SOPAC Member Countries National Capacity Assessments:

Tsunami Warning and Mitigation Systems

Republic of the Fiji Islands

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AUSTRALIA

SOPAC

Section

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1. Results Outline

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1.1. Executive Summary

The National Capacity Assessment of Pacific Islands Applied Geoscience Commission (SOPAC) Member Countries: Tsunami Warning and Mitigation Systems project aims to work in collaboration with the member countries of SOPAC to assess their capacity to receive, communicate and respond effectively to tsunami warnings. The Tsunami Capacity Assessment of the ability of the Republic of the Fiji Islands (hereafter referred to as "Fiji" or "Fiji Islands") to receive, communicate and effectively respond to tsunami warnings took place in a workshop held from 11 – 14 March 2008 in Suva, Fiji.

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

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

In 1953, a tsunami, generated by a coral reef platform collapse as a result of a magnitude 6.8 earthquake offshore from Suva, Viti Levu in Fiji, killed five people. In Fiji, local tsunami can be generated by submarine landslides caused by earthquakes within the Fiji Platform. In addition, Fiji is susceptible to tsunami regionally generated from the New Hebrides and Tonga subduction trenches (Refer to Figure 2) and distant sources from the surrounding so called "Pacific Ring of Fire" such as the subduction trenches off the coast of South America. Fiji's national response to the Tonga Trench tsunami (May 2006) and the Solomon Islands tsunami (April 2007) were reviewed during the workshop to enable the visiting assessment team gain an understanding of how Fiji's operational system.

Participants in the workshop stated a number of urgent priority areas that need to be addressed. Recurring themes included improved agency coordination and clarity of roles as well as 24/7 operation of key warning and response agencies. The workshop's resulting recommendations reflected the priorities raised by workshop participants. High priority recommendations made include:

- Review, approval and implementation of the revised disaster management legislation, risk management arrangements and tsunami response arrangements;
- The production, by each key agency involved in tsunami warning and response, of a set of Standard Operating Procedures (SOPs);
- Continued engagement in international tsunami forums; and
- Defining responsibilities and boosting cooperation between key agencies to ensure robust 24/7 warning and response for tsunami.

To ensure timely and effective tsunami warnings for the Fiji community it is essential that tsunami warning procedures are agreed upon and implemented. Central to these procedures is outlining how the international Pacific Tsunami Warning Centre (PTWC) tsunami message will be interpreted and disseminated nationally for Fiji. The visiting team and workshop participants came to the conclusion that currently in Fiji, the realisation of effective tsunami early warning communication to the community is impeded by a lack of defined and agreed agency roles and

responsibilities. It is evident that although the Fiji Mineral Resources Department (MRD) Seismology Section is officially responsible for issuing Fiji's national tsunami warnings, it does not operate 24/7 nor can it realistically fill the required role with current resources. It was however noted that the Fiji Meteorological Service (FMS) operates 24/7, has established international and national communications links and warning dissemination mechanisms.

In view that there is currently one single qualified seismologist at the MRD Seismology Section, a large increase in ongoing expert staffing and other resources is required to support 24/7 warning operations. It is recommended that institutional arrangements are developed that allow technical agencies involved in early warning systems and disaster risk management to be located together. This would streamline operations by enabling pooling and sharing of resources, information and knowledge. This would particularly benefit sharing of information technology and communication systems. The feasibility of FMS staff (who have strong science backgrounds) being trained to assume the role of analysing and interpreting tsunami messages and data and issuing tsunami warnings should be further explored as a possible measure.

FMS and MRD Seismology Section have an existing capability and expertise that can be further built upon to move the tsunami agenda forward in Fiji. The MRD Seismology Section is undertaking commendable initiatives in tsunami preparedness such as the coastal community awareness program as well as scientific studies and training. Fiji's emergency response capability is led by the Fiji National Disaster Management Office (NDMO) and supported by a combination of Government agencies, NGOs, the private sector and regional and international organisations. Fiji also has established relationships with overseas technical agencies and foreign aid agencies that can assist in areas such as seismic and sea level monitoring equipment. To realise the required improvements strengthening of inter-agency communication and existing national forums such as the Fiji Tsunami Working Group (TWG) is required.

Fiji workshop participants are encouraged to use this National Tsunami Capacity Assessment report to guide both national projects and aid funded projects to achieve targeted improvements on Fiji's tsunami warning and mitigation system. It is hoped that this could be achieved by using the National Tsunami Capacity Assessment report as the basis of a work plan for the strengthened Fiji TWG. In turn, this will assist in improving systems for other natural hazards such as earthquakes and cyclones.

Contingent on the availability of human and financial resources, the Australian Bureau of Meteorology (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 Fiji'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 Fiji's tsunami warning and mitigation system.

