Pacific Risk Tool Design Plan Summary:

Samoa

Prepared for Samoa PARTneR Stakeholders

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Executive summary

The Pacific Risk Tool for Resilience project (PARTneR) aims to tailor the RiskScape tool for application to disaster risk management (DRM) in Pacific Island Countries, and is being piloted in Samoa and Vanuatu. RiskScape is a natural hazards impact and loss modelling tool developed to support DRM related decision making in New Zealand, with applications to overseas contexts. PARTneR is being funded through the New Zealand Partnerships Fund administered by the Ministry of Foreign Affairs and Trade, and is managed by NIWA in collaboration with 5 partners: the Samoa Disaster Management Office; the Vanuatu Disaster Management Office working with the Vanuatu Meteorology and Geo-Hazards Department; GNS Science and the Pacific Community - Geoscience Division.

The tailoring of RiskScape and the application of outputs for decision making is framed around demonstration case studies. For Samoa, these case studies were identified during a two day workshop in September 2016. A range of stakeholders were invited and those that attended took part in a series of discussions which aimed to identify the risk data available, as well as future needs and projects which would benefit from an impact based assessment.

This document provides a summary of the design plan and serves as a roadmap for the tailoring and application of RiskScape for Samoa. It consolidates the information generated and decisions made during the design workshops.

The case studies' content includes:

1. The context, e.g., what is the purpose for the impact modelling and what the information will be used for. Who are the users of the results?
2. Hazard scenario(s), e.g., single or multiple hazard events of the same or variable sources and magnitudes.
3. Asset types of interest that are potentially at risk to hazards; e.g., buildings, roads, pipelines, etc. Asset impact types of interest, e.g., damage state, asset repair cost, disruption time, etc.
4. Impact scale, e.g., geographical scale, and per-asset or aggregated results within geographical boundaries.
5. Impact information formats and post-processing requirements, e.g., model results delivered as spreadsheets, maps, posters, reports, Geographic Information System (GIS) shapefiles to be uploaded to GIS viewer.

The following are the three selected case studies for Samoa:

- Tsunami risk and loss modelling for response planning;
- Near real time impact forecasting for Tropical Cyclones;
- Landslide risk for land use planning around Mt Vaea.

The case studies will be co-developed and implemented over the next 2 years of the project. Collaborative teams will draw expertise and share data between government departments and agencies so that PARTneR can encourage and support a 'whole of government' approach to risk assessment for DRM.

1 Introduction

1.1 PARTneR project

Disasters in the Pacific undermine development, but where science-based risk assessments inform land use planning, urban development and investment in resilience, the impact of future hazard events can be greatly reduced and socio-economic development protected. Effective disaster Risk Reduction (DRR) decision-making, as a component of Disaster Risk Management (DRM), needs to be underpinned by sound, context-derived risk information. However in the Pacific this is limited because of a lack of appropriate tools and processes for gathering, analysing and applying existing and future disaster risk information to underpin, inform, and prioritise investment in resilient development.

To address some of these issues the PARTneR: Pacific Risk Tool for Resilience Project, funded by New Zealand Ministry of Foreign Affairs (MFAT), will implement three core components over the three year project timeframe:

- The co-design and development of a natural hazards impact mapping and modelling tool for the Pacific;
- Integrated disaster risk data management systems;
- Sustainable targeted and tailored training and skills development.

Cross-cutting these components is the development of a sustainable partnership model for the development and application of risk tools in Pacific Island Countries.

The rationale for PARTneR came from joint discussions between NIWA, the Pacific Community – Geoscience Division (GSD), GNS Science, the Samoa Disaster Management Office and the Vanuatu Disaster Management Office (NDMOs), and the Vanuatu Meteorology and Geo-Hazards Department (VMGD) who together saw the opportunity to tailor the New Zealand based risk and impact modelling tool for use in Vanuatu and Samoa and potentially for the wider Pacific region. The project has been co-designed and will be implemented within a joint implementing framework.

PARTneR will tailor RiskScape, a disaster impact mapping and modelling software developed jointly by New Zealand Crown Research Institutes' NIWA and GNS Science (Schmidt et al 2011). The tailoring of RiskScape and the application of outputs for decision making is framed around demonstration case studies. PARTneR activities commenced with a review of current DRM stakeholder needs and risk data gaps. For Samoa, this was co-facilitated by all partners through workshops and consultations. Information obtained has been reviewed and provides the evidence base for this document; the Pacific Risk Tool Design Plan for Samoa.

The case studies which frame the design plan were identified during two day workshops held in September 2016. A range of stakeholders primarily from government sectors were invited to each workshop (see Appendix A for the list of participants and the workshop agenda). Those that attended took part in a series of discussions and hands-on activities which aimed to identify the available data, complementary projects, as well as upcoming needs and work which would benefit from an impact based assessment. This culminated in the identification of three targeted case studies (Section 3).

The case studies not only provide a framework for PARTneR implementation but also support the empowerment of the NDMO as they play a key role in communicating technical information on hazards and their impacts. Co-development also supports the various beneficiaries to take ownership of the project deliverables.

1.2 Pacific Disaster Risk Tools and Management Context

Priority for Action 1 of the Sendai Framework for DRR describes the requirement for DRM *to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazards characteristics and the environment* (UNISDR 2015). Challenges for Samoa, as well as other Pacific Island Countries (PICs), to support this priority include accessing, translating and applying risk data, and to have mechanisms in place to share and use available risk information for decision making. Despite these challenges, there are a plethora of risk-related projects in the Pacific. These range from community-managed DRR through to regional scale programmes targeting government resources and capacity such as the Pacific Resilience Programme (PREP).

The complex myriad of projects in the Pacific is a challenge but also an opportunity. The PARTneR project aims to leverage off existing and planned work as illustrated by Figure 1. The PARTneR project aims to act as the 'glue' between projects seeking to make use of hazard and asset data and translate this into usable information to support specific decision-making for a wide range of government stakeholders. For example, asset data collected during the Pacific Catastrophic Risk Assessment and Financing Initiative (PCRAFI[1]) programme will be a key dataset for the PARTneR case studies. PARTneR will act as a conduit for adding value to existing data through delivering impact information directly to those who require it. It will also help better define the type of data required in Samoa for effective risk analysis.

