOPs should be succinct and clear to enable users to follow instantly. The TC Operations Procedures would provide a basis.	High	Tsunami warnings	Tsunami specific	12
High	As High Frequency (HF) and Very High Frequency (VHF) radios and satellite phones used only in analogue voice mode, recommend implementation of digital modes for exchange of data via radio to automate dissemination of warnings.	High	Communications	Multi-hazard	18
High	Real time seismic monitoring and evaluation of local tsunamigenic earthquakes at office responsible for 24/7 tsunami warning.	Very High	Tsunami Monitoring Infrastructure	Tsunami specific	9
High	Acquire the necessary baseline data for population centres as part of a multi-hazard mapping activity. This will include acquiring high resolution topography (Light Detection and Ranging (LiDAR)) data particularly of low-lying populated areas as well as high resolution bathymetry data to assist in multi-hazard assessments, modelling and mapping (e.g. storm surge, tsunami, climate change).	Very High	Tsunami Hazard, Vulnerability, Risk & Mitigation	Multi-hazard	29
High	Seek international and regional support with inundation modelling for coastal communities on Tongatapu and other vulnerable islands to underpin response and evacuation planning. Include training in use of inundation modelling to develop national capacity in risk assessments and response planning.	Very High	Tsunami Hazard, Vulnerability, Risk & Mitigation	Tsunami Specific	27

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High – Medium	Conduct post tsunami event reviews in-country and feed into reviews coordinated for the Southwest Pacific region using existing structures such as the PTWS and the PTWS Southwest Pacific Tsunami Working Group.	Low	Regional and International Coordination	Tsunami specific	6
Medium - High	Continue to utilise existing expertise and output from organisations such as Intergovernmental Coordination Group (ICG) of the PTWS, Pacific Islands Applied Geoscience Commission (SOPAC), Pacific Disaster Risk Management Partnership Network, near neighbours etc. and developing formal hazard research partnerships between relevant agencies as appropriate.	Low	Research Expertise	Multi-hazard	8
Medium	DRM and tsunami information should be shared both regionally and internationally through existing mediums such as Pacific Disaster Net.	Low	Regional and International Coordination	Multi-hazard	7
Medium	Develop and maintain a central database of satellite phone numbers of critical agencies and posts.	Low	Communications	Multi-hazard	20
Medium	Continue relationship building with the media by providing information sessions on topics such as the science of tsunami, how to interpret the warnings and what the community should do when they hear the warning.	Low	Public and Stakeholder Awareness and Education	Tsunami specific	33
Medium	Continue engagement by Tonga in the Pacific Tsunami Warning and Mitigation System (PTWS) Southwest Pacific Tsunami Working Group and communication back to key agencies in-country regarding the outcomes of the meeting.	Medium	Regional and International Coordination	Tsunami specific	5

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Medium	Tonga Fire Authority expands the current Memorandum of Understanding (MoU) with South Australia Metropolitan Fire Service (SAMFS) to include Urban Search and Rescue (USAR) and confined space rescue equipment and training (Category 1 USAR).	Medium	Tsunami Emergency Response (including evacuation)	Multi-hazard	25



Section

2

2. Project Background

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

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, Non-Government Organisations (NGOs) 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, 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 Bulletins/Statements. 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 New Zealand (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.

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT



3. Country Background and the Tsunami Threat

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

3. Country Background and the Tsunami Threat

3.1. About the Kingdom of Tonga

The Kingdom of Tonga is a constitutional monarchy, unique in the Pacific. Under its Constitution of 1875, the Government consists of the King in Privy Council and Cabinet, the Legislative Assembly and the Judiciary. Tonga is made up of the main island groups Tongatapu, 'Eua Ha'apai, Vava'u and the two Niuas (Niua Toputapu and Niua Fo'ou) and has a total land area of 748 square kilometres (see Figure 1). The Kingdom, of which Nuku'alofa is the capital, has a population of 102,000 (2005). The percentage of Tongans who can read and write Tongan and/or English is 98.9%. The official languages in Tonga are Tongan and English (Tonga Government 2008, DFAT 2008).

Tonga has a small, open, South Pacific island economy. It has a narrow export base in agricultural goods. Squash, vanilla beans, and yams are the main crops, and agricultural exports, including fish, make up two-thirds of total exports (Tonga Government 2008). The country must import a high proportion of its food, mainly from NZ. The country remains dependent on external aid and remittances from Tongan communities overseas to offset its trade deficit. Tourism is the second-largest source of hard currency earnings following remittances. The government is emphasizing the development of the private sector, especially the encouragement of investment, and is committing increased funds for health and education (Tonga Government 2008). Tonga has a reasonably sound basic infrastructure and well-developed social services. High unemployment among the young, a continuing upturn in inflation, pressures for democratic reform, and rising civil service expenditures are major issues facing the government (Tonga Government 2008).

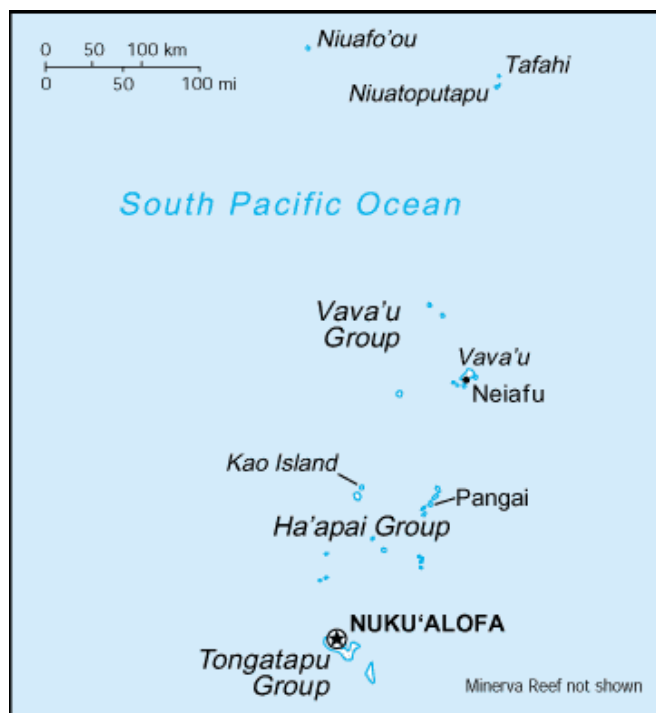


Figure 1: The Kingdom of Tonga (Source: <http://www.pmo.gov.to>)

3.2. Tsunami Threat Sources and Tsunami History in Tonga

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

The Southwest Pacific is surrounded by the "Ring of Fire", a region of intense tectonic activity. The tsunami threat faced by Pacific island countries consists of a complex mix of tsunami from local, regional and distant sources, whose effects at any particular location in the Southwest Pacific are highly dependent on variations in seafloor shape between the source and the affected area.