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

Table 1: Priority ranking and resource intensity scale

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

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

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Investigate options and formalise arrangements with Telecom Fiji, Digicel, Vodaphone and the Fiji Government to allow Short Message Service (SMS) messaging and a siren system to be used as mechanisms for warning the Fiji population.	Low (SMS) Medium (Siren)	Communications	Multi-hazard	25
Very High	Develop institutional arrangements that allow technical agencies involved in early warning systems and disaster risk management to be located together. This would streamline operations by enabling pooling and sharing of resources, information and knowledge. This would particularly benefit sharing of information technology and communication systems.	Medium	Governance and Coordination	Multi-hazard	1
Very High	That MRD Seismology Unit are adequately resourced to maintain adequately trained staff and systems (High Frequency (HF) radio, fax etc.) to enable a 24/7 (stand-by) operation for the interpretation of PTWC tsunami warning messages for Fiji and coordination with FMS for dissemination of national warnings through FMS communications channels and processes.	Medium	Governance and Coordination	Multi-hazard	2
Very High	Complete the review, approval and implementation of the revised National Disaster Management legislation for Fiji to clearly outline responsibility and authority for mitigation, preparedness (including effective early warnings), response and rehabilitation. Review other relevant Fiji legislation to ensure it compliments the National Disaster Management Act and make necessary amendments where required.	Medium	Governance and Coordination	Multi-hazard	4

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Complete the review, approval and implementation of the revised Fiji National Disaster Risk Management Arrangements (D17) and commence development of disaster risk management structures and plans at Divisional and District levels.	Medium	Governance and Coordination	Multi-hazard	5
Very High	Complete tsunami warning and response procedures outlining how the international PTWC tsunami message will be interpreted and disseminated nationally for Fiji with the aim of improving and finalising the draft Fiji Tsunami Warning System and Response Arrangements (D4a). Completion of this task should be a coordinated effort involving all key warning and response agencies. Upon agreement of these procedures, each agency involved must ensure they have in place a comprehensive set of SOPs to cover the responsibility of their agency.	Medium	Governance and Coordination	Tsunami specific	6
Very High	Fiji install a second back-up system at a second 24/7 operational centre to ensure redundancy in receipt of PTWC messages. It is recommended that this be in the form of additional Emergency Managers Weather Information Network (EMWIN) systems (Satellite or Internet) at a second 24/7 centre.	Medium	Tsunami Warnings	Multi-hazard	14
Very High	Use the tsunami hazard studies that have been completed for the Southwest Pacific Nations (D13, D19) to date and any historical tsunami records, to identify at low-lying communities which may be potentially prone to tsunami impacts and commence tsunami mitigation, response and evacuation planning using local knowledge.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	30

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Use the available inundation modelling for the Suva area (Suva hazard map) to assess and quantify likely impacts and continue to progress planning.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	31
Very High	Build on the tsunami community awareness program developed by the MRD Seismology Section with the aim of establishing a comprehensive national tsunami public education and awareness program reaching all sectors of the Fiji community. This program should be based on the knowledge of which communities are at risk where possible and fed into a multi-hazard, agency coordinated approach. Including: **a.** Focus on key "Tsunami Safety Rule" messages outlined in MRD Seismology Section print material (MRD Information Note 5) **b.** Separate Tsunami Safety Rules into two categories (1) Be prepared for a tsunami – with messages such as plan a tsunami evacuation route in your village and (2) Take action in the case of a tsunami – with messages such as stay out of dangerous areas until the all clear is given by the authority. **c.** Enhancement of key messages to explain the different scale of tsunami with words such as "even a small tsunami that does not wash onto land could cause danger to swimmers and damage to marine vessels". **d.** Incorporate evaluation into programs to review the effectiveness of the program. For example, what worked, what did not, and where resources and funds should be focused.	High	Public and Stakeholder Awareness and Education	Tsunami specific	38

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	*(Continued)* **e.** Identify dialect / language groups that may require tailored programs. **f.** Identify other community / business sectors that may require tailored programs (e.g. tourism and hotels). **g.** Continue the use and development of the suite of materials for public education, utilising existing national and international materials wherever possible. **h.** Consider the use of electronic media for delivery of educational messages (e.g. TV and Radio). **i.** Network with regional / international agencies, such as the International Tsunami Information Centre (ITIC) regarding funds and materials. **j.** Incorporate delivery of tsunami awareness activities into annual work plans and budget proposals.	High	Public and Stakeholder Awareness and Education	Tsunami specific	38
Very High	Investigate and implement (in a multi-hazard framework) an improved mechanism for dissemination of tsunami warnings to the population outside of waking hours, particularly remote villages. For example, a combination of SMS, tsunami sirens, dedicated HF radio (email enabled) or Very High Frequency (VHF) radio frequencies, Very Small Aperture Terminal (VSAT) etc.	High	Communications	Tsunami specific	24
Very High	Ensure NDMO has the resources it needs to fulfill the agencies responsibilities under the National Disaster Management Act and Plan. This should include ongoing refurbishment of operations centre and implementation of a 24/7 Duty Officer arrangement.	High	Tsunami emergency Response (including evacuation)	Multi-hazard	29