PARTneR also intends to support Samoa to report directly to the new Framework for Resilience Development in the Pacific 2017-2020 (FRDP). The FRDP requests national and subnational governments and administrations in PICs to: *Collect, use, share and manage accurate data and information in user-friendly formats to inform sound risk reduction decision making in relation to disaster damage and loss as well as loss and damage under the UNFCCC Paris Agreement on Climate Change.*

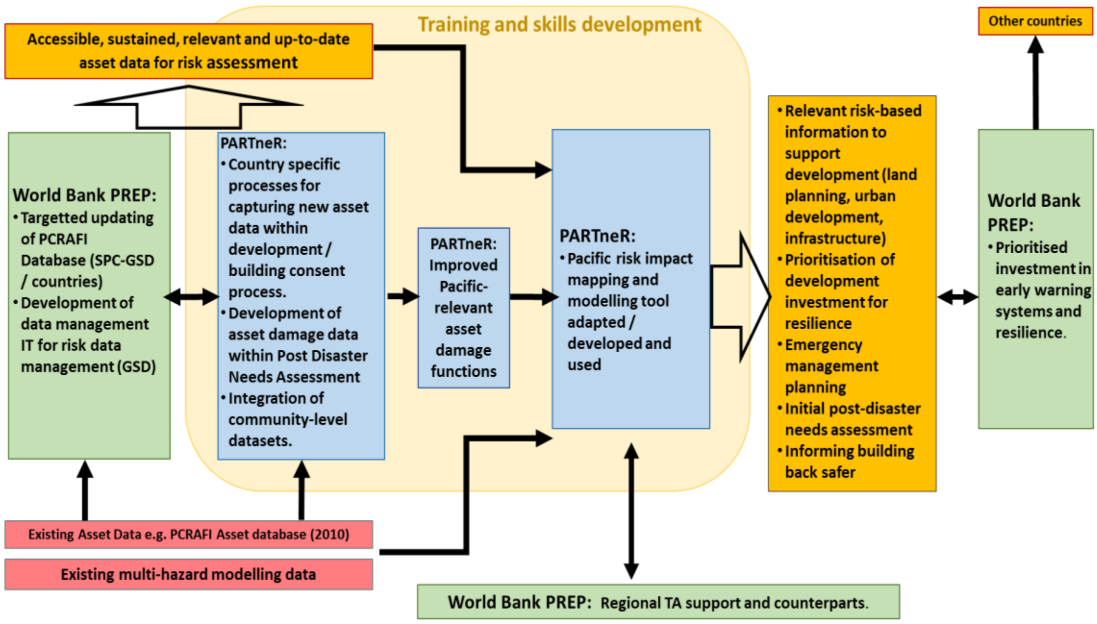

Figure 1: The alignment of PARTneR with existing and planned programmes in the Pacific.

[1] http://pcrafi.spc.int

1.3 Purpose and scope of this document

This document provides a roadmap for the tailoring and application of RiskScape for Samoa. It consolidates the information and decisions generated during two design workshops during September 2016. The agenda and attendance list of workshop participants is provided in Appendix A.

The case studies not only provide a tangible 'back bone' for the project but also a testing, learning and capacity development platform (see Figure 2). They will be critical to the monitoring and evaluation of the project as well as an opportunity to demonstrate the value of risk modelling tools resulting risk information to underpin decision-making in the Pacific.

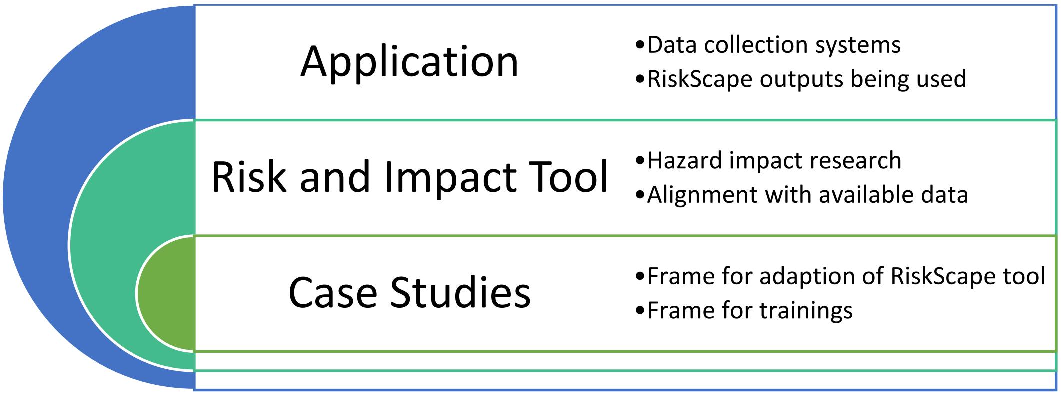

Figure 2: Illustrating how the case studies provide the 'framework' of the PARTneR project implementation.

1.4 Document structure

This document is a summary of the Pacific Risk Tool Design Plan which includes an overview of the Samoa risk setting, the method applied to select the case studies, an overview of each case study, implementation requirements and arrangements, timelines, milestones as well as a risk assessment for this stage of the project. A full version of the Design Plan can be obtained from the Disaster Management Office.

Sections 2 introduces quantitative risk assessment and a brief introduction to the RiskScape modelling process.

Section 3 of the report outlines the three case studies which were selected and designed by stakeholders which will be co-developed during the PARTneR project and refined as new information and ideas emerge. This is the first time RiskScape has been tailored and applied to specific Pacific Island contexts, and therefore the case studies and their components are considered experimental and may be transformed as the project evolves.

Section 4 outlines how these case studies will be implemented with an Implementation Framework and Work plan to monitor and guide the delivery of the case studies results. An overarching conclusion is provided in Section 5.