Thomas, Burbidge and Cummings, 2007 completed *A Preliminary Study into the Tsunami Hazard Faced by Southwest Pacific Nations*. 187 scenarios for an 8.5 moment magnitude (Mw) and 39 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. For the Mw 8.5 and 9.0 events Tonga was placed in Category 5 (normalised amplitude of greater than 250cm). This is due to the proximity of these countries to the subduction zones and the orientation of the fault lines which acts to direct the tsunami towards these nations.

A further study completed by Thomas and Burbidge (2009) attempts to answer the question "which Pacific nations might experience offshore amplitudes large enough to potentially 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 (Figure 2b), which lies to the east on Tonga is a source of hazard for this nation.

The hazard at the 2000 year return period can be expected to reach maximum amplitudes of up to 3.6 metres off Tongatapu, 3.9 metres off Haapai, 4.7 metres off Hunga and 4.3 metres off Niuatoputapu. In the more westerly islands, maximum amplitudes are lower but still potentially hazardous, for example up to 2.1 metres in Niuafuou. At a return period of 100 years, maximum amplitudes of up to 0.7 metres can be expected (Thomas and Burbidge 2009).

Investigation of the Bureau's deep ocean model-based tsunami prediction system conducted by Dr. Jane Warne (ATWS Project Network Design Manager) again demonstrates that the primary threat source for the Kingdom of Tonga is the Tonga Trench to the east of Tonga and New Hebrides Trench to the west of Fiji from roughly 15° south to 22° south (Figure 2b). There is also some threat from the Kermadec Trench to the south of Tonga however this is relatively limited (Figure 2b). The Peru-Chile Trench (Figure 2a) is also a threat with the potential to generate tsunami of travel times approximately 10 hours away from Tonga.



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



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

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT



4. The Tonga Tsunami Capacity Assessment

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

4. The Tonga Tsunami Capacity Assessment

4.1. Date and Location

The tsunami capacity assessment of the ability of the Kingdom of Tonga to receive, communicate and effectively respond to tsunami warnings took place from 29 May to 1 June 2007 at the Tonga National Emergency Management Office Training Room, Nuku'alofa.

4.2. Visiting Assessment Team and Participants

The visiting assessment team was made up of those outlined in Annexure 2. The focal point in Tonga for the completion of this project was Maliu Takai, Deputy Director, Tongan NEMO. 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 (29 May 2007)*

The workshop was opened with an official Opening Ceremony. Fr. Siketi Tonga opened and blessed the meeting. An opening address was made and the workshop declared open by the Guest of Honour, Hon Nuku, Minister of Works. Rick Bailey, Project Director Australian Tsunami Warning System Project and Team Leader of the Tsunami Capacity Assessment Team to Tonga) addressed the meeting. Fr. Siketi Tonga closed the opening ceremony. Maliu Takai was the Master of Ceremony. Participants around the room then introduced themselves and outlined their in-country responsibilities.

Presentations were given by Rick Bailey about the ATWS and PGSP Tsunami Capacity Assessments. This presentation was followed by a presentation from Ofa Fa'anunu, Director of TMS detailing Tonga's tsunami warning system arrangements.

The workshop participants then commenced discussing and recording answers to the questionnaire (refer to Attachment 1a).

4.3.2. *Day 2 (30 May 2007)*

The workshop participants continued to discuss and record answers to the questionnaire (refer to Attachment 1a).

4.3.3. Day 3 (31 May 2007)

The workshop participants continued to discuss and record answers to the questionnaire (refer to Attachment 1a) in the morning and site visits were conducted by the visiting team, accompanied by relevant Tongan Participants, in the afternoon. Visits were made to:

- Tongan Meteorological Services Office;
- Marine and Ports, Coastal Watch Office;
- National Emergency Management Office;
- Department of Communications in the Prime Minister’s Office; and
- Tonga Broadcasting Corporation.

4.3.4. Day 4 (1 June 2007) (Morning only)

A presentation regarding Community Awareness and Preparedness for a Tsunami was given by Mark Sullivan. This was followed by the presentation and discussion of preliminary findings from the visiting assessment team regarding Tonga’s strengths, opportunities for improvement and recommendations with regard to tsunami warnings and mitigation. This presentation was made by Rick Bailey.

4.4. Workshop Photos (Nuku’alofa May/June 2007)



Tsunami Capacity Assessment Team and Tongan National Experts



Guests of honour at the workshop opening ceremony



Child's artwork of tsunami wave and family on high ground



Workshop discussions



Visiting Coastal Watch



Draft tsunami evacuation zones for Nuku'alofa



Visiting the Tongan Meteorological Service



Sea level observing station, Nuku'alofa

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT



Section

5

5. Assessment Results

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

5. Assessment Results

5.1. Status of Key System Components

The Tsunami Capacity Assessment Workshop results are summarised below in Table 3 in which the status of key components of Tonga's tsunami warning and mitigation system are outlined (as at the date the Tsunami Capacity Assessment Workshop was held in May/June 2007, updates between then and the publication of this report are as marked).

Table 3: Summary of current status of key components of Tonga's tsunami warning and mitigation system as at May/June 2007.

Rating

Yes - fully realised
Partially realised
No - not realised

Key Component	Rating	Discussion
Authority, Coordination and NGO Role		
Legislation in place for tsunami warnings and response	Partially	Some provision in existing legislation. Specific disaster legislation is in draft and has been submitted.
Tsunami coordination committee or effort at a National and local level	Partially	National committee and working groups. Ad hoc discussion on tsunami issues. Local structures exist that can be built upon. Update May 2009 – Risk Management Strategy Working Group is the only working group that exists in Tonga at present. In future, the DRM NAP process is expected to cover all stakeholders.
Agency responsibilities clearly defined	Yes	In the draft National Disaster Management Plan (NDMP). Update May 2009 – The existing NDMP has been endorsed by NEMC but requires review.
NGOs have a defined role in tsunami warning dissemination, preparedness and awareness and emergency response	Yes	In an all hazards context primarily in post impact response and education. Key NGO's include the Foundation of the Peoples of the South Pacific International (FSPI), Red Cross and Tonga Trust. Further opportunity to build on existing strengths and resources.