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Ensure staff are adequately trained including: **a.** Completing training needs analysis of staff tsunami knowledge and skills in key warning agencies (MRD Seismology Section and FMS) and response agencies (NDMO, Police etc.). Based on this needs analysis, develop a competency based training program to address the identified training gaps of each agency. **b.** Possible topics identified throughout this process, in which relevant agencies may require further training, include: o Tsunami warning decision processes; o SOPs; o Model scenario interpretation; o Sea level data analysis; o Tsunami science and behaviour; o Communication systems; o Information management and networking; and o Exercise management. **c.** Development of ongoing staff training (including developing links with tertiary institutions and international technical agencies) and incentive programs to ensure maintenance of adequate technical staff in Fiji.	Very High	Tsunami warnings	Tsunami specific	17

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Share the findings of this report with international and regional organisations (those based in Fiji and others) to provide guidance on targeting future capacity development programs and projects and use the report to guide the work of the Fiji national TWG.	Low	Regional and International Cooperation	Multi-hazard	8
High	Ensure that project agreements with international donors for upgrade of equipment includes sharing of data internationally in real-time and suitable data formats (such as Seedlink, a seismic data exchange protocol) to facilitate improvements in accuracy of messages from international tsunami watch/warning providers.	Low	Tsunami Monitoring Infrastructure	Tsunami specific	11
High	Include action prompts (pre agreed between relevant agencies) in tsunami warnings advising the community on action to take pre, during and post the tsunami event.	Low	Public and Stakeholder Awareness and Education	Tsunami specific	41
High	Continue active participation in the Southwest Pacific Tsunami Working Group (WG5) of the Intergovernmental Coordination Group (ICG) PTWS.	Medium	Regional and International Cooperation	Tsunami specific	7
High	Due to the short time period available for tsunami warning, implement an interim measure whereby FMS issues a “Tsunami Watch” bulletin based on PTWC messages on behalf of MRD, before MRD Seismology Section comes online to qualify the threat.	Medium	Tsunami Warnings	Tsunami specific	13
High	Ensure key agencies (FMS, MRD and NDMO) have updated Iridium satellite phones with international and national voice and SMS backup capability.	Medium	Communications	Multi-hazard	21

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Incorporate tsunami into a multi-hazard media education program to assist the media to understand hazards and associated warnings and procedures, therefore passing the correct information onto the Fiji community.	Medium	Public and Stakeholder Awareness and Education	Tsunami specific	39
High	Develop a plan for tsunami education to occur regularly post a tsunami event. This is particularly important if a warning was issued and a small tsunami was generated that created unusual rips and currents. It is important to educate the public that it was not a false alarm to maintain confidence the tsunami warning system.	Medium	Public and Stakeholder Awareness and Education	Tsunami specific	40
High	In possible cooperation with Fiji Live or ITC (Information Technology Centre) FMS/NDMO/MRD Seismology Section should consider running an integrated messaging system that manages SMS, e-mail, fax and voice messaging that could be the database for all emergency contacts (including satellite phones), with the possibility of expanding this system to allow for public subscription. This system should maintain the details of active staff at all agencies their roles and operational status and be accessed by the web.	High	Communications	Multi-hazard	20
High	Continue to prepare evacuation plans for villages, major urban centres and across sectors that may have special requirements (such as tourism) and incorporate these plans into the Fiji Tsunami Warning System and Response Arrangements as well as associated agency SOPs.	High	Tsunami emergency Response (including evacuation)	Tsunami specific	28