2 Risk assessment and the RiskScape software

Natural hazard risk assessment is performed to identify the costs and benefits of options to avoid or mitigate the impacts of natural hazards. Risk assessment is commonly applied within a broader framework for risk management (Figure 3). The framework is generic and applicable for any location, natural hazard type and risk management activity. Risk assessment tasks are sub-divided into the three components outlined in Figure 3, which are further described in this section.

A quantitative risk assessment begins with identification of assets that are at risk (i.e. people, buildings, roads, utilities). *Risk identification* includes measuring the extent and/or intensity of hazardous processes and identifying assets exposed (i.e. at risk) to these phenomena. This information is spatially and/or temporally represented as hazard models and asset inventories respectively. When combined, the datasets form an exposure model whereby assets exposed within the extent of hazardous processes are identified. Exposure models are commonly applied in risk identification and can inform the data requirements to further qualify or quantify risk through a *risk analysis*.

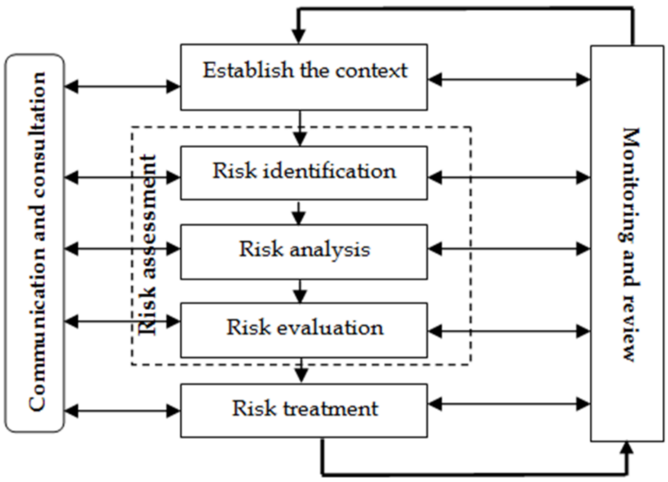

Figure 3: Conceptual framework for natural hazard risk assessment (AS/NZS ISO 31000:2009).

In risk analysis, a natural hazard *risk model* can be applied which commonly comprises of four components: hazard, exposure, vulnerability and loss (Figure 4). These components, often referred to as modules, are applicable in risk models for all natural hazards.
In a natural hazard risk model:

- The *hazard module* characterises hazardous processes in a natural hazard scenario that may expose and adversely impact assets at risk.
- The *exposure module* includes geospatial and attribute information about the assets at risk to hazardous processes. Hazard and exposure module information enables the vulnerability of assets to be quantified.
- The *vulnerability module* contains models relating the estimated degree of damage or loss sustained by assets exposed to hazardous processes of varying intensity.

  Finally, the *loss module* calculates direct and indirect impacts incurred by assets exposed to hazards processes. Losses are modelled for a single natural hazard event or multiple events over a specified time period. For the latter, risk is estimated when relating an expected loss to an expected frequency of occurrence.

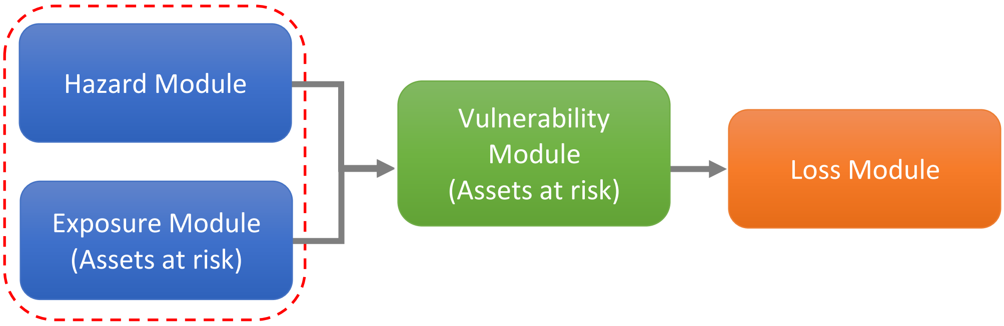

Figure 4: Module components of a natural hazard risk model applied risk analysis. Exposure model modules are identified within the red dash lines.

Loss information from a risk analysis assists an evaluation of costs and benefits for options to avoid or mitigate asset losses expected from exposure to hazardous processes.

Risk evaluation is performed to ensure that structural or non-structural risk treatment options to reduce asset losses are socially and economically viable. These options can reduce asset losses by either; avoiding the hazard exposure (e.g. excluding building in floodplains), mitigating the hazard exposure (e.g. defences to divert floodwaters around buildings), or becoming less vulnerable to loss from the hazard exposure (e.g. use more resistant building materials).

RiskScape (RS) is an open access software application built on a generic risk model framework for natural hazards (Figure 5). The software system is spatially configured for use worldwide and designed for multiple hazard, asset, vulnerability and loss types. A type standard 'language' employed by the system relates information in hazard, asset and vulnerability modules to calculate asset impact and loss. Type standards are adaptable, enabling modules conforming to the system language to be uploaded and used with other modules without requiring reconfiguration of the software system. This functionality supports both the management and application of module data at all spatial scales.

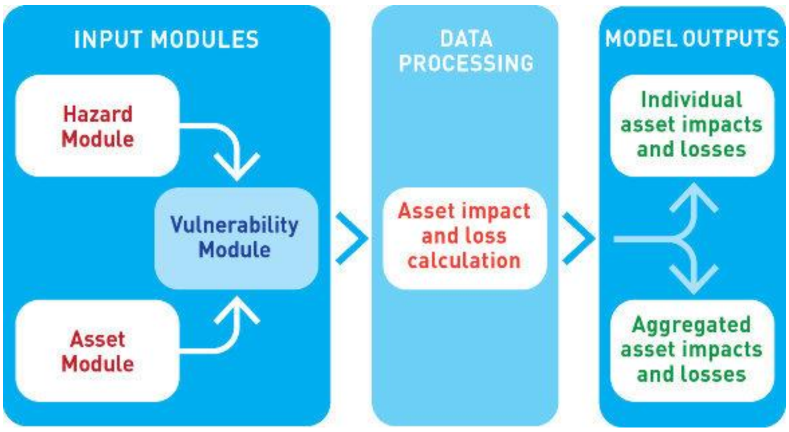

Figure 5: Conceptual diagram representing RiskScape software's natural hazard risk model framework.