Key Component	Rating	Discussion
Regional and International Cooperation		
Country represented at an international and regional level to aid cooperation in tsunami warning and mitigation efforts	Yes	Designated tsunami warning focal points, a member of the IOC and participates in the PTWS Southwest Pacific Working Group.
Priorities		
Priorities established for implementation of tsunami warning and mitigation system at a National level	No	More work to be done on focusing priority areas for improvement. Update May 2009 – Both this tsunami report and the anticipated DRM NAP process will assist in defining priorities.
Multi-hazard Approach		
Tsunami warning capabilities are being established within a multi-hazard framework	Partially	Further scope exists to incorporate tsunami warning and mitigation into initiatives for other natural hazards through legislation, plans and the DRM NAP process.
Research Expertise		
Active research is being undertaken within the country for seismology and tsunami to strengthen the tsunami warning and mitigation system	No	No formal research identified specific to tsunami. Generally reliant on the efforts of international and regional bodies, such as SOPAC. Update May 2009 – The Geological Services Unit (MLSNRE) has completed research related to tsunami.
Tsunami monitoring infrastructure		
Existence of seismograph stations and integration of real time data from these stations into the tsunami warning process	Partially	Seismic stations exist. Real time data not available to warning agency or PTWC. Tonga has no real time access to other stations in region. Update May 2009 – Tonga has an agreement with Japan International Cooperation Agency (JICA) to update its seismic network and share this data with Fiji who will have a compatible system.
Existence of sea level stations and integration of real time data from these stations into the tsunami warning process	Partially	One 3rd party owned (Bureau National Tidal Centre (NTC)) sea level station exists. Real time data accessible but not used in national warnings. Update May 2009 – Tonga expressed the desire for further sea level monitoring equipment between the Tonga Trench and Tonga landfall.

Key Component	Rating	Discussion
Tsunami monitoring infrastructure (Continued)		
Sharing of seismic and sea level data internationally to facilitate improvement of PTWC tsunami messages for the region	Partially	Not currently for seismic data. Japan upgrade of stations may assist. Sea level data is shared internationally via Global Telecommunications System (GTS) and the Bureau's registered user website.
Warnings		
Nation receives PTWC messages	Yes	Received by TMS.
24x7 operational staff at warning receipt and dissemination location	Yes	Staff resources not ideal to ensure 24/7 roster can be maintained (limited back-up). Update May 2009 – TMS has approximately seven staff. NEMO has the Director and two staff hired last year (one community awareness and one data communications).
Disseminate national tsunami warnings as guided by a Standard Operating Procedure	Yes	SOPs could be further detailed, shared amongst responsible agencies and regularly reviewed and updated. Update May 2009 – SOPs (including felt earthquake procedures using the Modified Mercalli Intensity (MMI) scale or magnitude Richter scale) need to be endorsed. For felt earthquakes procedures and community safety rules are "if you feel you are unable to stand or walk the earthquake is local and you should move immediately inland or to higher ground". More education is needed.
System redundancies in place for receipt of PTWC messages and dissemination of National warnings	Partially	Tonga Communication Cooperation (TCC) receive PTWC bulletins as a back up via e-mail but are not 24/7. No back up arrangements exist for dissemination of National warnings.
Redundant 24x7 methods available for dissemination of warnings to community (e.g. public radio, sirens etc.)	No	Amplitude Modulated (AM) station is main means of dissemination but is not 24/7. Scope for improvement by use of 24/7 manned marine coastal radio out of hours patching into public frequencies.
Effective warning dissemination to remote communities	Partially	Refer above.
Communications coverage of whole country that is effectively utilised for the dissemination of tsunami warning messages	Partially	Adequate communications coverage. Scope for improvement of use of this coverage for warning dissemination.

Key Component	Rating	Discussion
Warnings (Continued)		
Issue of marine tsunami warnings and guidance for vessels, harbours and ports	Partially	Reliability of broadcast equipment could be improved.
Emergency Response and Evacuation		
Disaster preparedness and emergency response system has been reviewed and opportunities for improvement and training identified	No	Not implemented Update May 2009 – This will be done through the DRM NAP process.
Tsunami emergency response, evacuation and recovery plan exists	Partially	A draft Tsunami National Response Plan exists. Update May 2009 - draft Tsunami National Response Plan has been reviewed (based on Samoa's plan) and needs to be endorsed. SOPs for the NEOC have been adapted from Fiji and are yet to be endorsed.
The designated agency for evacuation is identified and have authority by law	Partially	In part. This is being reviewed with the new disaster legislation. Update May 2009 – The Evacuation Act assigns Police as the designated evacuation agency.
Plans have been made for safe evacuation of population centres including aspects such as maps, routes and signage	Partially	This needs significant consideration. Some evacuation maps of Nuku'alofa have been developed but not implemented. Update May 2009 – No further arrangements have been made with the Mormon Church. Plans and centres still need to be worked on.
Procedures are tested and exercised to improve the response through better planning and preparedness	Partially	Participated in international exercises but need to routinely test national system Update May 2009 – At short notice, Tonga participated in Pacific Wave 2008. Communication to the community regarding the exercise was not comprehensive and created some confusion. Tonga was able to use the exercise to identify some issues with their system. The main problem remains getting the warning to the community. An exercise down to the community level will be undertaken towards the end of the year with NZ Ministry of Civil Defence and Environmental Management.

Key Component	Rating	Discussion
Land use policies and building codes are in place to mitigate against the tsunami hazard	Partially	Building codes exist but are generally only enforced in urban areas on public buildings. Land use is largely up to land owner.
Tsunami hazard, vulnerability and risk		
Completion of studies to assess the tsunami hazard in the country or Region	Partially	Preliminary Tsunami Hazard Assessment of the Southwest Pacific completed by GA. Update May 2009 – A probabilistic Tsunami Hazard Assessment of the Southwest Pacific Nations has also been completed by GA.
Local risk assessments have been completed for at risk communities	No	This has not been completed for tsunami.
Adequate data exists and local inundation modelling has been completed for population centres	Partially	No inundation modelling yet done to underpin hazard mapping. High resolution bathymetry data exists to undertake this for Tongatapu only. Update May 2009 – Inundation modelling of the whole of Tongatapu has been completed with assistance from the Institute of Geological and Nuclear Sciences (GNS) NZ using low resolution data. Further quality modelling is required for vulnerable communities in Nuku'alofa (the existing Nuku'alofa map is based on Pacific City and GIS information), coastal eastern villages to the north of Nuku'alofa and the Western District.
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	No	Scope for improvement exists.
Community level education and preparedness programs exist tsunami	No	Not specifically for tsunami but for some other natural disasters. Work has commenced on incorporating tsunami into these programs. Update May 2009 – No further community awareness has been completed for tsunami.
Training programs for the National media exist for natural hazard and tsunami	No	No specific media training programs exist.

5.2. Case Study – Tongan Islands Event, 3 May 2006

On 3 May 2006 (origin time 15:27 Coordinated Universal Time (UTC)) a magnitude 8.1 (later revised to 7.8) (USGS 2008) earthquake occurred on the Tongan Trench. This event was used as a case study throughout the assessment of Tonga's ability to receive and respond to tsunami warnings.

On this occasion, Tonga detected the earthquake. However, analysis of the earthquake did not occur in real time (only post event) due to technical difficulties with triangulation. The location was correct, but the magnitude was inaccurate. No sea level data was available to TMS at the time of this event.