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Acquire the necessary baseline data for other urban areas as part of a multi-hazard mapping activity. This will include acquiring high resolution topography (Light Detection and Ranging (LiDAR)) data of low-lying major urban areas (such as Nadi and Lautoka) as well as high resolution bathymetry data (for Nadi Bay and Lautoka area) to assist multi-hazard assessments, modelling and mapping (e.g. storm surge, climate change and tsunami). Current data available in Fiji is outlined in the report "Inventory of Geospatial Data and Options for Tsunami Inundation & Risk Modelling, Fiji Islands" (D11).	Very High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	34
High	Investigate future, long-term options for completing tsunami inundation modelling, particularly for large population and infrastructure centres. Ensure consideration is given to software, hardware and the information technology capacity to analyse, interpret and use this information in operations.	Very High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	36
Medium	That NDMO, the assigned responsible agency, schedule, formal meetings of the TWG and develop a Work Plan for this working group to improve interagency coordination and integration for tsunami. Ensure nomination to the TWG of an officer from each key agency involved in tsunami warning, mitigation and response in Fiji. This group should also be used for post tsunami real event and testing debriefing to capture lessons learnt and update plans and SOPs ensuring continuous improvement (from a warning, response and recovery perspective).	Low	Governance and Coordination	Tsunami specific	3
Medium	Continue to develop and foster links with international partners with the aim of encouraging scientific research in Fiji and training opportunities for Fiji staff. Develop a protocol to receive copies of all scientific research reports completed.	Low	Research Expertise	Multi-hazard	9

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Medium	Sign Australian Tsunami Warning System (ATWS)/ South Pacific Sea Level and Climate Monitoring Project (SPSLCMP) Memorandum of Understanding (MoU) to facilitate potential upgrade, possible future installations and ongoing maintenance of tsunami and climate monitoring sea level network and potential future seismic monitoring network options by Australia.	Low	Tsunami Monitoring Infrastructure	Multi-hazard	10
Medium	The TWG, as part of SOPs, discuss, develop and implement a tsunami warning distribution list for the responsible agency to use in the case of a tsunami event. Ensure this list is agreed to by appropriate stakeholders and regularly maintained.	Low	Tsunami Warnings	Tsunami specific	16
Medium	Incorporate into Fiji's tsunami warning procedures the issuing of tsunami warnings in Fijian, Hindi and English to cater for Fiji's community.	Low	Tsunami Warnings	Tsunami specific	19
Medium	Include in tsunami warning processes, issuing of "No threat" messages to the public and media for the following events: **a.** Felt earthquakes that are not large enough to generate tsunami; **b.** Tsunami that do not have the potential to threaten Fiji; and **c.** Under-sea earthquakes that do not have the required characteristics to generate a tsunami. This will prevent misinterpretation of information for sources external to Fiji, as well as maintaining practiced operational systems and community awareness when there is a long time between events.	Medium	Tsunami Warnings	Tsunami specific	15

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Medium	Work towards development of an information management system/database that enables various hazard and vulnerability data to be turned into a decision making tool for relevant Government departments. Incorporate available Global Telecommunications System (GIS) data into this database and continue capacity building in GIS use in-country.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	37
Medium	As part of SOPs, develop multi-agency and agency specific procedures to handle media and public enquiries and ensure accurate and timely information flow to the media and public during the warning, response and recovery stages of an operational tsunami event. These procedures could include, pre-recorded or text to voice phone warnings, designated spokespeople and topics, talking points, media release templates etc. Incorporate these arrangements into the draft Fiji Tsunami Warning System and Response Arrangements.	Medium	Tsunami Warnings	Multi-hazard	18
Medium	FMS utilise Cellular General Packet Radio Services (GPRS) for telemetry and also as a potential communications mechanism between its regional offices that have coverage.	Medium	Communications	Multi-hazard	23
Medium	Exercise the tsunami warning system and response procedures by conducting regular multi-agency exercises to facilitate coordination across Government and expose gaps and shortcomings. Exercises should include post exercise debriefs to ensure continuous improvement. It is preferable that exercises are conducted on an annual basis (at least at the strategic level) with full deployment exercises conducted every second year at all levels (National, Divisional, and District) to test the tsunami warning system and response arrangements.	Medium	Tsunami emergency Response (including evacuation)	Tsunami specific	27

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Medium	Partner with regional or international organisations to conduct paleo-seismic and paleo-tsunami studies to extend and enhance historical event records.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	35
Medium	Continue implementation of risk reduction recommendations from the Suva Earthquake Risk Management Scenario Pilot Project (SERMP, D19, 2002) and consider extension to other urban areas.	High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	32
Medium	FMS and other agencies activate their HF e-mail system. This is vital for during disasters when other communication mechanisms may fail.	High (Funding required)	Communications	Multi-hazard	23
Medium	FMS investigate access to Pacific sea-level data for tsunami warnings via the Global Telecommunications System (GTS) with the Bureau including agreement on the Bureau communicating to FMS when instrumentation is out of order.	Medium	Tsunami Monitoring Infrastructure	Tsunami specific	12
High	Complete an inventory of agency and national communication systems and investigate options for integration. Possibilities include: **a.** Investigating extending the use of the FMS direct line to Honolulu National Weather Service to PTWC for tsunami warning purposes; and **b.** FMS assisting NDMO to set up and maintain their EMWIN system by training NDMO staff.	Medium	Communications	Multi-hazard	26