Within RiskScape spatial information is held in hazard and asset modules which supports exposure modelling, a method commonly employed in risk identification. In these models, RS identifies assets located within a modelled natural hazard scenario extent and reports whether assets are exposed or not exposed to the hazard. Vulnerability models used in combination with this information enables risk modelling to be performed for risk analysis. Asset impact and loss estimates derived for each option can then be compared with the baseline estimate to determine the most cost effective form of risk treatment.

3 Case studies

An initial long list of case study ideas were identified by stakeholders based on their understanding of available data and risk assessment needs. The long list is provided in Appendix B and a glossary of key acronyms is provided in Appendix C. The long list was refined using criteria developed by the workshop participants. The criteria required that the case studies should aim to:

- Align or partner with existing projects and work plans e.g. PACWAVE (a regional tsunami exercise);
- Benefit a significant population from the risk reduction decision making;
- Benefit those who are particularly vulnerable;
- Have multi-sector usage;
- Be realistic;
- Use data that is already available[2];
- Can be used for monitoring purposes: e.g., population density and impact change over time.

Figure 6: Reviewing risk data during the design workshops.

[2] PARTneR aims to leverage off and add value to existing and planned risk data collection. Risk datasets were identified through a desk based data mapping exercise and then validated during the design workshops.

The long list case studies that ranked highest according to the criteria were then further refined during the workshop using the following checklist:

1. The context e.g. purpose for impact modelling and what the information will be used for. Who are the users of the results?
2. Hazard scenario(s) e.g. single or multiple hazard events of the same or variable source and magnitudes.
3. Asset types of interest that are potentially at risk to hazards e.g. buildings, roads, pipelines etc. Asset impact types of interest e.g. damage state, asset repair cost, disruption time etc.
4. Impact scale e.g. geographical scale, and per-asset or aggregated results within geographical boundaries.
5. Impact information formats and post-processing requirements e.g. model results delivered as spreadsheets, maps, posters, reports, GIS shapefiles to be uploaded to GIS viewer.

The stakeholders identified three case studies which are outlined in the following section. The remaining long list case study ideas could be tackled outside of the PARTneR project. These case studies are not designed to be comparable but stand alone, focused on specific hazards rather than a broader multi-hazard assessment.

Impact modelling for all these case study scenarios requires further assessment of the adequacy of available hazard models, asset datasets and appropriate fragility functions, including potentially refining and/or developing them where required.

3.1 Key Case Studies

A short list of four case study ideas were identified by stakeholders during the workshops:

- Tsunami risk and loss modelling for response planning;
- Near real time impact forecasting for Tropical Cyclones;
- Landslide risk for land use planning;
- Water outage risk from multiple hazards.

3.1.1 Case study 1: Tsunami risk and loss modelling for response planning

Aim

To better understand the risks that tsunami pose to people, communities, homes, infrastructure and lifelines through impact and loss modelling, in order to better inform response planning.

The context

For the case of tsunami, Samoa’s close proximity to the Northern Tongan Subduction Arc (NTSA) means that the southern shores of Samoa are directly exposed to a major tsunami originating at this source. The recent 2009 South Pacific Tsunami which originated at the NTSA caused major destruction to properties and businesses, displaced families and communities, and culminated in more than 140 deaths along southeast Upolu.

Hazard scenarios

Where practical, this case study may use the following hazard scenarios:

- Assess and use hazard and inundation models of the magnitude 8.1 2009 South Pacific Tsunami. Model this hazard event using present-day available asset data to provide an indication of expected losses if another event of similar circumstances was to occur.
- Use hazard and inundation models of a potential worse-case scenario event (e.g. magnitude 9.0+ earthquake and subsequent tsunami originating at the NTSA), to simulate the expected losses with a focus on Apia.
- Use available tsunami evacuation zone models/maps to simulate the exposure of coastal assets to indicate the total value of current and projected assets located within these zones.

Asset types of interest

In order to prioritise the asset data, the following questions were developed by the stakeholders:

- What influence does/would day or night have on the impacts on people (i.e. Number of casualties and/or injuries could be expected, including displacement and duration of displacement)?
- What disruption could be expected to critical lifeline services?
- What would the cost of damages and recovery be?
- What impacts could be expected to evacuation centres such as churches and schools, including disruption and implication of their capacity?

Impact scale

Whilst the stakeholders indicated that a country-wide geographic scale would be a long term goal, the practicality of realising this within the PARTneR timeframe will depend on the coverage and quality of available tsunami hazard models, asset datasets, and fragility functions. Nevertheless, simulating the impacts to exposed locations where all of the required data is available or can quickly be generated, provides indicative results which can be scaled to account for potential impact areas where data is lacking, in order to obtain probable country-wide impact estimates.

Impact scales for the modelling will encompass results aggregated to village, district, urban, land tenure, and evacuation zone boundaries for all coastal areas around the country. Where relevant, impacts will be modelled per asset.

Key implementing partners

- Disaster Management Office of MNRE (lead executing agency);
- Other MNRE Divisions (i.e., Samoa Meteorology Division, Spatial Information Agency, Planning and Urban Management Agency);

- Infrastructure and utilities agencies (i.e., Samoa Water Authority, Electric Power Corporation, Land Transport Authority – Project Management Division);
- First responders (i.e., Fire and Emergency Services Authority, Ministry of Police);
- Ministry of Women, Community and Social Development.;
- Building Division of the Ministry of Works, Transport and Infrastructure;
- Fa'ataua Le Ola' (FLO);
- NIWA, GNS, SPC-GSD (support/facilitation agencies).

Implementation of this case study should, as far as practical, ensure alignment and complementarity with the key identified projects listed in Table 1.

Table 1: Key projects linked to the Samoa tsunami hazards case study.