TMS received the PTWC cancellation only via the Emergency Managers Weather Information Network (EMWIN) system. PTWC did not include Tonga in the first warning however, this was corrected by the second warning. The warning was conveyed via phone to a number of sources but this was not timely due to the short lead time (only 25 minutes between the event and the time a small tsunami reached Nuku'alofa). No tsunami warning was issued by TMS. The TMS Urgent Tsunami Warning procedure (D5) was not in place at the time. The NEMO office did not receive PTWC bulletins, only the cancellation and it was some time before NEMO were aware of the earthquake size. TMS also experienced problems with the power outage resulting from the earthquake with back up power at the office not working for around 1.5 hours.

The Tongan population commonly felt the shaking associated with the earthquake. Some of the public were alerted to tsunami warnings by PTWC through global media and relatives. In general, the population did not respond to the event. No warning was issued by TMS. Earthquakes are common in Tonga so do not necessarily alert people to respond to a possible tsunami.

Although the draft National Disaster Plan and Emergency Procedures (D17) and the draft Tsunami Response Procedures (D22) had been developed at the time of the event, these were not activated due to the absence of timely warnings being received from PTWC because of the local source of the event.

No formal debrief was held after the event to capture the lessons learned, however the draft Tsunami Response Procedures (D22) were updated and the TMS Urgent Tsunami Warning procedure was inserted into TMS Procedure 1 'Issuing Tsunami Advisories, Alerts and Warnings' (D5) as a result of the event.

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

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 Tonga. These are outlined in Table 4.

Table 4 – Strengths, opportunities for improvement and recommendations under key topics

5.3.1. Governance and Coordination	
Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • There are existing structures at the community level, including District and Town Officers governed by the District and Town Officers Act, which can be utilised to coordinate and improve natural disaster preparedness and response capacity at a community level. • Existence of National level committee the NEMC, whose decisions go to the National Disaster Council (NDC) in Cabinet for endorsement. • Existence of discipline specific working groups under the NEMC (1) Planning and Mitigation (2) Public Awareness (3) Rehabilitation and Recovery with broad Government representation. • Working towards Cabinet approval of the draft Emergency Management Bill 2006 and Evacuation Act and Emergency Powers Act Repeal Bill 2006. • Draft NDMP 2007 and Emergency Procedures (awaiting Emergency Management Bill to be passed before finalising). • Working towards development of: <ul style="list-style-type: none"> ○ Tsunami Response Plan ○ Tsunami Evacuation Plan • Developed relationships between NEMO and community organisations 	<ul style="list-style-type: none"> • Working groups at the community level to coordinate and improve natural disaster preparedness and response capacity for tsunami and other hazards. • Coordination between working level of Government Departments could be improved to maximise leverage of initiatives across the board. • Completed, comprehensive National Emergency Management Legislation. Evacuation legislation exists, but there is no finalised tsunami evacuation plan. • Finalisation of draft NDMP 2007 and Emergency Procedures. • National and Regional post tsunami event debriefing, reviewing of lessons learned and reporting (e.g. back to service providers such as the PTWC). • Greater focus on DRM issues at a Government decision making level. • Update May 2009 – <ul style="list-style-type: none"> ○ Risk Management Strategy Working Group is the only working group that exists in Tonga at present. In future, the DRM NAP process is expected to cover all stakeholders. ○ The existing NDMP has been endorsed by NEMC but requires review. ○ Both this tsunami report and the anticipated DRM NAP process will assist in defining priorities.

Governance and Coordination (Continued)

Recommendations:

1. Review of DDRM related legislation and NDMP to facilitate finalisation of agency roles and responsibilities in relation to tsunami and other hazards.
2. Establishment of a formal national tsunami management consultative committee, on which key agencies, organisations, and at-risk communities are represented to lead development of tsunami response plans and procedures for Tonga. Once these plans are endorsed, include tsunami warning and mitigation topics under the three NEMC working groups, ensuring all key agencies are involved and a mechanism developed to link the work of these groups to communities and vice versa.
3. Continue formulation of DRM structures and plans on the outer islands and district level that are formalised by legislation and involve the relevant District and Town Officers and other community members. Set-up of reporting arrangement between these remote committees and agencies with National responsibilities such as the NEMO.
4. Continue to demonstrate the benefits of DRM to Government, to facilitate commitment to the DRM agenda in order to deliver tangible benefits to the community.

5.3.2. Regional and International Coordination

Strengths:

- Tonga is well connected with international and regional bodies and forums that can assist in DRM for tsunami and in an all-hazards framework.
- Tonga has designated Tsunami National Contacts and Tsunami Warning Focal Points for receiving information on regional tsunami mitigation activities and tsunami alerts or advisories from the PTWC and Japanese Meteorological Agency (JMA) that serve as the international tsunami warning centres for the PTWS.
- Tonga became a Member State of the IOC in 03 January 1974.

Opportunities for Improvement:

- Comprehensive Regional post event review for tsunami events to feed into PTWS.

Recommendations:

5. Continue engagement by Tonga in the PTWS Southwest Pacific Tsunami Working Group and communication back to key agencies in-country regarding the outcomes of this meeting.
6. Conduct post tsunami event reviews in-country and feed into reviews coordinated for the Southwest Pacific region using existing structures such as the PTWS and the PTWS Southwest Pacific Working Group.
7. DRM and tsunami information should be shared both regionally and internationally through existing mediums such as Pacific Disaster Net.

5.3.3. Research Expertise	
Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • Update May 2009 – The Geological Services Unit (MLSNRE) has completed research related to tsunami. 	<ul style="list-style-type: none"> • Whilst there is no national organisation or coordinated effort specific to tsunami, mechanisms and forums need to be established to ensure maximum sharing of information available from regional and international organisations.
Recommendations:	
<p>8. Continue to utilise existing expertise and output from organisations such as ICG/PTWS, SOPAC, Pacific Disaster Risk Management Partnership Network, near neighbours etc and developing formal hazard research partnerships between relevant agencies as appropriate.</p>	

5.3.4. Tsunami Monitoring Infrastructure	
Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • Earthquake monitoring capability of five seismic stations with potential for real time communications to facilitate determination of local tsunami. Local tsunamigenic earthquakes can be detected automatically and parameters calculated in country during office hours. • Real time sea level monitoring capability, with one sea level gauge in Nuku'alofa. • Update May 2009 – Tonga has an agreement with Japan International Cooperation Agency (JICA) to update its seismic network and share this data with Fiji who will have a compatible system. 	<ul style="list-style-type: none"> • Real time seismic evaluation and reporting to monitor local tsunamigenic earthquakes • Exchange Tongan seismic data real time to international community through global networks to improve estimation of earthquake parameters to feed into PTWC bulletins and subsequently benefit Tonga. • Real time access to other seismic data in the region to improve accuracy and speed of earthquake calculations. • Training in utilisation of access to coastal sea level information from Tonga and the wider Pacific to facilitate verification and early warning of tsunami threat. • Update May 2009 – Tonga expressed the desire for further sea-level monitoring equipment between the Tonga Trench and Tonga landfall.
Recommendations:	
<p>9. Real time seismic monitoring and evaluation of local tsunamigenic earthquakes at office responsible for 24/7 tsunami warning.</p> <p>10. Make locally monitored seismic information available in real-time to international community through global networks.</p>	

5.3.5. Tsunami warnings

Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • TMS, as the provider of warnings to Tonga for both tropical cyclone and tsunami, is well placed to be seen as the authoritative and creditable source. The overlap between some aspects of both types of warnings is very useful, particularly in building familiarity with systems and personal linkages with key players. • TMS operated 24/7 to receive and issue tsunami warnings. • Planned co-location of key warning dissemination agencies TMS and Coastal Watch at Fua'amotu International Airport , Nuku'alofa. • Some SOPs exist for tsunami at TMS. 	<ul style="list-style-type: none"> • TMS staffing is essentially configured to provide operational requirements (and can even then be at times under staffed). Extra staff resources are required to ensure back-up during leave, emergencies, etc, and to provide additional duties like public awareness. • Coordinated on-ground notification/warning systems to disseminate advice to the community. • Tsunami warning SOPs need further development and routine testing/evaluation. • Update May 2009 – <ul style="list-style-type: none"> ○ TMS has approximately seven staff. ○ SOPs (including felt earthquake procedures using the MMI scale or magnitude Richter scale) need to be endorsed. For felt earthquakes procedures and community safety rules are “if you feel you are unable to stand or walk the earthquake is local and you should move immediately inland or to higher ground”. More education is needed.
Recommendations:	
<ol style="list-style-type: none"> 11. Analysis of adequate staffing at TMS needs to be undertaken to allow the office to maintain 24/7 arrangements for tsunami and other warnings. The analysis should then support requests to the National Government for increased funding. 12. Because the need to issue a tsunami warning occurs relatively infrequently it is important that a clear set of SOPs are provided to all operators in the warning centre and response agencies. The SOPs should be succinct and clear to enable users to follow instantly. The TC Operations Procedures would provide a basis. 13. The effectiveness of the warning message could be improved by the addition of local content from other agencies. E.g., pre-prepared and agreed messages to the community regarding significant residual currents and tides when cancellations are issued. 14. Continue to build the credibility of Tonga’s national tsunami warning provider with the public through actions such as on air broadcasts for TMS staff both routinely (to raise awareness) and during an event. The impact of the warning can be amplified by hearing it direct from an expert. In this regard closer relations between the TMS and the TBC and TCC should be pursued to facilitate effectiveness of warning dissemination. 15. Development of improved ‘last mile’ warning methods. This should include an evaluation of different warnings methodologies which would be best used in the Tongan context. Ideally, multiple mediums should be used, some of which are technology infrastructure independent (such as church bells). Technology options include: <ul style="list-style-type: none"> • Implementing a broadcast option for SMS text warnings • Using 24/7 manned Coastal Marine Radio Station with identified capability of operating out of hours on public frequencies. 	

Tsunami Warnings (Continued)**Recommendations:**

- 16.** Issuance of no threat advice to the public concerning small (felt) earthquakes as well as tsunami in the region, which do not have the potential to threaten Tonga. This will help prevent unnecessary public concern as awareness of threat and risk increases, and will reduce possible false alarms associated with felt earthquakes.
- 17.** Ensure system redundancies are in place by undertaking a critical path analysis. Some steps may include:
- Define the parameters that determine success (e.g. a warning issued within x minutes)
 - Determine the elements that are critical to the success of the warning process (e.g. staff resources)
 - Determine what items contribute to the success of these individual elements (e.g. Meteorologist to analyse the warning information and issue the warning)
 - Determine how to ensure redundancies are in place for each item (e.g. back up arrangements for critical staff, on call staff arrangements)

This process can be repeated for hardware, software etc.

5.3.6. Communications	
Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • Communications coverage of whole Kingdom via, TBC, TCC and Tonga Defence Service (TDS) using radio, phone and fax including use of satellite phones. • Most households have a radio. • Cellular phone networks with SMS available Tongatapu, Ha'apai, and Vava'u with good public take-up of service. • Good Police HF/VHF network for land based warnings and good Marine Radio HF/VHF service for coastal and high seas warnings. • Good TDS HF/VHF network with main base stations on Tongatapu, Ha'apai and Vava'u. Can be deployed in an emergency to backup TBC, TCC, Police and Marine transceivers. • Update May 2009 – <ul style="list-style-type: none"> ○ Tonga has been chosen to participate in the first pilot deployment of the Chatty Beetle. ○ Tonga has received funding to install a HF e-mail server system at Fua'amoutu Airport. 	<ul style="list-style-type: none"> • Implementation of 24/7 communication capabilities to provide updates on tsunami warning information to the public during an event through activation of Radio Tonga out of hours or similar. • Broadcast option for SMS Text warnings • Radio transceivers and satellite phones need to be available 24/7 for receipt of warnings. • Ensure some older communications equipment in use have required capability e.g. transceivers used by the Marine Coastal Radio Station do not have the range they had when new. • Investigation into the use of HF and VHF radio digital modes for exchange of data via radio which could automate dissemination of warnings.
Recommendations:	
<ol style="list-style-type: none"> 18. As HF and VHF radios and satellite phones used only in analogue voice mode, recommend implementation of digital modes for exchange of data via radio to automate dissemination of warnings. 19. Ensure radio transceivers and satellite phones are accessible and operational 24/7 for the receipt of warnings. 20. Develop and maintain a central database of satellite phone numbers of critical agencies and posts. 21. Conduct a needs analysis for replacement of critical older communications equipment and communication redundancies and schedule into budget / funding plan where possible. 	

5.3.7. Tsunami Emergency Response (including evacuation)

Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • With available resources, Tonga (especially NEMO) has been able to deliver good emergency management outcomes (albeit limited) for those hazards perceived as highest risk. • Capable, well resourced TDS, supporting emergency response activities. • Capable NEMO to coordinate preparedness, response and recovery. • Update May 2009 <ul style="list-style-type: none"> ○ NEMO has the Director and two staff hired last year (one community awareness and one date communications). ○ The Evacuation Act assigns Police as the designated evacuation agency. ○ No further evacuation arrangements have been made with the Mormon Church. Plans and centres still need to be worked on. 	<ul style="list-style-type: none"> • Required, sustained funding for DRM initiatives to ensure activities are not ad hoc. • Police and TDS working together to ensure credibility and resources are fully utilised in the case of a disaster or emergency. Ensure both entities have a clear mandate and SOPs. • Resources to increase capacity of the NEMO to more adequately prepare and respond to tsunami and other hazards, including support for 24/7 on-call operations. • Evacuation planning, procedures and infrastructure such as evacuation routes, signage and refuges etc. • Update May 2009 - <ul style="list-style-type: none"> ○ Draft Tsunami National Response Plan has been reviewed (based on Samoa's plan) and needs to be endorsed. SOPs for the NEOC centre have been adapted from Fiji and are yet to be endorsed. ○ Tonga participated in Pacific Wave 2008.
Recommendations:	
<p>22. Finalisation of the draft Tonga Tsunami Response Plan (2007) including mitigation, preparedness, response (including evacuation) and recovery.</p> <p>23. Consideration should be given to boosting the resources available to the NEMO, including:</p> <ul style="list-style-type: none"> • Physical resources (computers, whiteboards, field radios etc.); • Adequate staff resources to allow for leave, sickness etc.; • Progressing the NEMO to 24/7 on call operations, including a mechanism for receiving emergency calls and warnings and subsequently activating the NEOC; and • Information management system software and data displays. <p>24. Develop evacuation plans for Nuku'alofa and other coastal communities, based on risk assessment, GIS information and evacuation modelling (if possible). This plan should be supported by an evacuation centre management plan, the production of evacuation maps and community consultation and communication of resulting plans.</p> <p>25. Tonga Fire Authority expands the current MoU with SAMFS to include USAR and confined space rescue equipment and training (Category 1 USAR).</p> <p>26. Tsunami plans and arrangements, once finalised, should be exercised at least at the strategic level on an annual basis. Full deployment exercises should be conducted (with the intention that they expose gaps and shortcomings) on a twice-yearly basis.</p>	