Projects	Implementing
Family and Livelihood programme	MWCSD, MAF, MOH - GOS
East Coast inland route	LTA – WB
Mapping water catchment	Sky Eye – UN
CDCRM	MNRE – NZ gov + GOS
PCCR – Pacific Climate Change Resilience Project	MNRE – WB, LTA
SLM – Sustainable Land management	MNRE
SMEC – vulnerability studies	LTA – WB
PREP- Pacific Resilience Programme	MNRE, LTA, MOF, MWCSD, MESC -WB
SMSMCL	MNRE – Land management
LIDAR	MNRE – WB
CCIR (central cross Island road project)	LTA, MNRE, WB
EU Building Safety and Resilience in the Pacific (BSRP)	MNRE

Post-PARTneR applications and expansions on this case study could include:

- National level exposure modelling which relies on national (updated) building asset data
- Scaling up and replicating of local scale tsunami impact modelling
  - Expansion of tsunami hazard model library to support near-real time impact modelling

3.1.2 Case Study 2: Near/ real-time impact forecasting for Tropical Cyclones

Aim

To develop a near-real time impact forecasting methodology for Tropical Cyclone (TC) risk to assist response planning and actions.

Context

Samoa's risk to TCs is extreme and have the potential to impact the entire country from ridge to reef causing loss of life and devastating economic damage. Building resilience to such events is fundamental given the potential for higher intensity TCs occurring in future as climate changes, as well as the annual risk to TCs in Samoa. This case study aims to link tropical cyclone forecasts with impact modelling and may provide near-real time impact information to emergency responders as tropical cyclone are being forecast.

The three most notable TCs to cause wide-spread damage in Samoa over the last three decades include:

- The 1990 Cyclone Ofa;
- The 1991 Cyclone Val;
- The 2012 Cyclone Evans.

For the case of Cyclone Val (category 4), wind speeds exceeding 240 km/h impacted the Samoan islands causing widespread damage to buildings, communities, vegetation and reefs. This occurred whilst recovery was still underway from the impacts of Cyclone Ofa's 215 km/h wind speeds, and the combined impacts of the two events were devastating to Samoan communities.

For the case of the Cyclone Evan (category 3), extremely intense rainfall resulted in major flooding of the Vaisigano and Fuluasou Rivers, subsequently impacting downstream low-lying areas of greater Apia.

Hazard scenarios

The above TC events provided impact information which could be used to understand the potential impacts and loss distribution of present-day assets exposed to similar wind and flood hazards during a TC. Where applicable, wind field and rainfall intensity hazard data obtained from real-time TC forecast track/threat maps could be used to simulate on-the-fly wind models or rainfall –flood models within days to hours in advance. Impact modelling of the suggested TC wind, rainfall induced flood, and also storm surge hazard scenarios would require an assessment of the adequacy of available hazard models, asset datasets and appropriate fragility functions, including potentially refining and/or developing them where required.

In summary, this case study should attempt to link rapid TC forecast models for wind, rainfall and storm surge with the RiskScape tool.

Asset types of interest

Given the real-time application of this case study the assets should reflect the immediate information needs of emergency responders. These immediate needs generally relate to:

Direct impacts:

- Numbers of people exposed and causalities;
- Building and infrastructure damage;
- Exposure of evacuation shelters and critical buildings such as schools;
- High risk hotspots (locations that will be most impacted in terms of building damage and socio-economic loss).

Indirect impacts:

- Displacement (location, numbers of people and duration);
- Exposure and impact on critical resources (i.e., what are the expected locations and distances of impacts from responders including estimated response times, and what resources would be available for response from potential non-impacted or less impacted nearby locations?);
- Lifelines disruption;
- Economic costs.

Impact scale

Whilst the long term goal for Samoa would be to capture impacts at the country-wide geographic scale, the practicality of realising this will depend on the coverage and quality of available TC related hazard models, asset datasets, and fragility functions. For example, it may not be possible to model the country-wide impacts of TC wind hazards in an exposed location if the asset data is lacking from that location. Similarly, the variable distribution of impacts associated with cyclone hazards can result in different localised areas being subjected to different hazards.

Nevertheless, simulating the impacts to an exposed location where all of the required data is potentially available or can quickly be generated (e.g., Apia), will provide indicative results which can be scaled to account for potential impact areas where data is lacking. This approach can be used to obtain probable first order country-wide impact estimates.

Where relevant, impact results can be modelled and provided per asset.

Key implementing partners

- Disaster Management Office of MNRE (lead executing agency);
- Other MNRE Divisions (i.e., Samoa Meteorology Division, Spatial Information Agency, Planning and Urban Management Agency);
- Infrastructure and utilities agencies (i.e., Samoa Water Authority, Electric Power Corporation, Land Transport Authority – Project Management Division);
- First responders (i.e., Fire and Emergency Services Authority, Ministry of Police);
- Ministry of Women, Community and Social Development;

- Building Division of the Ministry of Works, Transport and Infrastructure;
- NIWA, GNS, SPC-GSD (support/facilitation agencies).

Implementation of this case study should, as far as practical, ensure alignment and complementarity with the key identified projects listed in Table 2.

Table 2: Key projects linked to the Samoa cyclone hazards case study.

Projects	Implementing
Mapping water catchment	Sky Eye – UN
Community Disaster Climate Risk Management (CDCRM)	MNRE – NZ gov + GOS
PCCR – pacific Climate Change resilient Project	MNRE – WB, LTA
SLM – sustainable Land management	MNRE
SMEC – vulnerability studies	LTA – WB
PREP	MNRE, LTA, MOF, MWCSD, MESC -WB

3.1.3 Case study 3: Landslide risk for land use planning for Mt Vaea

Aim: To test a landslide modelling framework for the Pacific within RiskScape and contribute an exposure analysis for Palisi, Mt Vaea, Samoa, for applications within land use planning.

Context

Landslides are a recognized potential hazard in areas of deforestation for the purpose of building housing, businesses and infrastructure. This is particularly relevant for urban areas under pressure to expand. One such area is the Palisi neighborhood on the slopes of Mt. Vaea in Apia. The outputs of a landslide susceptibility case study would be primarily targeted at those responsible for future land use planning decisions and emergency management. This case study would align and build on an existing DMO led *Mt Vaea hazard study* (stage 1).

Hazard scenario

Landslides in Samoa are triggered by extreme rainfall (including but not limited to those engendered by cyclones) and earthquakes.

A methodology to quantify landslide hazard, relying mostly on available data, will need to be developed (e.g. Schmidt et al 2008).

At this time there is no available hazard map. However some relevant data exists for this case study, such as:

- Rainfall data and maps are available from the Samoa Meteorology Division (SMD) of the Ministry of Natural Resources and Environment (MNRE);

- A geotechnical report is expected to be generated at the end of an ongoing feasibility and geotechnical study being conducted by OTT Construction Company for Development Consent Application (DCA);
- LiDAR data is available from the Spatial Information Agency of MNRE and ground shaking maps from the Geosciences Section of SMD.

A number of completed and ongoing activities in the Palisi area could provide additional data to support the case study:

- Mt Vaea Hazard Study (ongoing);
- Community Integrated Management (CIM) Plans (formerly Coastal Infrastructure Management Plan);
- National Disaster Management Plan (NDMP 2017-2020 pending approval);
- PCRAFI maps;
- Development Consent Database (MNRE-PUMA);
- Aerial maps (housed at MNRE-SIA);
- Forestry inventory maps (Forestry Division of MNRE);
- National Hazard Review 2015 (led by MNRE-NDMO);
- State of the Environment Report (SOE, 2014).

Asset types of interest

Landslides can impact a wide range of socio-economic assets however the PalIsi area is predominately residential. PARTneR stakeholders identified the assets most likely to be affected by a landslide would be residential buildings, people, roads and lifelines. A few businesses who cater to tourists would also be impacted.

Landslide damage can be binary, in other words land movement usually leads to complete destruction of building and complete rebuild is required. The impact results from this case study are therefore likely to focus on exposure in the first instance and then depending on specific land use planning requirements expand using very simple damage functions to estimate other indirect impacts as follows:

Direct:

- Exposure of buildings and population

Indirect:

- Human displacement
- Reinstatement costs
- Wider service disruption

Impact scale

Impact scale for this case study will be the land use planning zone and per building level.

Key implementing agencies and users:

This case study focuses on developing a landslide risk and impact modelling process that can directly feed into land use planning processes. The key implementation agencies therefore reflect both the data requirements as well as those responsible for land use planning in Samoa.

Asset information does partially exist for this region and can be gathered from the following sources:

1. SBS (Census Data on age, sex, disability, employment, etc);
2. LTA and MWTI (Road and Drainage Asset Database);
3. MNRE-WSCU and SWA (Water and Sanitation Survey Data);
4. EPC (Asset Database);
5. Bluesky and Digicel (Asset Database)
6. SBS, MNRE-PUMA, PCRAFI, and MESC (Asset Database/Building Inventories);
7. MNRE-WSCU, MNRE-WRD and MNRE-SMD (Water resources data).

Primary users:

MNRE-NDMO, CDCRM/DRM, MNRE-PUMA, MWTI, EPC, LTA, SWA.

Secondary users:

Investors, the business community and donors are seen as the secondary users, with the local (Palisi) community and the public at large being the tertiary users.

3.1.4 Impact information formats and post-processing requirements

Stakeholders indicated a desire for information results to be readily usable for planning and decision purposes. In this context, scenario results should be readily available as an easily read PDF document which can be stored/accessed via computer or mobile smart phone, printed document and possibly online for ease of access and use in rapid analysis and decision making. These aggregated PDF documents are to be supported by data displayed in spreadsheets and GIS maps. In order to meet these needs, the following result delivery formats are suggested:

- PDF summary reports of aggregated results showing loss/impact distribution maps, accompanying numeric data tables, and caveats/uncertainties for use in rapid decision making;
- Raw numeric data available via spreadsheets for further statistical analysis and longer-term mitigation planning;
- GIS compatible map files of impacts per aggregation unit and/or per individual asset for further geospatial analysis, land use and mitigation planning;

- Compilation of results into a single document, forming a baseline resource of probable risk/impact scenarios for use in planning as well as future emergency response to such hazards (e.g., impact forecast to a future NTSA sourced tsunami).

3.2 Limitations

The case studies outlined above will require further design and adjustment throughout the project. Elements may be adjusted due to data availability and quality, or changing user needs. The PARTneR team will remain flexible in their approach in order to deliver useful, useable and used case studies.

The case studies are not designed to provide a broad and comparable multi-hazard assessment, instead they are stand alone in order to address a range of stakeholder interests from emergency management to land use planning. In the future, opportunities may exist to support countries in developing approaches for multi-hazard comparisons.

4 Implementation, monitoring and milestones

The case studies outlined above will be co-developed and implemented with key stakeholders and the PARTneR team. An implementation framework as outlined in Table 3 below has been developed in consultation with stakeholders which will guide the development and implementation in four phases. NIWA will lead the software development changes required. Work to link databases, models and other tools with RiskScape will be jointly carried out by both the NIWA software development team and SPC-GSD.

Table 3: Case study implementation framework.

<table>
<tr><th>Phase</th><th>Tasks</th></tr>
<tr><td>Phase 1</td><td>Work plan (log frame) development;
Case Study Inception Meetings
Introduce work plan
Allocation and agreement on roles to deliver plan activities.
Meet with key stakeholders to organise data acquisition.
Refine case study deliverables based on data availability and consultations with key stakeholders.
Remove/ redefine unpractical deliverables and determine methodologies to complete the final deliverables
Deliverable: Case study work plan</td></tr>
<tr><td>Phase 2</td><td>Data preparation
Desktop review. Compilation of existing hazard, asset, vulnerability and aggregation data.
Desktop collection. Review and collection of missing asset geospatial or statistical data.
Desktop scoping. Development of any required hazard and vulnerability modelling.
Hold expert elicitation workshops to co-create relevant fragility models.
Undertake development of new RS modules where needed for the case study.
Case study site data collection if required.
RiskScape Software Configuration
Identify model output requirements.
Identify software type standard, module and functionality requirements to support case study.
Deliverable: Data collection complete.</td></tr>
</table>

Phase 3	• RiskScape Software Configuration
	  • Implement configuration requirements.
	