5.3.8. Tsunami Hazard, Vulnerability, Risk and Mitigation

Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • Preliminary Southwest Pacific hazard assessment and probabilistic report completed by GA using deepwater tsunami modelling to identifying critical tsunami sources. • Availability of some higher resolution bathymetry and coastal topography data to assist inundation modelling (high resolution bathymetry surveys exist for parts of both Tongatapu and Niuafouou) • Progress with GIS (bathymetry, topography and infrastructure) that can be used for DRM preparedness and response. • Existence of a building code. • Large hazard and vulnerability database established in MLSNRE (GeoSource Tonga) that could assist risk assessments. • Preliminary evacuation zone planning for Tongatapu. • Update May 2009 – Inundation modelling of the whole of Tongatapu has been completed with assistance from the Institute of Geological and Nuclear Sciences (GNS) NZ using low resolution data. Further quality modelling is required for vulnerable communities in Nuku'alofa (the existing Nuku'alofa map is based on Pacific City and GIS information), coastal eastern villages to the north of Nuku'alofa and the Western District. 	<ul style="list-style-type: none"> • Local inundation modelling for vulnerable areas using input from international deepwater modelling, to underpin hazard mapping, response and evacuation planning. • Further high resolution bathymetry and topography data to assist inundation modelling and underpin response/evacuation planning • Quantification of the risk and more awareness of the wide range of impacts, especially given the number of islands and relatively low topography. • Enforcement of approved Building Code • Greater continuity of staff engaged in relevant activities to ensure consistency and efficiencies.
Recommendations:	
<ol style="list-style-type: none"> 27. Seek international and regional support with inundation modelling for coastal communities on Tongatapu and other vulnerable islands to underpin response and evacuation planning. Include training in use of inundation modelling to develop national capacity in risk assessments and response planning. 28. Transfer of existing hazard and vulnerability database established in MLSNRE (GeoSource Tonga) into a decision making tool for relevant Government departments. 29. Acquire the necessary baseline data for population centres as part of a multi-hazard mapping activity. This will include acquiring high resolution topography (Light Detection and Ranging (LiDAR)) data particularly of low-lying populated areas as well as high resolution bathymetry data to assist i 30. Investigate options for enforcement of the building code which would increase the overall level of the building standard and as a result, make buildings more resilient to hazards such as earthquakes and tsunami. 	

5.3.9. Public and Stakeholder Awareness and Education

Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> • Tonga has a very high degree of social capital, strong family ties, good family support for special needs groups, strong commitment to religious faith and high exposure to other natural hazards such as cyclone and earthquake. This creates a high level of resilience that can be built on by the Tongan community in response to other hazards, such as tsunami. • Relatively small population and small geographic area, making it easier to educate the public, prepare and implement response plans. • Ability to educate the public due to high literacy and only two key languages to translate information into. 	<ul style="list-style-type: none"> • Greater public awareness and preparedness in relation to the tsunami threat, especially from the Tonga Trench. • Increased awareness of tsunami may lead to increased anxiety about felt earthquakes, requiring routine advice from authorities when “No Tsunami Threat” to the community. • Education programs specific to the media on the threat, warning process, preparedness and response needs. This is particularly important, as the media are the main warning dissemination mechanism. • Update May 2009 – No further community awareness has been completed for tsunami.
<p>Recommendations:</p>	
<ol style="list-style-type: none"> 31. Include a training needs analysis for key front line agencies involved in tsunami warning and response in the National Tsunami Plan. In the plan, identify a strategy for development and implementation of competency based training including participating in training courses provided by international organisations. In particular, training of NEMO’s communications staff member is required to enable system maintenance. 32. Establish a comprehensive, structured tsunami public awareness program to improve the awareness and preparedness of the Tongan population. Where possible, this program should: <ul style="list-style-type: none"> • Be conducted in an multi-hazard approach; • Be integrated into existing programs (e.g. Natural Disaster Week) and educational frameworks such as school curriculum, vocational education and training; • Be based on scientific data including risk assessment and modelling; • Ensure the delivery methodologies follow best practice in Tonga (e.g. what has worked for other hazards?); • Be developed across agencies to include consideration of all components of tsunami warning and mitigation within Tonga; • Be evaluated to gauge its success; • Take advantage of material already developed by Regional and International bodies, including visual tools; and • Identify the key messages and target audiences for each activity. 33. Continue relationship building with the media by providing information sessions on topics such as the science of tsunami, how to interpret the warnings and what the community should do when they hear the warning. 	

5.4. Additional Workshop Benefits

In addition to this report, additional benefits of the Tsunami Capacity Assessment Workshop in Tonga were:

- Strong working relationships with counterparts and associated agencies and organisations;
- Exchange of information on respective activities and capabilities;
- Trilateral discussions (Tonga, Japan, Australia) proposed to facilitate real-time access to Tongan and regional seismic information for local earthquake/tsunami warnings;
- Access to regional sea level data in real-time (including Nuku'alofa tide gauge) via the Bureau's Registered User Website and sharing of case study examples of ATWS model scenario output;
- Reference and source information provided on 3 May 2006 Tongan and 2 April 2007 Solomon Islands earthquakes and tsunami; and
- Exchange of information on community awareness and preparedness planning and implementation and emergency response.

5.5. Next Steps

Tonga 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 Australian Bureau, SOPAC 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 to facilitate further capacity development projects being undertaken based on the results of this project. .

Tonga 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 of Tonga's tsunami warning and mitigation system. In turn, this will assist in improving systems for other natural hazards.