	• Impact modelling
	  • Simulation of scenarios in RiskScape; develop modules.
	
	  • Assess outputs generated against stakeholder expectations, including validation where historical data exists;
	  • Tool and output modification/tailoring as required;
	  • Evaluate and develop standard reporting and communication formats/avenues.
	Deliverable: Case study scenario runs complete, tested and documented appropriately

Phase 4 (can run parallel with phase 3 if appropriate)	• Application and utilization of results for emergency response planning/management, land use management/planning:
	
	  • Development of decision making guidance/support materials on how to use the output data;
	  • Applications training workshop for stakeholders;
	  • Communicate findings via a relevant hazard/risk/disaster conference (domestic and regional/international).
	
	Deliverable: Scenario integrated for decision making, with training materials and guidelines, communicated to relevant stakeholders.

The Gantt chart below (Figure 7) lists the phases and milestones for the development of the case studies. This was created by combining the recommendations from the design workshop participants, the PARTneR team and the existing PARTneR budget and timeline.

		Year 1		Year 2				Year 3			
	Activity	**Qtr 3**	**Qtr 4**	**Qtr 1**	**Qtr 2**	**Qtr 3**	**Qtr 4**	**Qtr 1**	**Qtr 2**	**Qtr 3**	**Qtr 4**
		Jan-March	April - June	July - Sept	Oct-Dec	Jan-March	April - June	July - Sept	Octo-Dec	Jan-March	April - June
Workshops budgeted											
Output 1 Tool - Workshops											
Output 2 Data - Workshops											
Output 3 - Training workshops											
Samoa											
Case study 1: Tsunami risk and loss modelling for response planning	**Phase 1**										
	Milestone: Case study work plan										
	Phase 2										
	Milestone: Data collection complete										
	Phase 3										
	Milestone: Case study scenario runs complete, tested and documented appropriately										
	Phase 4										
	Milestone: Scenario integrated for decision making and within training materials and guideline and communicated to relevant stakeholders.										
	Case Study ready for PACWAVE 2018										
Case study 2: Nr-real time impact forecasting for Tropical Cylones forecasting	**Phase 1**										
	Milestone: Case study work plan										
	Phase 2										
	Milestone: Data collection complete										
	Phase 3										
	Milestone: Case study scenario runs complete, tested and documented appropriately										
	Phase 4										
	Milestone: Scenario integrated for decision making and within training materials and guideline and communicated to relevant stakeholders.										
Case study 3: Landslide risk modelling for land use planning	**Phase 1**										
	Milestone: Case study work plan										
	Phase 2										
	Milestone: Data collection complete										
	Phase 3										
	Milestone: Case study scenario runs complete, tested and documented appropriately										
	Phase 4										
	Milestone: Scenario integrated for decision making and within training materials and guideline and communicated to relevant stakeholders.										

Figure 7: Gantt Chart for Case Studies. This provides an indicative guide for key milestones to deliver the case study results within the project lifespan. Timeframes may shift to align with emerging unforeseen opportunities. Yellow indicates a budget available for a workshop, green indicates budget available for mentoring visits and dots indicate vocational training visits.

5 Conclusion

This document outlines the design plan and systematic approach for the customization of the RiskScape natural hazards impact and loss modelling tool in Samoa under the PARTneR project. The design plan is framed using 3 case studies that were identified and refined during stakeholder engagement workshops held in Samoa in September 2016.

Case studies identified include:

- Tsunami risk and loss modelling for response planning.
- Near real-time impact forecasting for tropical cyclones.
- Landslide risk for land use planning.

Additionally, a cross-cutting issue that overlaps each of the three case studies was identified which encompasses modelling a 'water outage scenario' in each case study.

Implementation of the design plan will be carried out in four phases from January 2017 to June 2019, and will run in parallel with the PARTneR training and guideline development component of the project. The implementation process is designed to be agile and flexible to emerging opportunities over the implementation timeframe, as well as potential risks that may be encountered. Contingency measures to mitigate these risks have been identified and will be implemented as required.

6 Acknowledgements

This document is a summary of the Pacific Risk Tool Design Plan document which was the first of a series of technical reports and guidance produced by the PARTneR project. The PARTneR project is a New Zealand Aid partnership fund project (2016-2019). This project has been co-developed and implemented by five collaborative partners: NIWA, GNS Science, the Pacific Community - Geoscience Division, the Vanuatu Disaster Management Office and Vanuatu Meteorology and Geo-Hazards Department, and the Samoa Disaster Management Office.

Participants who attended the Samoa Stakeholder Co-design Workshop in September 2016 and contributed their knowledge and experience during this process are acknowledged and thanked (see Appendix A). This project aims to work across whole of government of many departments whom have contributed time towards the selection and design of these case studies.

External advisors who reviewed this document are acknowledged and thanked.