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT



Section

6

6. Annexure

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

6. Annexure

6.1. Annexure 1 - Record of Participants

Organisation	Position	Title	First Name	Last Name	Postal Address	Telephone	Fax	Mobile	E-mail	Attended
Tongan Met Service	Director	Mr	Ofa	Fa'anunu	PO Box 845 Nuku'alofa Tonga (Fua'amotu Airport)	676 35355 or 35123	676 24145		ofaf@met.gov.to	Y
National Emergency Management Office	Deputy Director	Mr	Maliu	Takai	PO Box 52 Nuku'alofa Tonga (Nuku'alofa)	676 26340	676 28 220	676 76458	makai@kalianet.t o	Y
Ministry of Works	Director of Works	Mr	Sione	Taumpoepeau	PO Box 52 Nuku'alofa Tonga	676 57/65	676 23102		mowtonga@kalianet.to	?
Geological Services Unit, Ministry of Lands, Survey & Natural Resources	Geologist	Mr	Kelepi	Mafi	PO Box 5, Nuku'alofa Tonga	679 23611	679 23216		tmfatai@yahoo.co.nz	Y
Tonga Communication Corporation	Administration Manager	Mrs	Etina	Kilisimasi	T.C.C, Nukualofa, Tonga (Foufola)	676 20001	676 24789	676 15727	etina.kilisimasi@tcc.to	Y

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

Organisation	Position	Title	First Name	Last Name	Postal Address	Telephone	Fax	Mobile	E-mail	Attended
Prime Minister's Office	Deputy Secretary	Mr.	Alfred	Soakai	P.O.Box 62, Nukualofa, Tonga	676 24 644	676 23 888	676 16342	asoakai@pmo.gov.to	N
Ministry of Police	Acting Commander	Mr	Taniela	Faletau	Ministry of Police, Nukualofa	676 23 318/23 233	23318, 28738, 23036	676 18 109	ksoakai@police.gov.to	N
Tonga Defence Services	Commander	Mr	Tauaika	Utaatu	TDS, Box 99, Nukualofa	676 23 099		676 16 468	tauaikautaatu@dpcc.to	N
Ports Authority		Mr	Sitalingi	Payne	Ma'ufanga	23168			pfononuku@kalianet.to	Y
Tonga Association for Non Government Organisations (TANGO)		Ms.	Vao	Langi	Ma'ufanga	22551-41-567				Y
Ministry of Land, Survey, Natural Resources and Environment (MLSNRE)		Ms.	Halalilika	Etika	Nuku'alofa	23-611			hetika@lands.gov.to	Y
Ministry of Foreign Affairs (MFA)		Mr.	Sione Sonata	Tupou	Nuku'alofa	23-600, 75-538			sona_ta@hotmail.co.uk	Y
Tonga Defense Service (TDS)		Mr.	Toni	Fonokalafi	Nuku'alofa	23-099 or 870-5233			molimoli@yahoo.com	Y
Marine and Ports		Mr	Soane	Haseli	Nuku'alofa	24-933 or 23-350			marine@kalianet.to	Y
Fire / Police		Mr	Viliani	Tuihalamaka	Longolongo	23-144 or 28-599			firehelp@kalianet.to	Y

Organisation	Position	Title	First Name	Last Name	Postal Address	Telephone	Fax	Mobile	E-mail	Attended
									b_tuihlk@yahoo.com	
Ministry of Agriculture and Food, Forests and Fisheries		Mr	Mana'ia	Halafihi	PO Box 14, Nuku'alofa, Tonga	25-355			mhalafihi@hotmail.com	Y
Council of Churches		Mr	Siketi	Tonga		23-291				Y
Tonga Red Cross		Mr	Sione	Tanmoefolau	Taufa'ahaurd	21360 (Emergency 8785761)	21508		redcross@kalianet.to	Y
Tonga Broadcasting Commission		Mr	George	Lavaka	PO Box 36, Nuku'alofa, Tonga					Y
Tonga Met Service	Senior Met	Mr	Moleni	Tu'uholoaki		35-123 or 35-355			molenit@met.gov.au	Y
Marine and Ports		Mr	William LS	Johnson	Nuku'alofa	(676) 26-555			marine@kalianet.to	Y

6.2. Annexure 2 – The visiting assessment team

Team Position	Name	Position within Organisation	Organisation
Team Leader	Rick Bailey	Project Director (BoM), Australian Tsunami Warning System	Australian Bureau of Meteorology
Team Coordinator	Cherie O'Brien	Project Support Manager (BoM), Australian Tsunami Warning System	Australian Bureau of Meteorology
Natural Hazards Warning Expert	Grahame Reader	Supervising Meteorologist WA Region	Australian Bureau of Meteorology
Data Communications Expert	Garry Clarke	International Operations Manager	Meteorological Service of New Zealand Ltd.
Regional Expert	Noud Leenders	Senior Community Risk Management Advisor	SOPAC
Regional and Tsunami Expert	Helen Pearce	Coordinator Tsunami Risk Assessment Project	SOPAC
Emergency Management Expert	Mark Sullivan	Director Capability Development	Emergency Management Australia
Emergency Management Expert	Andrew Gissing	Manager Planning	NSW State Emergency Service

6.3. Annexure 3 – Agenda, Tonga Tsunami Capacity Assessment Workshop



National Capacity Assessment of SOPAC Member Countries: Tsunami Warning and Mitigation Systems Agenda Tonga May 2007

DAY 1: Tuesday 29 May 2007		
LOCATION: National Emergency Management Training Room		
SESSION 1: Welcome and Introductory Presentations		
Time	Topic	Chair
9.30 am to 10.00am	Welcoming Ceremony	
10.00am to 10.30am	Morning Tea Break	
10.30am to 10.45am	Introduction and Welcome	Rick Bailey
10.45am to 11.00am	Overview of the Australian Tsunami Warning System Project and relationship to tsunami warnings in the Pacific Region	Rick Bailey
11.00am to 11.15am	Question Time	
11.15am to 11.45pm	Overview of community preparedness progress and projects in Australia	Mark Sullivan
11.45 to 12.00pm	Question Time	
12.00pm to 1.00pm	Lunch Break	
1.00pm to 2.00pm	System overview - Tongan tsunami warning and mitigation capabilities	To be confirmed
2.00pm to 2.30pm	Question Time	

SESSION 2: Specialist Topics (Round Table Meetings and Visits)		
<i>Informal round table meetings will be held on specialised topics. This discussion will be based on the questionnaire, allowing these questions to be answered.</i>		
Time	Topic	Chair
Topic 1: Authority and Coordination		
2.30pm – 3.00pm	<ol style="list-style-type: none"> 1. Organisations Involved 2. Legislative Framework 3. National Strategy for Disaster Risk Reduction 4. Tsunami Warning Priorities 	Grahame Reader
Topic 2: International and Regional Cooperation		
3.00pm – 3.30pm	<ol style="list-style-type: none"> 1. International standards assistance 2. International coordination 3. Regional cooperation 	Rick Bailey
3.30pm – 4.00pm	Afternoon Tea Break	
Topic 3: Tsunami Science, Technology and Infrastructure		
4.00pm – 5.00pm	<ol style="list-style-type: none"> 1. Research expertise 2. Seismic and sea level infrastructure 3. Utilisation of satellite systems 	Rick Bailey

DAY 2: Wednesday 30 May 2007		
SESSION 2: Specialist Topics (Round Table Meetings and Visits)		
LOCATION: Tonga Meteorological Service (Airport)		
Topic 4: Tsunami Warnings		
9.00am – 12.00pm	<ol style="list-style-type: none"> 1. Warnings currently received 2. Dissemination of warnings (major population centres and remote communities) 3. National tsunami warning centre 4. Procedures for issuing land and marine warnings 5. Strengths and weaknesses of tsunami warnings 	Grahame Reader
12.00pm – 1.00pm	Lunch Break / Travel	

LOCATION: National Emergency Management Training Room		
Time	Topic	Chair
Topic 5: Tsunami Emergency Response		
1.00pm – 3.00pm	<ol style="list-style-type: none"> 1. Capacity of the disaster management system 2. Emergency response plans and legislation 3. Evacuation 4. Testing and exercises 5. Tsunami mitigation efforts and critical infrastructure 	Andrew Gissing
3.00pm – 3.30pm	Afternoon Tea Break	
Topic 6: Tsunami hazard, vulnerability and risk		
3.30pm – 5.00pm	<ol style="list-style-type: none"> 1. Post tsunami surveys 2. Tsunami hazard studies 3. Tsunami vulnerability studies 4. Numerical modelling studies 5. Community participation in assessing tsunami risk 	Noud Leenders
5.00pm	Confirmation of Session 3: Follow up sessions Thurs 31 May (Day 3) afternoon	Rick Bailey

DAY 3: Thursday 31 May 2007		
SESSION 2: Specialist Topics Round Table Meetings and Visits		
LOCATION: National Emergency Management Training Room		
Topic 7: Public education		
9.00am – 10.30am	<ol style="list-style-type: none"> 1. Assessment of public awareness 2. The role of public awareness in understanding tsunami warnings 3. Public awareness and education programs 	Mark Sullivan
10.30am – 11.00am	Morning Tea Break	
Topic 8: The Tongan Trench event		
11.00am – 12.00pm	The Tongan Trench event (3 May 2006) will be used as a case study of tsunami response in Tonga.	Rick Bailey
Time	Topic	Chair
12.00pm – 1.00pm	Lunch Break	
Topic 9: Non Government Organisations and Multi Hazard Framework		
1.00pm – 2.00pm	<ol style="list-style-type: none"> 1. The role of non-government organisations 2. Tsunami response in a multi-hazard framework 3. Tsunami memorials and museums 	Mark Sullivan
SESSION 3: Follow up sessions		
LOCATION To be confirmed		
2.00pm – 5.00pm	Tongan experts are asked to please make themselves available to the team to allow the team members to follow up one on one to fill any knowledge gaps they may have.	Multiple (To be confirmed)

6.4. Annexure 4 – Supporting Documents Log

Ref.	Document Name	Obtained (Y/N)	Format (H = Hard Copy) (E = Electronic)
D1	Tonga 2007 Telephone Directory – including a page on natural hazard awareness (including tsunami)	Y	E
D2	Completed application form for Japan's technical cooperation detailing the project 'Operation of Seismic Observation Network'	Y	E
D3	Draft Policy paper to seek Cabinet approval for the 'Emergency Management Bill 2006 and Evacuation Act and Emergency Powers Act Repeal Bill 2006'	Y	E
D4	Emergency Management Bill 2006 – Explanatory Note	Y	E
D5	TMS Procedure 1 'Issuing Tsunami Advisories, Alerts and Warnings'	Y	E
D6	Tongan Annotated Note 85/06 (26 November 2006) and 'Memorandum of Understanding between the Government of Australia and the Government of the Kingdom of Tonga relating to tsunami warning systems and climate monitoring networks'	Y	E
D7	Kingdom of Tonga Strategic Development Plan 8 2006/07 – 2008/09	Y	H (E copy of 11.4 Disaster Risk Reduction and Management, p. 128 – 129)
D8	UNESCO IOC ITIC Tsunami Brochures.	Y	E
D9	Chanel of communication for receiving and disseminating tsunami warning information (flow diagram)	Y	E
D10	Study Report 1 – Geo Source Tonga. Part 1: Stakeholder Consultation Part 2: GIS Spatial Layers – discussion and recommendations Part 3: Land Imaging – discussion and recommendations Part 4: Hardware, Software and Support – discussion and recommendations Part 5: Topographic Mapping – discussion and recommendations	Y	E
D11	Study Report 4: Identifying Natural Hazards and the Risks they pose to Tonga, GeoSource Tonga	Y	E
D12	Study Report 5: GIS System and Administration Training, GeoSource Tonga	Y	E
D13	Study Report 6: Survey Transformations, GeoSource Tonga	Y	E
D14	Study Report 7: Survey Legislation, GeoSource Tonga	Y	E
D15	Graphic - Active volcanic centres and recorded activity, Tonga	Y	E
D16	Draft Emergency Management Bill 2006	Y	E
D17	National Disaster Management Plan and Emergency Procedures	Y	E

Ref.	Document Name	Obtained (Y/N)	Format (H = Hard Copy) (E = Electronic)
D18	Graphic – Large historical earthquake epicentres with the potential to generate near-field tsunami that should have impacted Tonga.	Y	E
D19	Graphic - Location of historical earthquakes generating pan-pacific tsunami that have impacted Tonga	Y	E
D20	Graphic – Seismicity affecting the Kingdom of Tonga. Epicenters of earthquakes of magnitude > 5 within approximately 200km (1973 – 1996 data from US National Earthquake Information Centre), and known large (magnitude 8 – 9) historical earthquakes (1902 – 1957)	Y	E
D21	Graphic – Tectonic setting of Tonga	Y	E
D22	Tonga Tsunami Response Procedures (2007), Prepared by the Tsunami Working Group	Y	E
D23	Map – Draft tsunami evacuation zones	Y	E (photos)
D24	Natural disaster school aged drawings	Y	E (photos)
D25	District and Town Officers Act (1988 Revised Ed)	Y	E
D26	District and Town Officers (Election) Regulations (1988 Revised Ed)	Y	E
D27	Evacuation Act (1988 Revised Ed.)	Y	E
Further Relevant Documents – Not Obtained			
	Police and Fire Services Act	N	NA
	Building Code	N	NA
	Police and Fire Services Disaster Plan (01)	N	NA
	Mormon MoU	N	NA
	Map of seismic station locations	N	NA
	Defence Act	N	NA

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.
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Section

7

7. CD Attachment

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT

7. CD Attachment - Supporting Documents

- a. Assessment Questionnaire
- b. Supporting Documents
- c. Presentations

TONGA TSUNAMI CAPACITY ASSESSMENT REPORT