7 References

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Appendix A Design Workshop Agenda and Participant Registration List

DAY 1 AGENDA	
Time	**Activity**
0900-1000	Introductions and welcome
1000-1030	Risk Assessments Needs
1030-1100	Refreshment Break
1100-1200	Risk Data Mapping
1200-1300	Mapping existing or upcoming complimentary projects/needs
1300-1400	Lunch
1400-1500	Case Study identification and ranking
1500-1530	Final Case Study selection

DAY 2 AGENDA	
Time	Activity
0900-0930	Recap & Introduce aims of day
0930-1030	Case study scenario development
1030-1100	Refreshment Break
1100-1200	Case study scenario development cont.
1200-1300	Action planning
1300-1400	Lunch
1400-1500	Presentation of Case Studies for final validation
1500-1600	Core team discuss workshop outcomes and plan any final requirements

Table Appendix 1 & 2: Samoa Workshop Agenda

Name	Organisation	Name	Organisation
Sisavaii Tagata	MCIT	Shaun Williams	NIWA
Della Savaiinaea	MNRE-PUMA	Titimanu Simi	MNRE-NDMO
Puni Maatusi	FESA	Iosefo Aiolupotea	EPC
Pei Tauiliili	FLO	Malia Pisi	MNRE-NDMO
Moleli Moleli	SAA	Ephraim Reynolds	Sky Eye
Krishna Schwenke	MOP	Sam Saili	Sky Eye
Nick Horspool	GNS	Emarosa Romeo	MNRE-WRD
Pau Ioane	MNRE-Tech Div	L Faletolu Lofipo	MJCA
Anna Blake	MNRE-NDMO	Toai Bartly	MNRE-NDMO
Loia Jr Kolia	MWTI	Lisabelle R	MWTI
Misa Akeripa Jr Misa	MWCSD	Kate Crowley	NIWA
Mose Topeto	SBS	Gabriella Turek	NIWA
Aliilelei Esera	LTA	Filomena Nelson	MNRE-NDMO
Herve Damlamian	SPC-GSD		

Table Appendix 3: Samoa Workshop Participant List

Appendix B Long list of case studies

Samoa	Case Study
Short list	**Tsunami and Tropical Cyclone Response Planning** What are the impacts from a tsunami and/or tropical cyclone (including flooding, storm surge, wind, landslides) on people, buildings and lifelines across Samoa and how can we use this information to develop response (contingency) plans including considerations such as locations that may be impacted?
	Palisi Hill Landslide Risk What is the impact from landslides originating from Palisi Hill, with a particular focus on nearby villages, health centres including the hospital and schools and how can new development avoid creating new risks?
	Water outage and restoration times How would the potable water supplies be affected by natural hazards including drought, earthquake etc. And how would this impact households, critical services (e.g. hospital), agriculture, and other needs e.g. beer production?
	Assessing risk on coastal infrastructure from coastal erosion What coastal infrastructure is at risk from coastal erosion and how can new development avoid high risk areas?
Long list	
	Assessment/ and integration of the vulnerability at a community level in order the support the mainstreaming of vulnerable groups (women, Children, Elderly and disabled) voice into the decision making process (of response plan?).
	Multihazard Impact on key transport infrastructures (bridges and roads) and its secondary disruptions
	Multihazard Impact on key Health infrastructure (hospitals) and its secondary disruption or impact
	Multihazard Impact on agriculture and food security
	Assessing impact and restoration of services to Fagaloa area (electricity and roads) from multi-hazards. This includes vulnerable lifelines and evacuation routes.
	Identify vulnerable villages to tsunami in the Aleipata area (southeast Upolu coast) in the context of: Access to exit/evacuation routes. Access roads. Percentage of vulnerable elderly and special needs citizens. Community composition (e.g. age, gender). Schools, churches, and pre-schools. Access to basic necessities (e.g. water resources). Access to nearby health clinics?
	Exposure of schools (national level).
	Vulnerability of assets (e.g. agriculture, tourism, residential building) to Asau forest fire hazard.
	Vulnerability/risk of buildings and other assets to urban fires, oil fires (e.g. wharves, airports) associated with earthquakes.
	What lifelines are essential for government and business continuity in case of disruption (disruption mitigation)?

	Vulnerability study of the proposed Vaiuvu Wharf to: sea level rise, heavy rainfall, earthquake.
	Environmental impacts of the proposed Vaiuvu Wharf due to: spillage , traffic noise
	A study to inform a response plan to a health pandemic
	Feasibility study of relocation of vulnerable villages
	Impact study of volcano eruption on local villages, and of ash fall on air traffic, airport (tourism)
	Assessment of economic losses for government buildings and assets
	Impact of erosion on coastal infrastructure e.g. natural and man-made from sand mining
	What would be the potential impact on utility services around the Palisi-Lalovaea area if a major landslide occurred? How many roads, pipelines, networks, would be affected?
	Impact of natural hazards on the international airport and Impacts on tourism industry (employment)
	Assess the evacuation rates for different areas to tsunami
	Ecological impacts of an oil spill on Apia
	Impacts to bridge infrastructure during flood events – what are the local impacts and regional in terms of access etc.
	Local tsunami from coral reef landslide
	Strengthening media awareness of climate risk assessment

Appendix C Glossary

Acronym	Denotation
ADB	Asian Development Bank
ADRA	Adventist Development and relief Agency
CDCRM	Community Disaster & Climate Risk Management
DRM	Disaster Risk Management
DCA	Development Consent Application
EPC	Electric Power Corporation
EU	European Union
FESA	Fire and Emergency Services Authority
FLO	Fa'ataua Le Ola'
LTA	Land Transport Authority
MCIL	Ministry of Commerce, Industry and Labour
MCIT	Ministry of Communications and Information Technology
MESC	Ministry of Education, Sports and Culture
MNRE	Ministry of Natural Resources and Environment
MNRE-SMD	MNRE – Samoa Meteorology Division (Met Division)
MNRE-NDMO	MNRE – National Disaster Management Office
MNRE-PUMA	MNRE – Planning and Urban Management Agency
MNRE-SIA	MNRE – Spatial Information Agency (Tech Division)
MNRE-WRD	MNRE – Water Resources Division
MNRE-WSCU	MNRE – Water and Sanitation Coordination Unit
MOF	Ministry of Finance
MOH	Ministry of Health
MOPP	Ministry of Police and Prisons
MPMC	Ministry of the Prime Minister and Cabinet
MWCSD	Ministry of Women, Community and social Development
MWTI	Ministry of Works, Transport and Infrastructure
PIF	Pacific Islands Forum
SAA	Samoa Airport Authority
SBS	Samoa Bureau of Statistics
SPA	Samoa Ports Authority
SPC-GSD	Secretariat of the Pacific Community – Geoscience Division
SPREP	Secretariat of the Regional Environment Programme
STA	Samoa Tourism Authority
SWA	Samoa Water Authority
UN	United Nations